RADIO NEWS

APRIL
1948

RADIO-ELECTRONIC
ENGINEERING
EDITION

RADIO IMPULSES CONTROL THIS MODEL SAILBOAT

page 39

RCA VS-099 Farm Pack and RCA VS-036 A Batteries

. . . for extra energy . . . extra hours

● It's RCA's special "Radio Mix" in these super-powered radio batteries that gives them longer life *at less cost per hour!* The RCA VS-099 Farm Pack will power a 4-tube battery set for a period ⅓ longer than the average farm pack—at least *a full season's service!* The RCA VS-036 A battery has *twice* the life of average cells . . . *50 per cent* more life than standard "long-life" types in *heavy-drain* portable radio receiver service!

What's more, the RCA VS-099 and VS-036 are *leak-resistant, swell-proof and climate-proof*—because they're *sealed in steel.* They *stay* powerful and fresh!

The RCA VS-099 and VS-036 give the customer the most for his money. You can get your stock conveniently and quickly from your local RCA Distributor.

SELL RCA BATTERIES—*THE COMPLETE LINE FOR THE RADIO AND ELECTRONIC TRADE*

TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.

Here's how hundreds of men working in Radio WIN PROMOTIONS, EXTRA PAY

I TRAINED THESE MEN AT HOME

Sixteen Years' Previous Experience

"Before I enrolled with NRI, I had 16 years of actual Radio experience, but found many helps in your Course. I am now Administrative Assistant to the Officer in Charge of a U.S. Army Applied Electronics School."—Wallace G. Baptist, 1907 Willow Spring Road, Dundalk, Maryland.

Seven Years' Previous Experience. Now Department Head

"I did not start as a beginner, but had seven years' experience as a commercial Radio operator. Last April I came to work for the Gates Rubber Company to set up, train and install a complete industrial equipment department."—Norman R. Hood, Denver, Colo.

Ten Years' Previous Experience. Doubles Earnings

"I had been servicing Radios for ten years. I found it necessary to get the technical knowledge I lacked, so enrolled with NRI. I believe my earnings have more than doubled since taking the NRI Course."—I. L. Hankey, Jr., 278 W. 5th St., Frederick, Md.

NRI Training Helps Operator Win Advance

"Before taking the NRI Course I felt I was a phony holding a job as Assistant Communications Operator. Now I feel I am worthy of the job and future advancement. . . have advanced to Assistant Aircraft Communicator."—John Keller, S. Market St., Martinsburg, Pa.

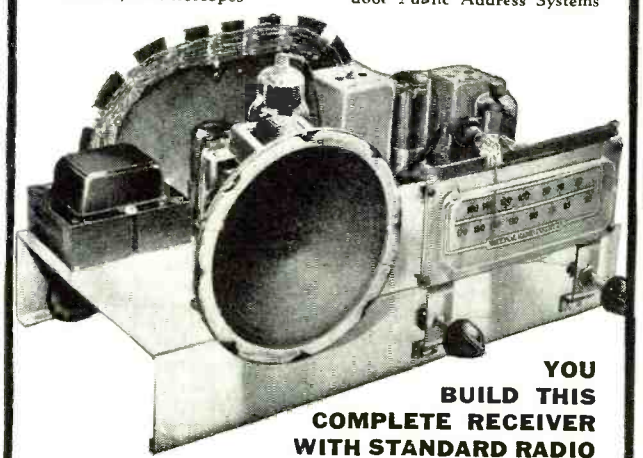
NOW LET THIS WORLD-FAMOUS NRI COURSE HELP YOU STEP AHEAD

MAKE MORE MONEY IN RADIO!

My Course Teaches Timesaving Service Methods, Techniques, Television, FM, Electronics

Here are just a few of the topics covered:

- Photoelectric Control Circuits with Relays
- Peak and Band-Pass R.F. Tuning Circuits
- Broadcast, All-Wave and Television Superhet Receiver Principles
- Light-Sensitive Cells for Control Circuits
- The Vacuum Tube as an A.C. Generator in Radio-Television Circuits
- Current, Voltage and Resistance Measurements
- Vacuum Tube Voltmeters, Cathode Ray Oscilloscopes
- Frequency Modulated Signals, the F-M Receiver
- Automatic Tuning Control Systems
- Professional Radio Servicing Techniques
- How to Isolate Defective Section and Stage
- How to Isolate Defective Circuit and Part
- Tuning Circuit Troubles
- Field and Bench Testing of Radio Parts
- Uses for Optics in Electronics and Television
- Practical Electronic Equipment
- Essentials of Outdoor and Indoor Public Address Systems



YOU BUILD THIS COMPLETE RECEIVER WITH STANDARD RADIO PARTS I SUPPLY

You get valuable experience testing and repairing this and many other circuits you build from N.R.I. Kits. These kits are not loaned to you, but become your property. Mail coupon for full details!

THE way to EARN more money in Radio is to handle MORE service jobs in LESS time! And the N.R.I. Course is designed to help you do just that! With N.R.I. training, you KNOW the shortcuts and timesavers that speed up routine repair jobs. You KNOW how to locate trouble fast on the tough jobs as well as the easier ones. And you KNOW up-to-date servicing methods needed on FM, Television and Electronics.

Find Out What N.R.I. Can Do for YOU

Read the letters at top of this page. They are from just a few of many men who were working in Radio before they took my training. I helped them get ahead and I can help you. Mail the coupon for my 64-page book, "How to be a Success in Radio, Television, Electronics," FREE. See how I train you at home, how I give you UP-TO-DATE, PRACTICAL knowledge . . . how you get professional experience building, testing, repairing real Radio circuits with kits I send.

J. E. SMITH, President
National Radio Institute

SAMPLE LESSON FREE

I'll send you a Sample Lesson FREE to show you how quickly you learn from my illustrated, easy-to-understand lessons. No obligation. Get Sample Lesson and Book by mailing coupon. Just mail Coupon NOW in envelope or paste on penny postal! **J. E. Smith, President, Dept. 8DR, The National Radio Institute,** *Pioneer Home Study Radio School,* **Washington 9, D. C.**

VETERANS APPROVED UNDER G. I. BILL

Good for Both—FREE

Mr. J. E. SMITH, President, Dept. 8DR
National Radio Institute
Washington 9, D. C.

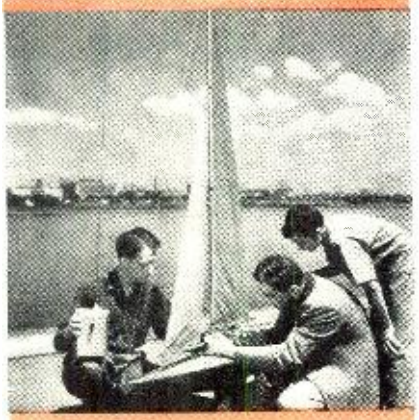
Mail me FREE Sample Lesson and 64-page book. (No Salesman will call. Please write plainly.)

Name ..... Age ..

Address .....

City ..... Zone ..... State .....

☐ Check If Veteran



COVER PHOTO: Putting final touches on the radio controlled model sailboat in the model boat sailing basin on the Charles River, Boston. Under FCC regulations, an amateur radio operator's license is required.
(Photo by Walter Steinhard)

First in radio-electronics
Average Paid Circulation over 148,000

RADIO NEWS

Trade Mark Registered U.S. Patent Office No. 378427

CONTENTS — APRIL, 1948

DEPARTMENTS

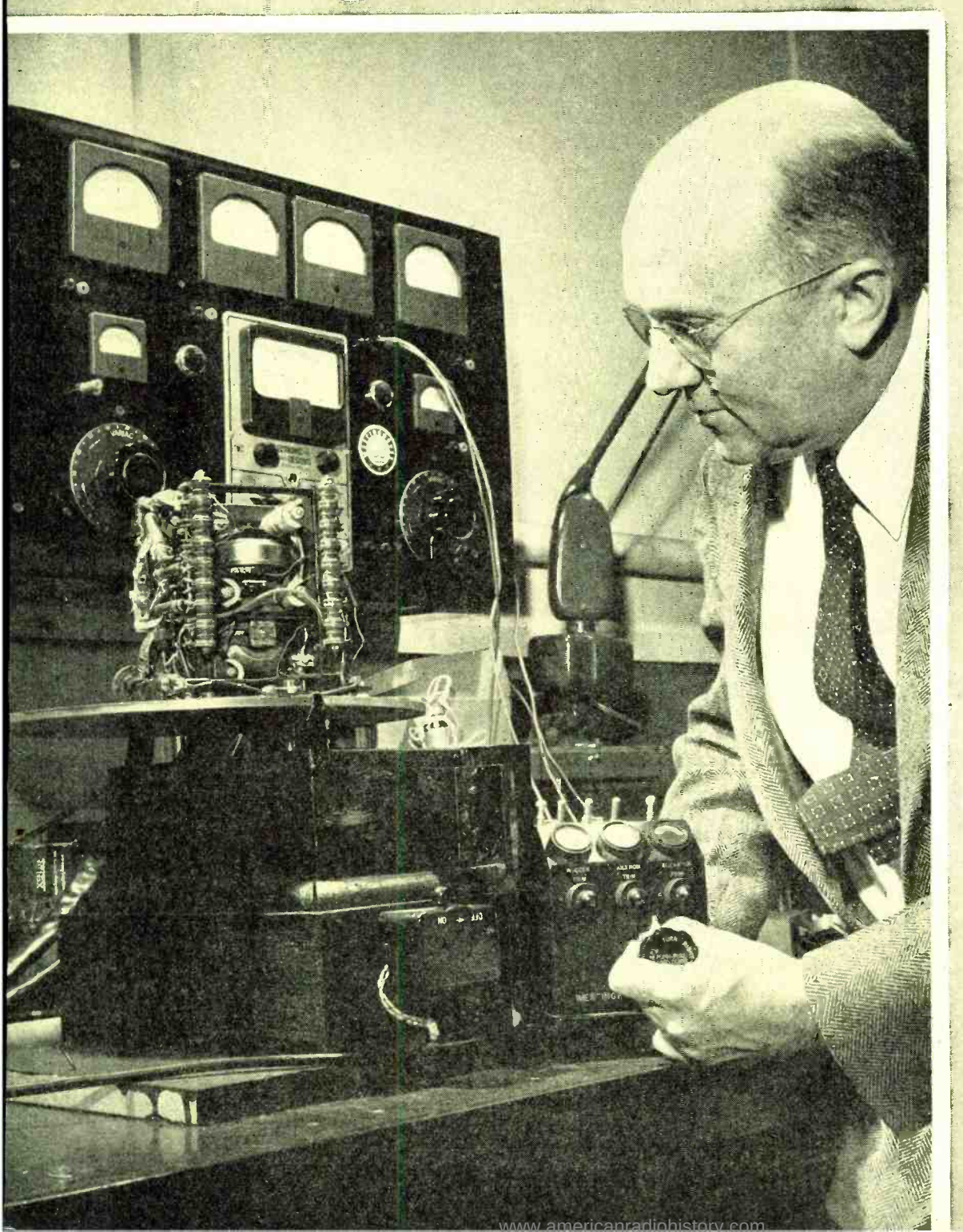
185 North Wabash Ave., Chicago 1, Ill.
VOLUME 39 • NUMBER 4

RADIO NEWS is published monthly by the Ziff-Davis Publishing Company, 185 N. Wabash Ave., Chicago 1, Ill. Subscription Rates: in U. S. and Canada $4.00 (12 issues), single copies 35 cents; in Mexico, South and Central America, and U.S. Possessions, $4.00 (12 issues); in British Empire, $5.00 (12 issues)—all other foreign countries $5.00 (12 issues). Subscribers should allow at least 2 weeks for change of address. All communications about subscriptions should be addressed to: Director of Circulation, 185 N. Wabash Ave., Chicago 1, Ill. Entered as second class matter March 9, 1938, at the Post Office, Chicago, Illinois, under the Act of March 3, 1879. Entered as second class matter at the Post Office Dept., Ottawa, Canada. Contributors should retain a copy of contributions and include return postage. Contributions will be handled with reasonable care but this magazine assumes no responsibility for their safety. Accepted material is subject to whatever revisions and by-line changes that are necessary. Payment made at our current rates, covers all authors', contributors' or contestants' rights, title, and interest in and to accepted material, including photographs and drawings.

APRIL, 1948

RADIO NEWS

RADIO-ELECTRONIC *Engineering*



TELEVISION

RADAR

ELECTRONICS

RESEARCH

COMMUNICATIONS

MAINTENANCE

RADIO NEWS

RADIO-ELECTRONIC Engineering

"Reg. U. S. Pat. Off."

ELECTRONICS • COMMUNICATIONS • TELEVISION • RESEARCH • MAINTENANCE

APRIL, 1948

RADIO-ELECTRONIC ENGINEERING is published each month as a special edition in a limited number of copies of RADIO NEWS, by the Ziff-Davis Publishing Company, 185 N. Wabash Avenue, Chicago 1, Illinois.

VOLUME 10, NUMBER 4,

COVER PHOTO—By Acme

Kurt A. Oplinger of Westinghouse Elec. Co., Pittsburgh, Pa. at the controls of the automatic pilot which he helped develop. The unit is mounted on a turntable for testing purposes, to simulate motion of a plane in flight. Three small gyros are contained in the unit to control the motion of the plane.

ATTENUATORS

By LLEWELLYN BATES KEIM
Consulting Radio Physicist*

Fig. 1. The Roxy Theatre Control Console. Provision is made for 52 slide attenuators; 38 are shown in operation. In left foreground, front rotary attenuator is stereophonic control

First of two papers covering the modern attenuator as used in the broadcasting and sound industries. Problems of use and proper selection are discussed.

THE modern attenuator has evolved through the last two decades from a simple, crude, slide wire unit, reminiscent of an old-fashioned filament rheostat, to the present day precision unit universally used in broadcasting and sound recording installations and in laboratory measurement procedures. However, little has been written during this period to assist the younger engineer and newcomer to these industries in the proper method of using these devices; and even less has been written on the selection of the correct type of attenuator for a specific use and the reasons for that selection. The catalogues offered by the makers of these units do not give any real assistance on technical data. So the author will attempt to cover all aspects of this field of the sound industry.

In order to present the matter clearly, varying uses and applications of attenuators will be discussed before attacking the problem of selecting the proper type for a particular application. A discussion of the electrical circuits associated with these interesting controls will be dealt with later.

Three forms of the attenuator can serve as a simple gain control for amplifiers, but the most frequently chosen is the potentiometer. The tee, ladder or tone-compensated ladder are used, depending upon the purpose of the amplifier, but the high impedance gain control is most popular. Both broadcasters and sound men have found the cheap paper with carbon deposit type of resistance far from satisfactory and have insisted upon a step-by-step construction of the gain control, whose resistance elements themselves are frequently of the carbon resistance type, selected for both accuracy of calibration and freedom from noise in the audio spectrum. Wire wound resistances can also be used, but their higher cost is not justified except in precise laboratory installations. Figs. 2 and 5A show the circuits of these units; Fig. 3 is a modern attenuator of the potentiometer type.

Studio installations of speech input equipment almost universally use ladders (Fig. 2C) or bridged tee (Fig. 5B) attenuators as the mixing and volume level controls. Where the cost factor must be considered, a poteniometer is frequently used as master gain control, but only where the entire speech equipment is built as a unit incorporating amplifiers and mixing equipment in one housing. This is done to avoid long, high impedance leads, and the attendant danger of hum pickup. The design of a mixing system is covered in later paragraphs.

Changing the characteristic impedance of a sound channel is often necessary, particularly in test installations, and a special type of attenuator is available for this purpose, offering either the minimum loss for the ratio of impedances matched, or a constant loss for any ratio selected. This is a little known but useful piece of equipment for the research worker.

Installations of any form of public address equipment for sound reinforcement present the problem of control of level from individual or groups of loudspeakers where a single amplifier feeds more than one transducer. The power attenuator can be used to control the sound level delivered without altering the volume from the remaining speakers connected to the same power amplifier source. Such installations are desirable when it is necessary to give the individual control of the speaker near him without affecting the group. As the control must dissipate power, its size and selection depends upon the level at which the loudspeaker is designed to work. Frequently these devices for group control assume large physical dimensions. In this connection it is well to observe that the power rating of such devices is based upon sine waveform, and use for speech and music will allow a slight overloading of the control with safety. However, not more than 25 per-cent overload can be economically tolerated unless it is for a very short period of time, or the attenuator's life is endangered.

There are more complicated uses of attenuators and a few of them are discussed here. The tone compensating attenuator, a newcomer, is illustrated in Fig. 4, and this unit can be converted from the intended function to a straight ladder by means of the special external connections shown. Electrically, it appears diagrammed in Fig. 7A. Here we find a unit especially engineered to overcome the loss

* *Formerly Sales Manager, The Daven Company, Newark, N. J.*

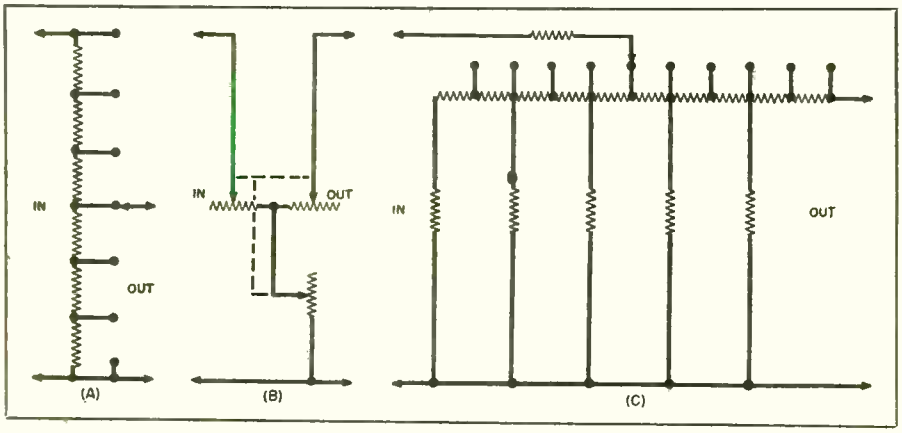


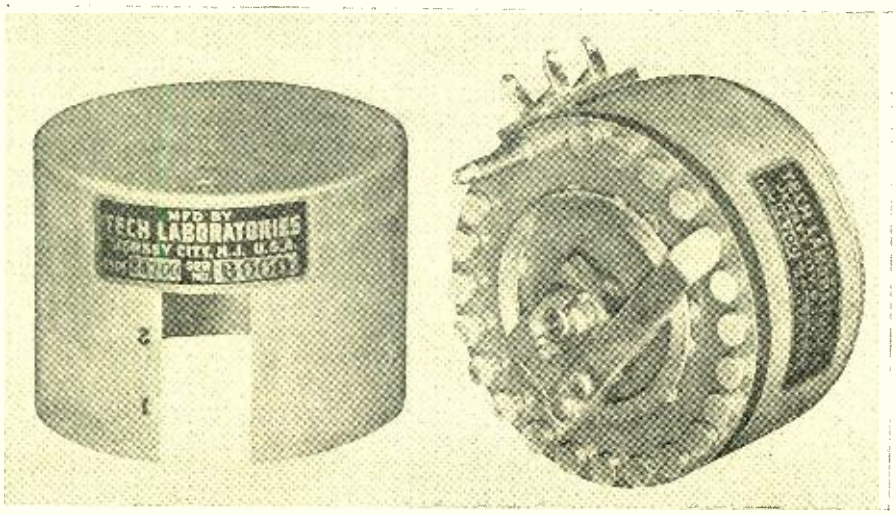
Fig. 2. (A) Potentiometer schematic. (B) The Tee pad. Note that all three resistors vary simultaneously. (C) The Ladder schematic.

of sensitivity of the human ear to certain tones at low volume levels, but attenuators can generally be used to achieve tone compensation where they are merely elements of a complex correcting circuit, as in the familiar equalizing units offered in the trade. In the recording process, at 33⅓ r.p.m. used in making transcriptions, there must be considerable equalization as the recording radius is reduced. Attenuators lend themselves nicely to this function, and can be actuated by the recording lead screw mechanism or manipulated separately at the discretion of the recording engineer. When attached to the recorder they take the form of sliding units, or those with an arc movement, operated through mechanical linkages to the traveling recording head.

Readers who attended the 1936-37 Dallas, Texas exposition perhaps witnessed the open air stereophonic sound installation, where the voice of the performing artist moved across stage, with the actor's motion. This is a special application of attenuators, which in its simplest form allows one control to govern two banks of power amplifers and their loudspeakers. At mid-position, half power is delivered to each bank of loudspeakers and as rotation takes place, left or right of center, one bank of speakers is driven at full power, while the other is greatly reduced, but not quite cut off. Thus there is an illusion of movement of the projected voice. The degree of loss introduced is in the neighborhood of 12-15 decibels. A variant of this was automatically accomplished in a separate sound track run coincidentally with the projection print of Fantasia, and was utilized in those theaters which had been equipped to handle this type of sound projection.

The last special use of attenuators to be discussed here is the application in circuits measuring volume level. The familiar decibel meter, a rectifier type of voltmeter, has long been used in all sound installations, and is still widely used in laboratory, test, and recording studios. Where it is necessary to terminate the measured circuit in its characteristic impedance, the meter can be connected to a tee pad across the line thus serving to adjust the range of the meter too. If it is electrically possible to bridge the meter across the circuit to be measured, a potentiometer can be used. The accuracy of measurement is determined by the accuracy of calibration of the resistances built into these meter multipliers. Eight years ago the broadcasting organizations cooperated in developing a standard measuring instrument, the VU meter, which today is universally used in that industry. Possessing specific, desirable ballistic characteristics and reading a power level of plus 4 dbm.* at zero VU on its scale, it is clearly evident that some form of multiplier is necessary here too. This takes the form of a pure tee pad, so that the characteristics of the meter are not changed, nor any inordinate loss imposed upon the audio line being measured. A small attenuator, in the form of a rheostat, is incorporated in these circuits wherever it is necessary to standardize many instruments throughout a broadcasting network to read alike. Such standardization takes place daily with a constant tone signal transmitted before network operations commence.

Fig. 3. The Potentiometer. A 20 step unit with protective cover removed.

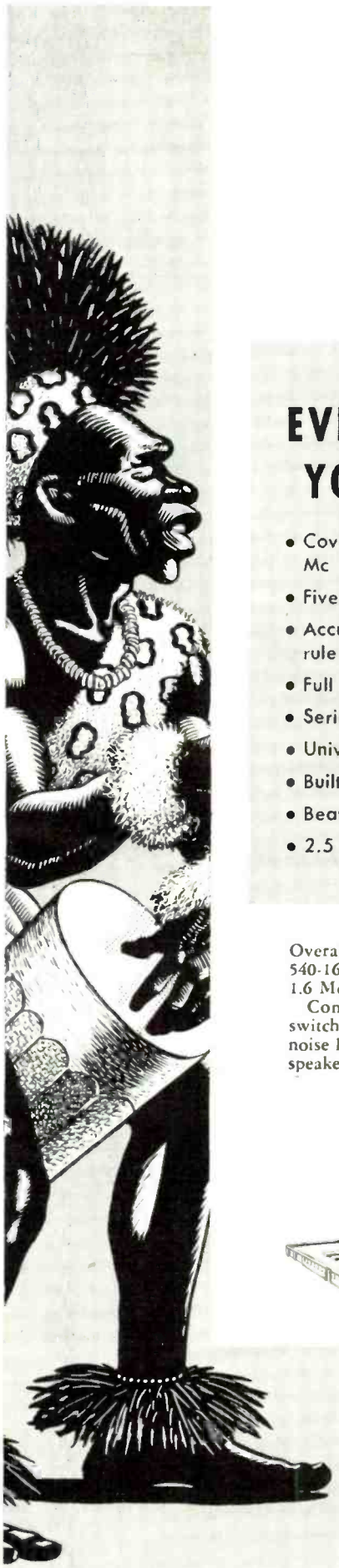


So far we have been talking about variable attenuators, but there is a vast field of applications for fixed attenuators, or fixed pads. In mixing installations, the several incoming signals are frequently not of identical level and any great discrepancy can be compensated for by a fixed pad of suitable circuit configuration—to match the general schematic of the mixer—balanced or unbalanced to ground. When two amplifiers are coupled together at low impedance, good engineering practice dictates that at least six decibels of loss in the form of a fixed attenuator should be included in the circuit between the two connected transformer windings. This will eliminate any circulating audio currents.

Multiple end use of a single source of sound energy, such as feeding both an AM and FM transmitter or driving many power amplifiers in a sound system, calls for the use of a dividing network. This is a form of fixed attenuator, offering a small loss between the source and its respective loads, but simultaneously presenting considerable separation between the several loads. Inverted, the same pad becomes a combining network, for assembling several sources into one load. Usually these pads are designed to present a uniform impedance to all terminals, and assume several complicated circuit configurations, but they are all examples of attenuators.

When connecting a bridging amplifier across a properly terminated junction of source and load, a bridging pad can be used, if the second

*Reference level 1 mw. at 600 ohms Z.



EVERYTHING YOU WANT..... in a high quality low cost receiver

Model hallicrafters NEW S-53

- Coverage: 540 kc to 54.5 Mc
- Five bands
- Accurately calibrated slide rule dials
- Full electrical bandspread
- Series noise limiter
- Universal antenna input
- Built-in PM speaker
- Beat oscillator
- 2.5 watt audio output

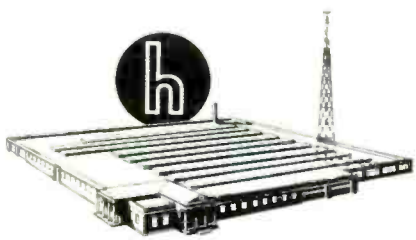
Hallicrafters Model S-53 takes an important position in the Hallicrafters line of high quality communications receivers. Completely modern. Superbly engineered for top flight performance at remarkably low price. All the Hallicrafters built-in quality features amateurs expect and demand in a good receiver. Extended frequency range from 540 kc to 54.5 Mc in five bands. Uses two Mc IF which positively eliminates all amateur station images or repeat points within the ham bands. The strikingly designed, edge lighted dial is precisely calibrated. A separate bandspread control provides full electrical bandspread on all frequency bands. Latest series type noise limiter circuit; voltage stabilized oscillator; iron core IF's; built-in PM dynamic speaker. Rich satin-black steel cabinet with satin chrome trim. Complete with seven tubes and rectifier. 105-125 volts, 50-60 cycles AC **$79.50**

Overall tuning range: 540 kc to 54.5 Mc. Band 1: 540-1630 Kc; Band 2: 2.5-6.3 Mc; Band 3: 6.3-1.6 Mc; Band 4: 14-31 Mc; Band 5: 48-54.5 Mc.

Controls: main tuning, bandspread, bandswitch, RF gain, audio volume, tone control, noise limiter, standby-receive, phone-code switch, speaker-headphone switch and phone jack on rear panel. Input jack for record player pickup connection.

New superhet circuit uses: 1—6C4 oscillator; 1—6BA6 mixer; 2—6BA6 IF's; 6H6 detector-AVC-noise limiter; 6SC7 BFO-1st audio; 6K6GT audio output and SY3 rectifier.

Size: 12⅞" x 6⅞" x 7⅞".



hallicrafters
RADIO
THE HALLICRAFTERS CO.
4401 W. Fifth Ave., Chicago 24, Illinois
MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT

LISTEN FOR THE *Gatti* - hallicrafters *expedition*

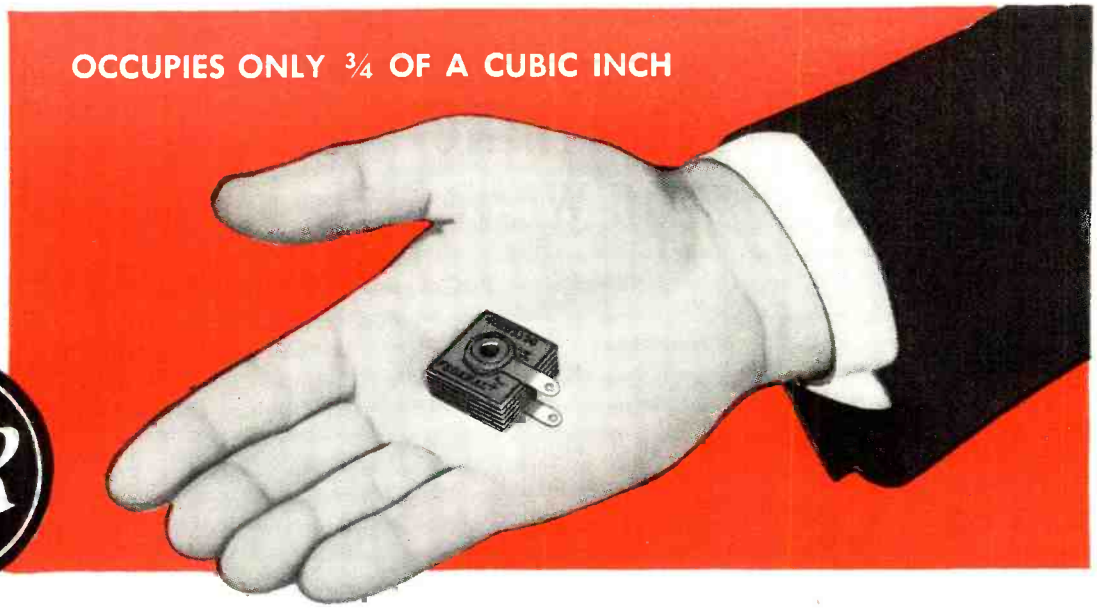
Hallicrafters mobile, radio-equipped expedition now operating via short wave from the Mountains of the Moon, Africa. Listen for these call letters:

VQ5-GHE **VQ3-HGE** **VQ4-EHG** **VQ5-HEG**

Visit your distributor for maps, itinerary, schedules, other details.

NOW SMALLER THAN EVER!

Federal Offers You a New 75-Ma Selenium Rectifier that is



FTR

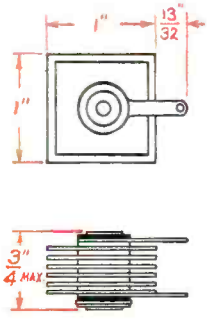
A new solution to the *space problem* in your smallest electronic equipment

WHEN FEDERAL first introduced the Miniature Selenium Rectifier to replace the rectifier tube in AC-DC radio receivers, it was the smallest, most compact unit of its type ever developed. Now the new 75-Ma rectifier is even *smaller* than before —providing additional space savings so valuable in modern miniature receivers and equipment. It's easier to install in restricted spaces—leaves more "hand room" to work in. And this reduction in size has been made without any sacrifice in performance or dependability. In fact, it incorporates *added* safety factors for longer trouble-free operation.

Compared to a rectifier tube, this space-saving Selenium Rectifier offers the advantages of longer life, rugged all-metal construction, only two soldered connections, and instantaneous current output without warm-up. For complete data on the new 75-Ma rectifier, write to Federal today-Dept. F 559.

APPROXIMATE DIMENSIONS

75-Ma Rectifier — No. 402D3150



NOTE: **This rectifier is electrically interchangeable with Rectifier No. 402D2788.**

KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

Federal Telephone and Radio Corporation

SELENIUM and INTELIN DIVISION, 1000 Passaic Ave., East Newark, New Jersey

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors:—International Standard Electric Corp. 67 Broad St., N. Y.

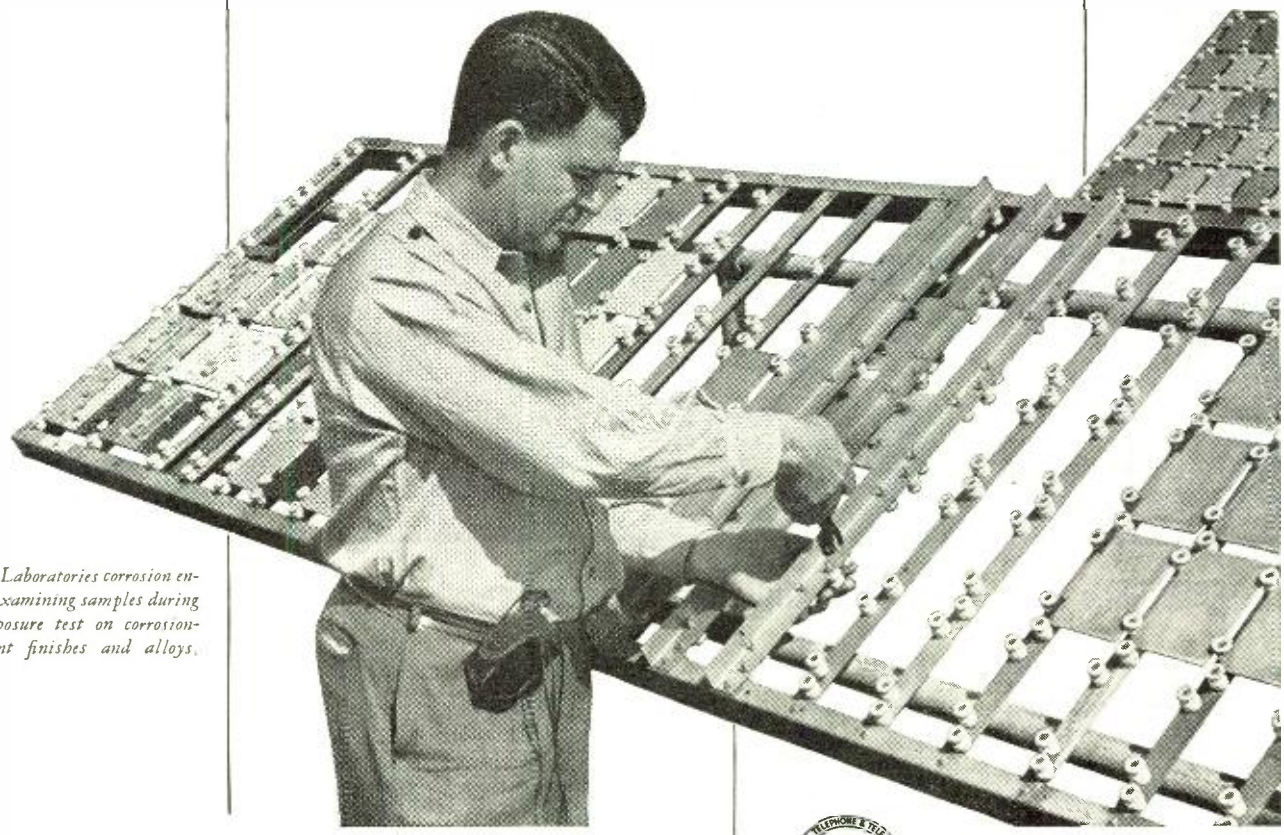
The battle of the atoms

Telephone equipment is constantly at war against invisible forces of nature which seek to take it apart, atom by atom. On all fronts, Bell Laboratories chemists must fight corrosion — an enemy able to make a telephone circuit noisy or perhaps to sever it altogether.

An example: for years lead cable had lain protected in wooden ducts. Then in certain areas something began to eat the sheath, exposing wires to moisture. Corrosion chemists of the Laboratories were called in. The corrosion, they found, came from acetic acid generated in the wood during the preservative treatment then in use. They pumped in neutralizing ammonia. Corrosion stopped. Now telephone duct wood is controlled for acidity.

In a large city, smoke-polluted air was coating the silver surfaces of contacts with sulphide. Noisy circuits resulted. Chemists discovered minute traces of sulphur vapor in the air. They filtered incoming air with activated charcoal. Today, the latest telephone contacts are of palladium — not affected by sulphur.

Corrosion in metals is only one type of deterioration which engages Bell chemists against hostile forces. Plastics, paper, metals, rubber, textiles, coils, waxes and woods all have enemies. But knowledge, and persistence, are steadily winning out—to the benefit of the telephone user.

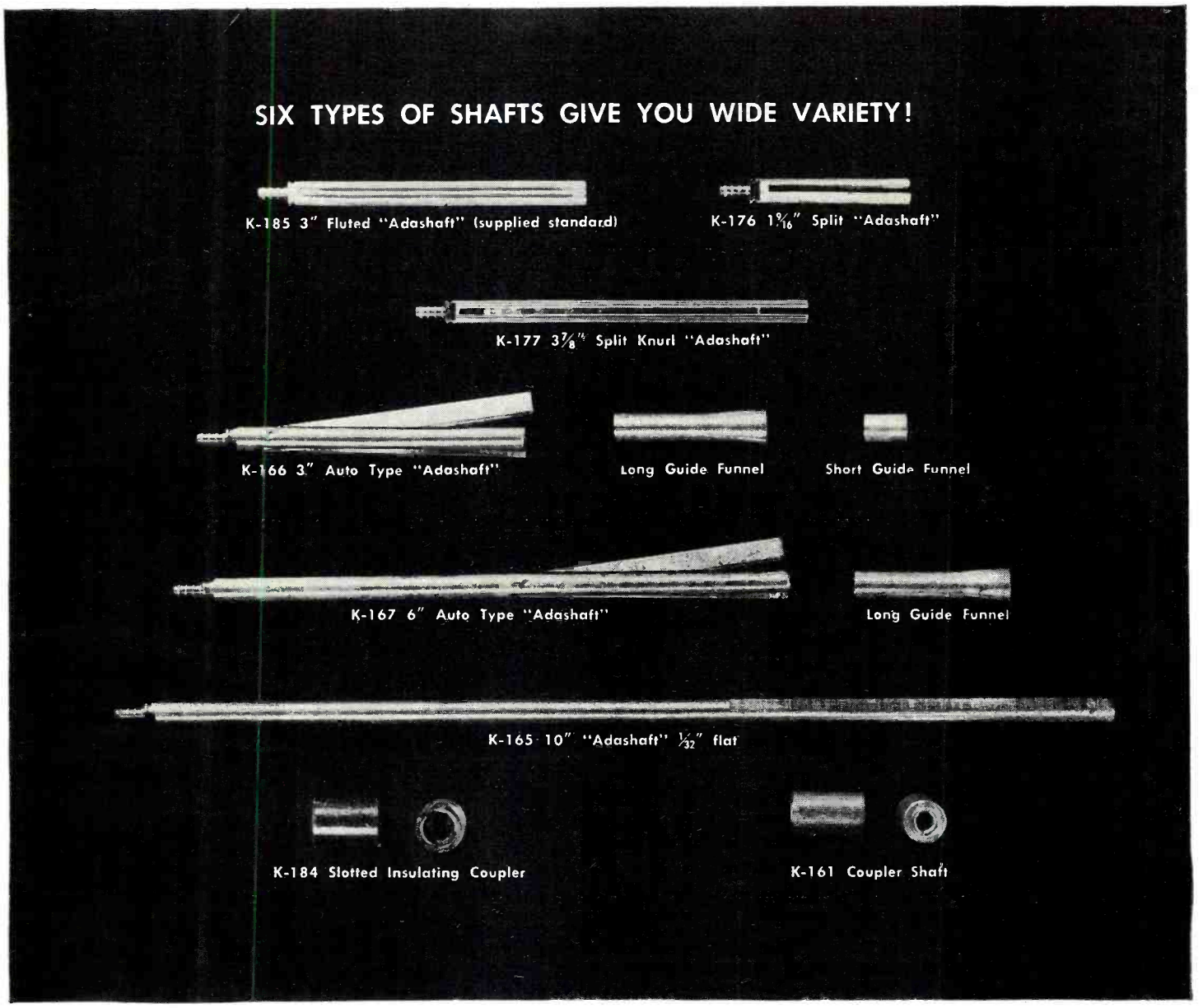


A Bell Laboratories corrosion engineer examining samples during an exposure test on corrosion-resistant finishes and alloys.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Improved "Adashaft"* Radiohm!



See how "Adashaft" Radiohms cut down overhead on service and repairs!

NOW, YOU CAN HAVE a small stock of controls on hand, yet be prepared to handle almost any kind of control replacement problem for your customers! Yes, that's what Centralab "Adashaft" Radiohms give you, and that's why more and more radio service dealers are using them to speed up service and cut down inventory.

Centralab "Adashaft" Radiohms are available in all sizes for all Model "M" volume control applications. See for yourself how they can streamline your service operations. Ask your jobber about them, or write direct for further information.

Centralab

CRL

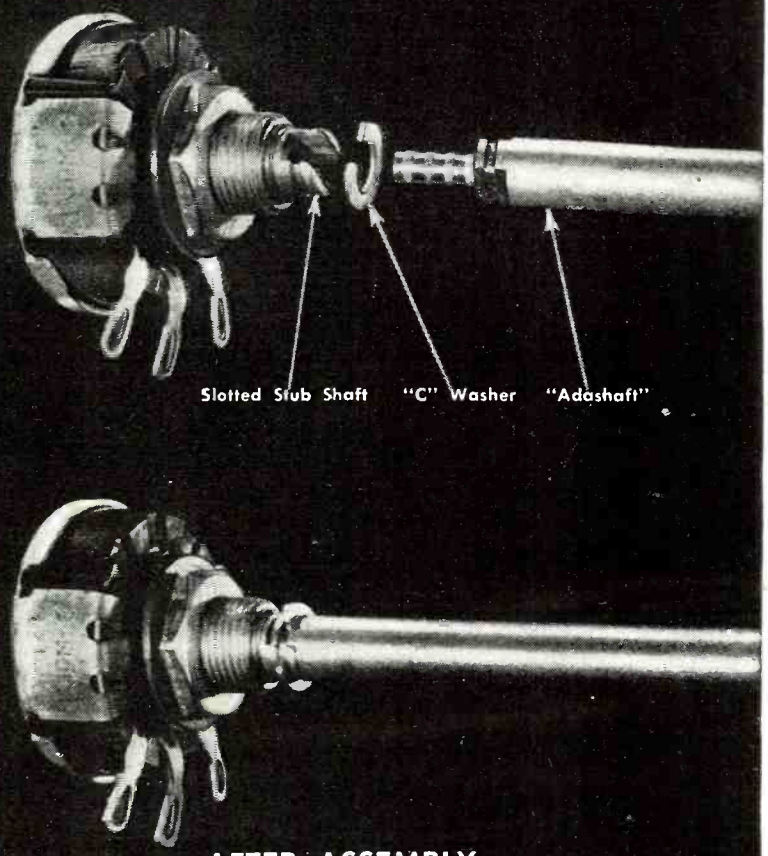
Division of **GLOBE-UNION INC., Milwaukee**

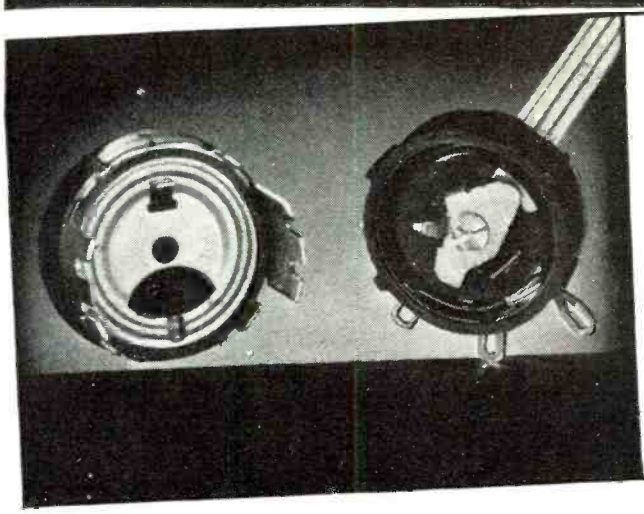
Centralab Announces an

See how EASILY and QUICKLY "Adashaft"* Radiohms can be assembled!

No WIGGLE, no wobble, no slip when you use Centralab's "Adashaft" Radiohm. Just insert shaft pilot in hole provided in control stub shaft, and slip "C" washer into place. Quick as a wink, control and shaft become an integral unit, ready for smooth, trouble-free operation. Notice the wide selection of shaft types which Centralab offers you — for every kind of set from large radio-phonograph combinations to small automobile receivers. Shafts are rugged—built to withstand hard usage, yet easy to cut to lengths required.

**Trademark registered*





Where line switches are required, use CRL attachable Switch Covers!

Available in five types for "R" Radiohms, 4 types for "M" Radiohms, 1 type for "E" Radiohms. Minimum life of 50,000 mechanical and electrical operations. Underwriters approved. Contact carrier is propelled by full-floating, compression type spring, provides easy, positive action. Rated at 3 amp. 125 volts; 1 amp., 250 volts.

SAVE TIME — SAVE MONEY
SAVE TUBES....

With the New HYTRON Miniature Pin STRAIGHTENER

Ever cussed the pins of miniatures when they broke as you fussed to straighten them with your fingers or with long-nose pliers? Unfortunately the pins have to be pliable to avoid cracked buttons. But you can make pin straightening easy and safe.

For only 49c — less than cost — a fraction of normal price, you can own a new Hytron Miniature Pin Straightener. You then merely press a 7-pin miniature gently into the Straightener until the button base seats squarely. Presto, the pins are straight again! Best of all, avoiding just one broken tube can pay for the Straightener twice over.

Features: precision die of wear and rust resistant steel for long life and close tolerances, production-tested, easy clean-out, adapted to hand or bench use. It's faster, cheaper, safer to use the Straightener *always* before plugging in miniatures. You need three Pin Straighteners — for bench — for field tool kit — for counter. *Available only from Hytron jobbers.* Order yours today.

ONLY 49c
AT YOUR HYTRON JOBBER'S

A PREVIEW

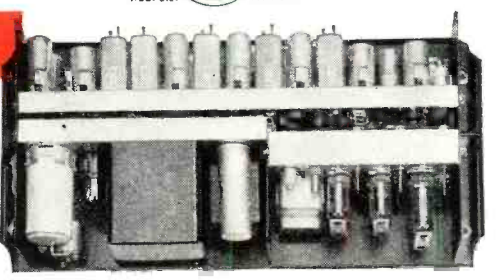
The Hytron Miniature Tube Pin Straightener and Handy Tube Tapper are just the beginning. Watch for more lower-than-cost Hytron tube tools designed especially for you. They will save you time — help you make more money. Follow the Hytron ads for announcements. Order the tools from your Hytron jobber.

Hytron Handy Tube Tapper — novel and useful tool locates elusive intermittent "shorts" and "opens". Pencil, eraser, and tube tapper. Fits breast pocket. Compact and nonmetallic. Rugged and effective. Only 5c at your Hytron jobber's.

BENDIX RADIO
REG. U.S. PAT. OFF.

TUBES ARE KNOWN BY THE COMPANY THEY KEEP

Bendix MRT-3A, 152-162 mc f-m taxicab transmitter uses Hytron tubes generously.
Companies with top names like Bendix pick top quality components. You, too, choose the best when you ask for Hytron. Join the leaders. Specify Hytron tubes.



SPECIALISTS IN RADIO RECEIVING TUBES SINCE 1921

These service tools made available to you on a non-profit basis by both Hytron and its jobbers.

HYTRON
RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

eleven years. He was also associated with the *Pan American Airways System* for eighteen months during the war as a flight radio officer on trans-Pacific clippers.

Before joining the *Farnsworth* company two years ago, Mr. Patton was the acting chief engineer of the Common Carrier Engineering Section of the Federal Communications Commission. During the war, he served with the Board of War Communications and was the Engineering Department's representative in the coordination of activities with the FCC legal staff.

* * *

RAY HUTMACHER is *Utah Radio Products, Division of International Detrola Corporation's* new representative in Illinois, Wisconsin, and St. Louis County, Missouri. Also appointed at the same time as Mr. Hutmacher, of *Ray Hutmacher & Associates* of Chicago, was William S. Lee of Detroit, who will cover the entire state of Michigan for *Utah*.

Both Mr. Lee and Mr. Hutmacher have many years' experience in the marketing of radio replacement parts and are well-known through their respective territories.

* * *

DAVID T. SIEGEL, Chicago manufacturer, has announced the purchase of *American Relay & Controls, Inc.* This company manufactures electrical relays, switches, and specialized controls.

The newly purchased firm is now located at 4900 West Flournoy Street, Chicago 44, Illinois.

* * *

FRED T. STERRITT, was recently appointed Advertising and Sales Promotion Manager of *Sparks-Withington Company's* Radio and Appliance Division.

Mr. Sterritt, recently District Merchandiser for *Sparton* in Chicago and Northern Illinois, had been an advertising and sales promotion executive for *Sparton* for some years before the war, and later acted in a similar capacity for *Zenith Radio Corporation*.

* * *

GENERAL ELECTRIC COMPANY has appointed Richard H. Rudolph as Sales Manager of precision and laboratory test equipment and crystals for the *Specialty Division*.

Formerly a commercial engineer in the division, he will now have charge of the sale of this equipment to nucleonic, research, manufacturing, and educational organizations.

Mr. Rudolph holds a B.S. degree in electrical engineering from Ohio University. In 1943 he joined *General*

(*Continued on page* 201)

READ MORE RANGES · MORE ACCURATELY · MORE EASILY

- 12 D. C. Voltage Ranges on 4.4″ scale. Mirrored for Accuracy. Special multipliers for permanent accuracy.
- 6 A. C. Voltage Ranges on 4″ Scale. Mirrored for Accuracy. Special multipliers for permanent accuracy.
- 6 D. C. Current Ranges on 4.4″ Scale. Mirrored for Accuracy. Wire wound shunts for permanent accuracy.
- 3 Resistance Ranges on 5″ scale. Mirrored for Accuracy. Special multipliers for permanent accuracy.
- 6 Decibel Ranges on 3.33″ scale. Mirrored for Accuracy. Special multipliers for permanent accuracy.

MODEL 625-NA

Dealer Net Price $45.00

For the Man who takes Pride in his work

The new Model 625-NA, with 39 ranges and many added features, is the widest range tester of its type. Note the long mirror scale on the large 6″ meter for easier, more accurate reading. Resistance ranges to 40 megohms give you all the ranges needed for general servicing, plus Television and FM. And with 10,000 ohms per volt A. C. you can check many audio and high impedance circuits where a Vacuum Tube Volt meter is ordinarily required. A proven super-service instrument for laboratory, field maintenance and radio repair.

Write for complete technical information on Dept. N47.

RANGES

D. C. VOLTS: 0-1.25-5-25-125-500-2500, at 20,000 Ohms/Volt
0-2.5-10-50-250-1000-5000, at 10,000 Ohms/Volt
A. C. VOLTS: 0-2.5-10-50-250-1000-5000, at 10,000 Ohms/Volt
D. C. MICROAMPERES: 0-50, at 250 Millivolts
D. C. MILLIAMPERES: 0-1-10-100-1000, at 250 Millivolts
D. C. AMPERES: 0-10, at 250 Millivolts
OHMS: 0-2000-200,000 (12-1200 at center scale)
MEGOHMS: 0-40 (240,000 ohms at center scale)
DECIBELS: −30 +3 +15, +29, +43, +55, +69 (Reference level "O" DB at 1.73 V. on 500 ohm line)
OUTPUT VOLTS: 0-2.5-10-50-250-1000-5000, at 10,000 Ohms/Volt

TRIPLETT ELECTRICAL INSTRUMENT CO. • BLUFFTON, OHIO

In Canada: Triplett Instruments of Canada, Georgetown, Ontario

Precision first...to Last

TRIPLETT

Within the TV INDUSTRY

RALPH T. BRENGLE of *Potter and Brumfield Sales Company,* Chicago, was reelected president of the National Association of Relay Manufacturers at their first annual meeting at the Graemere Hotel, in Chicago.

Daniel R. Dooley, vice-president in charge of sales of *C. P. Clare & Co.,* Chicago, was elected vice-president; J. J. Rowell of *Guardian Electric Mfg. Company,* Chicago, secretary and treasurer. Directors elected included: H. W. Pfeffer, *Struthers-Dunn, Inc.,* Philadelphia, Pa.; L. V. Roughan, *Price Electric Co.,* Frederick, Md.; E. Gillette, *Allied Control Co., Inc.,* New York, N. Y.; H. L. Huntsinger, *R. B. M. Division, Essex Wire Corp.,* Logansport, Ind.; and Fred W. Falk, *Advance Relay Company,* Los Angeles, Cal.

A constitution and by-laws were adopted and a committee on standards and nomenclature appointed to make a thorough study of the subject of relay contact ratings with a view to setting acceptable standards.

* * *

NEWELL B. PARSONS, associated for the past several years with *Webster-Chicago Corporation,* has been appointed sales representative for the company.

Mr. Parsons will cover the Chicago and Milwaukee trading areas for the *Webster-Chicago* line of recorders, record changers, and phonographs in order to maintain closer contact with manufacturers, distributors, and dealers.

* * *

HARLEY R. WALL has been named manager of *Air King's* contract division. In his new capacity, Mr. Wall will contact all private brand users in the country.

Previously Mr. Wall was associated with *International Detrola Corporation* as Sales Manager and prior to that was connected with the *Sparks-Withington Company.*

* * *

BELDEN MANUFACTURING COMPANY, Chicago manufacturers of electrical wire and cable products, recently inducted four new members into their 25-Year Club. All received watches in recognition of their quarter-century of service.

These four members are, H. W. Clough, Vice-President, who joined the company in April of 1922; Shelton Wright, industrial sales division, who joined a little more than a week after Mr. Clough; Hoyne Howe, also of industrial sales, who came with the company in May of 1922, and Thomas P. Redmond, in charge of sales estimating for the merchandise division, an employee since December of 1922.

* * *

SIGHTMASTER CORP. of New York has appointed Henry L. Haines and John Cooper French as Philadelphia representatives. Mr. Haines and Mr. French will have offices at 1500 Walnut Street, Philadelphia, Pa., where they will be in charge of sales and distribution of the *Sightmaster* line of television receivers.

* * *

CARL K. NICKELL was recently appointed Vice-President in Charge of Sales for the *H. M. Tower Corporation, Crosley* distributors in Connecticut.

For the past two years Mr. Nickell was Sales Manager for the *J. N. Ceazan Company, Crosley* distributors in San Diego, California, and previously he was associated with the *Midland Company,* of Indianapolis. Mr. Nickell is a veteran of the radio and electric appliance industry.

* * *

OWEN P. NANGLE, district sales manager for *Zenith Radio Corporation,* died recently at Grant Hospital in Chicago at the age of 42.

Mr. Nangle started in radio sales in 1935, and served during the war with the Army-Navy Expediting Production Agency. He joined *Zenith Radio Distributing Corporation* in 1944 as key account salesman in Chicago, and in September, 1947 was appointed district sales manager of *Zenith Radio Corporation,* serving Lower Michigan and most of Indiana.

* * *

PHILIPS B. PATTON, for the past two years technical coordinator of the Mobile Communications Division of the *Farnsworth Television & Radio Corporation,* has been appointed West Coast engineering and sales representative of the Division.

Mr. Patton will make his headquarters at 42 Beverly Street, in San Francisco and will represent *Farnsworth's* mobile products in California, Oregon, Washington, and Nevada.

A native of California, Mr. Patton was with the *Western Union Telegraph Company* in San Francisco for

NEW! VERSATILE! EFFICIENT!

TUBE CHECKER YTW-1

Obsolescence is the big problem with tube checkers. The new YTW-1 has been especially designed to guard against early obsolescence. Blanks, mounted with locking rings, for easy removal, provide for future tube types that may be developed. This, together with exceptional circuit switching flexibility, makes the YTW-1 an outstanding piece of equipment—the tube checker you must have on your bench.

The YTW-1 is crammed full of features which servicemen will appreciate. Study them carefully—then place your order.

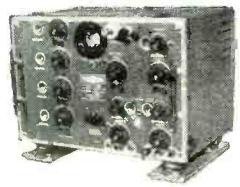
- Checks virtually all receiving type tubes, including the nine pin types. Tuning indicator tubes are checked by visual indication—just as if they were operating in a set.
- Tube checker "short" light remains "on" unless there is a short. This gives constant indication of the YTW-1's operation.
- Loads are so chosen that tubes "on their way out" will show up as weak or questionable, even though their mutual conductance may be within factory tolerances. This is a prime advantage of the emission check.
- Where tubes have internal "jumpers" it is possible to tell that "jumpers" are present and they are indicated on the roll chart by asterisks.
- Makes "short" tests with minimum stress on delicate tube elements. It is possible to directly identify the shorted elements.
- Like numbered pins on all sockets are connected—sockets for tubes developed in the future, easily connected.
- Roll chart is placed directly under the levers for easy reading and fast operation and *can be readily removed for replacement.*
- The YTW-1 includes an exceptionally accurate d-c voltmeter.

Save time—save money—speed service—order the YTW-1 today. For complete information write: *General Electric Company, Electronics Park, Syracuse, N. Y.*

GENERAL ELECTRIC

164-G2

BENDIX 100 WATT TRANSMITTER 49.95



FOUR SEPARATE ELECTRONIC COUPLED OSCILLATORS CHECK THESE VALUES: Three 807 Tubes, four 12SK7, one 2 inch 5 amp. RF meter, four Separate Master oscillators. (These can be easily changed to cover 20-40-80 meters and by using crystal for the 10 meter band you will have a complete coverage transmitter.)

Four separate output tanks.

One 4 position selector channel switch having seven sections which changes the ECO, IPA and output tanks simultaneously. All the controls are mounted on the front panel. The housing is cast aluminum; shields and case are sheet aluminum. Dimensions 11 x 12 x 15 inches, weighing 35¼ lbs. Complete, simple instructions for conversion furnished. Complete with tubes.

Sun Radio FOR THE HOTTEST VALUES IN Surplus Parts

CRYSTALS!

In the greatest purchase of radio transmitting crystals ever made by one wholesaler in the history of the Radio Parts Industry Sun Radio acquired title to over a half million dollars ($500,000) of Army Surplus, precision built, exactly tooled crystals in moisture proof holders which are shock mounted. Please note that crystal shipments of 6 or less are packed in cloth containers to expedite handling. . . . No worry because all crystals are shock mounted and guaranteed delivered perfect. All crystals have Army MC harmonic rating but Sun encloses directions for deriving the correct fundamental frequency in kilocycles.

CRYSTALS WITH A MILLION USES

Fractions Omitted

kc	kc	kc	kc	kc	kc	kc	kc	kc	kc	kc	kc
412	420	429	437	445	457	469	479	490	497	506	516
413	422	430	438	446	458	470	481	491	498	507	518
414	423	431	440	447	459	472	483	492	501	508	519
415	424	433	441	448	462	473	484	493	502	509	522
416	425	434	442	451	463	474	485	494	503	511	523
418	426	435	443	453	466	475	487	495	504	512	
419	427	436	444		468	477	488	496	505	515	

49¢ each

I.F. Frequency Standards

kc	kc	kc
450	454.166	461.111
451.388	455.556	464.815
452.777	459.259	465.277

99¢ each

Crystal Frequency Standards 98.356kc

Easily altered for 100 kc Standard Mounted in low loss 3 prong holder.

$3.89 each

For Crystal Controlled Signal Generators 525kc

526.388	531.944	536.111
527.777	533.333	537.500
529.166	534.722	538.888
530.555		

99¢ each

ASSORTED MISCELLANEOUS CRYSTALS

Fractions Omitted

370kc	376kc	381kc	384kc	387kc
372	377	383	386	388
374	379			
375	380			

39¢ each

priced at a fraction of the cost of their holders alone.

FOR HAM AND GENERAL USE

Fractions Omitted

390kc	395kc	402kc	405kc	408kc
391	396	403	406	409
392	397	404	407	411
393	398			
394	401			

79¢ each

- Payments must accompany order. Enclose 20c for postage and handling. Minimum order—$2.00 plus postage.
- Crystals are shipped packed in cloth bags inasmuch as they are shock mounted. All shipments guaranteed.

110-VOLT AC SUPERHETERODYNE RECEIVER

This crystal fixed frequency receiver comes with full conversion instructions for variable tuning of all ham bands and broadcast. A highly selective superheterodyne receiver, 110 V. A.C. power supply built in. Using the following tubes: 6K7—RF Amplifier; 6K8 Output and Noise Suppressor; 80 Rectifier. Dimensions—3½x19x11½ inches. Comes complete, brand new, with one set of coils and two sets of tubes. . . **$16.95**

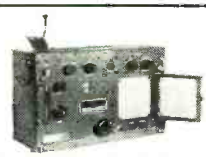
Extra set of coils. $2.95

NAVY SPEAKER

Stromberg Carlson and RCA waterproof speakers. Brand new in original cartons. 25 Watt PM driver unit with line matching transformer and projector mounted in heavy duty round metal baffle. Ideal for communication receivers and sound systems at lowest price ever offered. **$14.95**

BC-221 FREQUENCY METER

We have just received another shipment of these meters, probably our last. Complete with tubes, crystal, calibration chart (from 125kc to 20,000kc) and guaranteed accuracy of .01% or 500 cycles whichever is greater. These are slightly used but guaranteed perfect and A-1. . . . . **$36.75**



1-222 SIGNAL GENERATOR

Brand new; Frequency from 8MC to 230 MC in 2 bands. Calibration graph furnished. Crystal controlled check points. 110V AC power supply. Output attenuator. Dial calibration 10 points per division. A true laboratory instrument. A $350 value for only. **$54.95**

V.H.F. TRANSMITTER

Here is one of the greatest offerings in war-surplus! Hundreds sold at $20 and now closed out at an amazingly low price. Brand new. Battery operated (67½ v B and 1½ v A.) Frequency 80 to 105 mc. Complete with 2—1G4 tubes and full instruction manual. Ready to go on the air.

Less Batteries. **$6.95**

TS-13 HANDSET

Combining a 200 ohm carbon mike and 2500 ohm earphone with butterfly switch for listen and talk. Has 6' flexible rubber cord with 1—P155 and PL68 plugs attached.

Brand New. **$2.95**

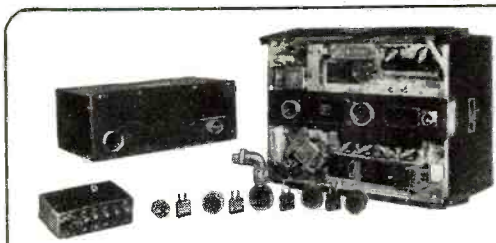
MAGNETIC HEADPHONES

2000 ohms, 8' cords with Army plug. All unused; show slight handling. **$1.98**

PANEL METERS

ALL METERS BRAND NEW AND GUARANTEED

West	2" Round	O-300 D.C.-M.A.	$2.97
GE	2" Round	O-500 D.C.-M.A.	2.97
Simpson	2" Round	O-15 D.C.-V.	2.97
Triplett	2" Square	O-40 D.C.-V.	2.97
Sun	2" Round	O-300 D.C.-V.	2.97
GE	3" Square	O-150 A.C.-V.	3.49



SCR-522 VHF XMTR-RCVR

The finest oll purpose equipment on the surplus market. Tunes 100-156 MC. Don't confuse these with other incomplete and abused 522s. Sun Radio offers electronically perfect and guaranteed 522s . . . AND COMPLETE with tubes (one 10 tube superhet receiver with squelch circuit and one 7 tube transmitter), remote control box, 28 volt dynamotor (can be converted to 110V operation), 4 crystals and ALL CABLE CONNECTORS but less cables. **$24.95**

5-GANG TUNING CONDENSER

Brand new . . . 5 gang, 365 mmfd. per section . . . a truly precision built condenser with ceramic insulation. A $13.50 volue in the greatest offering ever mode in tuning condensers for only. **$2.95**

- All items F.O.B., Washington, D. C. All orders $30.00 or less cash with order. Above $30.00 25 per cent with order balance C.O.D. Foreign orders cash with all orders, plus exchange rate.

SUN RADIO

OF WASHINGTON, D. C.

938 F STREET, N. W. WASH. 4, D. C.

Mr. Radio Dealer DON'T BREAK

Give FM a Break... with the

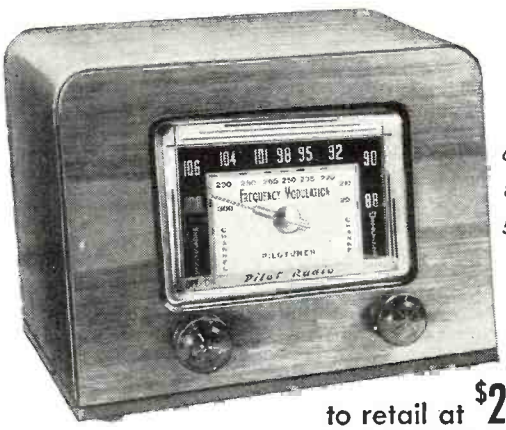
Pilotuner

Face the Facts! FM can be a Smash Hit . . . if YOU don't smash it — by selling the public "LAME DUCK" FM tuners.

FM "bloopers" . . . "fly-by-night" FM tuners . . . chiselling, cut-corner, half-way FM equipment can ONLY give a black eye to FM — and to the misguided dealer who sells them.

Why not play the proven winner . . . the FM PILOTUNER . . . which *knows no compromise* on quality! Into the Pilotuner go Pilot Radio's more than 30 years of experience . . . the "know-how" that assures complete satisfaction—first, last and always.

A sensation in '47, the amazing PILOTUNER is headed for an even greater '48. Display it—promote it . . . get your share of the new business, extra traffic, satisfied customers! Send coupon now for complete information.



6¾" high,
8¾" wide,
5¾" deep

to retail at $29.95
Slightly Higher West of Rockies

PILOT RADIO CORP., 37-06 36th St., Long Island City, N. Y..

Send me full information concerning the FM PILOTUNER.

NAME .....

ADDRESS .....

CITY.....ZONE NO..... STATE.....

4

PILOT RADIO CORPORATION
37-06 36th ST., LONG ISLAND CITY, N. Y.
Makers of PILOTONE VINYLITE RECORDS • PIONEERS IN FM

McMurdo SILVER ADDS 3 NEW LCETI

1

NEW MODEL 905A "SPARX" SIGNAL TRACER AND UNIVERSAL TEST SPEAKER

The new "SPARX" is here — the *super*-sensitive r.f., i.f. a.f. signal tracer, phono pick-up, microphone and speaker tester. Like all SILVER LCETI, it goes far beyond the ordinary. Built-in is a 6" PM speaker and 8 watt *truly universal* output transformer with two panel switches give impedances of 325 thru 70,000Ω single or push-pull. In the new 905A "SPARX" you get the world's finest signal tracer, the world's most universal test speaker, separately usable universal output transformer — *three instruments for the price of one.*

ONLY $44.50 NET

2

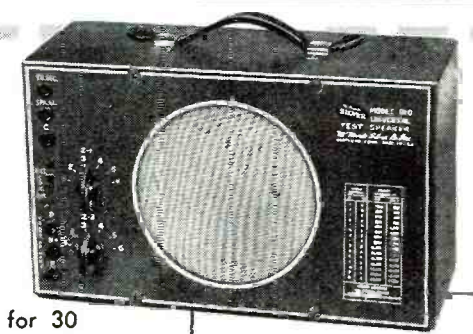
NEW FM & TV SWEEP SIGNAL GENERATOR

FM and TV are here — must be serviced by every technician today. Model 909 and any good 'scope does the TV and FM alignment job — visually — easily — simply — perfectly — and fast. Three bands 2 thru 266 mc., linear electronic sweep panel variable from 40 kc. to 10 mc. It's no wonder Model 909 — first announced in late January — is the "hottest" instrument in radio. Model 909 is another "must" for every service laboratory — new Silver inventions make it newest and by far the best. With complete instructions.

ONLY $48.50 NET

3

NEW MODEL 910 UNIVERSAL TEST SPEAKER



Six-inch high-quality PM speaker and 8 watt *truly universal* output transformer of the new "SPARX" give you any transformer impedance, single or push-pull, from 325 thru 70,000Ω. Panel jacks and switches permit combined or independent use of transformer and/or high-quality 6" PM (3Ω voice coil) speaker. Chart on panel instantly shows correct switch positions for 30 different impedances — can't get lost. Size and style matches "VOMAX", 906 FM/AM Signal Generator — all SILVER LCETI.

ONLY $22.70 NET

LCETI — *L*aboratory *C*aliber *E*lectronic *T*est *I*nstruments.
See them at your favorite jobber.

SEND FOR COMPLETE CATALOG. See these and Silver communication transmitters, receivers, "Micromatch", TV preamplifier, pretuned freq. multiplier at your jobber.

OVER 37 YEARS OF RADIO ENGINEERING ACHIEVEMENT

McMurdo Silver Co., Inc.

EXECUTIVE OFFICES: 1240 MAIN ST., HARTFORD 3, CONN.
FACTORY OFFICE: 1249 MAIN ST., HARTFORD 3, CONN.

Make More Money in Radio TELEVISION & ELECTRONICS NOW!

You build this fine modern Superheterodyne Receiver and other units, with the complete standard parts we send you. This valuable equipment becomes yours to use and keep.

You learn by building equipment with standard radio parts we send you

Get these 2 BIG BOOKS FREE!

If you are already employed in the great Radio Industry, you know how great the demand is for trained, experienced servicemen, operators and technicians. You know how fast the field is growing and how important it is to keep up with new developments in F.M., Television and Electronics. The Radio industry is alive with opportunity for the qualified technician whose knowledge is up-to-the-minute. You can be an F.M., and Television specialist . . . get into the lucrative Radio Service Field . . . . own a business of your own, if you prefer. National Schools of Los Angeles, for over 40 years a practical resident and home study trade school, has put into effect its New 1948 Training Program. This program, adapted to National's Master Shop Method Home Study Course, can qualify you in your spare time as a Radio and Television technician. For details of this Program fill out and mail the coupon below.

NOW! New Professional Multitester Included! This versatile testing instrument is portable and complete with test leads and batteries. Simple to operate, accurate and dependable. You will be able to quickly locate trouble and adjust the most delicate circuits. You can use the Multitester at home or on service calls. It is designed to measure AC and DC volts, current, resistance and decibles. You will be proud to own and use this valuable professional instrument.

SHOP METHOD HOME TRAINING
FROM A TECHNICAL TRADE RESIDENT SCHOOL

National Schools brings its exclusive Shop Method of training right into your own home. You can learn the most up-to-date approved practical training projects, systems and modern circuits from the very beginning in your spare time. Here is sound and practical home training—the development of experienced instructors working with students right in the shops, NEW Television and Broadcast Studios and Experimental Laboratories of NATIONAL SCHOOLS—one of the most advanced technical trade education centers in the world.

LEARN BY DOING

Work with Real Experimental Equipment Furnished without Extra Cost as Part of your National Schools Training

Send Coupon and prove to yourself what YOU can do in RADIO and TELEVISION!

Experience is the best teacher. You learn by experience with the exclusive National Shop-Method of Home Training. With the apparatus sent you, you actually build various types of standard equipment—a powerful superheterodyne receiver, a signal generator, an audio oscillator, low power Radio transmitter and other units. You make tests and conduct experiments that show you the why and how of Radio. You understand what makes the various elements of Electronics operate because you actually see them work for you. Not only do you gain splendid experience by this method of learning, but you receive valuable equipment you will use on the job in the practice of your profession as a Radio Technician. Mail the coupon and learn what this means to you.

Take Advantage Now of these Outstanding Features of National Schools 1948 Training Program

1. National Schools' 1948 Course is planned to prepare you for real success in Radio, Television and Electronics.
2. Experimental equipment supplied with the Course has been completely revised to give you the most up-to-date practical experience with new circuits, new units, etc., right in your own home.
3. New Television Lessons have been expanded to give you training in the latest developments in this important field.
4. The 1948 Course includes a Professional Multitester (shown above) for your use in spare or full-time Radio work.
5. National Schools gives you advanced training—the key to the better positions in Radio, Television, Electronics.
6. You are sent standard Experimental Equipment, including tubes and accessories, for building a modern Short Wave and Standard Broadcast Superheterodyne Receiver. All equipment becomes your personal property.
7. National Schools' 43 years of experience in Technical Trade Training . . . our modern shops and laboratories . . . highly trained instructors are back of your time-tested Training Plans for a brighter future.

VETERANS

If you qualify for training under G. I. Bill, check the coupon for a Special Bulletin.

FREE LESSON INCLUDED

Examine the exclusive National Shop Method of Home Training. See for yourself how sound and practical it is. Be convinced that you can learn Radio, Electronics, Television—quickly and easily in your spare time. This trial is ABSOLUTELY FREE.

Mail the coupon here for the books that tell you the complete story of National Schools Master Shop Method of Home Training in Radio, Electronics and Television.

This is the MODERN SYSTEM OF TRAINING, it matches the rapid progress constantly being made in Radio, Television and Electronics. It is TIME TESTED, too. National Schools has been training men for more than a third of a century. It is the very same training that has helped thousands to more pay and greater opportunity. You owe it to yourself—your future—to read the book "Your Future in Radio, Electronics and Television"—FREE to you when you send in the coupon.

G. I. APPROVED

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA EST. 1905

MAIL OPPORTUNITY COUPON FOR QUICK ACTION

MEMBER: NATIONAL COUNCIL OF TECHNICAL SCHOOLS

MEMBER: NATIONAL HOME STUDY COUNCIL

NATIONAL SCHOOLS, Dept. RN-4
4000 South Figueroa Street, Los Angeles 37, California

(Mail in envelope or paste on penny post card)

Mail me FREE the two books mentioned in your ad, including a sample lesson of your course. I understand no salesman will call on me.

NAME ..... AGE .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

.... Check here if Veteran of World War II

HOWARD W. SAMS WINS "OSCAR" FOR AID TO RADIO SERVICE INDUSTRY!

The handsome plaque awarded to Howard W. Sams carries the inscription: "The Federation of Radio Servicemen's Associations of Pennsylvania Award to Howard W. Sams in Recognition of His Outstanding Efforts in Behalf of the Radio Service Industry, 1947." The award is a tribute to the practical usefulness of PHOTOFACT Publications—the world's finest radio service data—indispensable to the Radio Serviceman.

PHOTOFACT Publications Cited as Outstanding Effort in Behalf of Servicemen

"For Outstanding Efforts in Behalf of the Radio Service Industry"—reads the citation of the first annual award bestowed on Howard W. Sams by the Federation of Radio Servicemens' Associations of Pennsylvania. The "Oscar" was presented before a group of over 600 persons, including many radio industry leaders, at a banquet held on January 12, 1948, at Philadelphia's Bellevue-Stratford Hotel. The surprise ceremony was arranged as a demonstration of appreciation for the significant, practical aid made available to Radio Servicemen in PHOTOFACT Publications, and for the efforts of the SAMS' organization in behalf of the Radio Service Industry. This spontaneous demonstration marks a milestone in the Radio Service field. It is a healthy sign of growing recognition of the Serviceman's importance to the Radio Industry.

These Are the Award-Winning Service Aids that Earn More Money for You!

Own PHOTOFACT Volumes 1, 2 and 3—world's most complete, accurate, practical radio service data manuals. Here is everything you need for faster, easier, more profitable servicing—bound in easy-to-use volumes. Exclusive Standard Notation Schematics; photo views keyed to complete replacement parts lists; exhaustive electrical and mechanical analysis of every set covered. Brings you right up to January 1948! Have the exclusive advantages that are now earning bigger profits for thousands of servicemen!

Vol. 1. All post-war models up to Jan. 1, 1947.
Vol. 2. Models from Jan. 1, 1947 to July 1, 1947.
Vol. 3. Models from July 1, 1947 to Jan. 1, 1948.

YOUR PRICE, EACH VOLUME, IN EASY-TO-USE DELUXE BINDER . . **$18.39**

Radio Receiver Tube Placement Guide

Shows you exactly where to replace each tube in 5500 radio models, covering 1938 to 1947 receivers. Each tube layout is illustrated by a clear, accurate diagram. Saves time—eliminates risky hit-and-miss methods. You'll use this handy pocket-sized book every single day. 192 pages, completely indexed. Order several copies now. *ONLY*..... **$1.25**

Dial Cord Stringing Guide

The book that shows you the *one right* way to string a dial cord. Here, for the first time, in one handy pocket-sized book, are all available dial cord diagrams covering over 2300 receivers, 1938 through 1946. Makes dial cord restringing jobs quick and simple. A "must" for every service bench and tool kit.
Order your copies now. *ONLY*.. **75c**

1947 Automatic Record Changer Manual

Nothing like it! Complete, accurate data on over 40 post-war models. Exclusive exploded views, photos from all angles. Gives full change cycle data, information on adjustments, service hints and kinks, complete parts lists. PLUS—for the first time—complete data on leading WIRE, RIBBON, TAPE and PAPER DISC RECORDERS! 400 pages; hard cover; opens flat. Order now! *ONLY*.... **$4.95**

HOWARD W. SAMS & CO., INC.
INDIANAPOLIS 6, INDIANA
Export—Ad. Auriema—89 Broad St., New York 4, N. Y.—U. S. of America
Canada—A. C. Simmonds & Sons, 301 King St., East—Toronto, Ontario

PHOTOFACT SERVICE

"The Service that pays for itself over and over again"

BOOST YOUR EARNING POWER!

Mail This Order Form
to HOWARD W. SAMS & CO., INC.
2924 E. Washington St., Indianapolis 6, Indiana.

My (check) (money order) for $.....enclosed.

- ☐ Send.....SAMS' TUBE PLACEMENT GUIDE(S) at $1.25 per copy.
- ☐ Send PHOTOFACT Volume 3 (including Sets Nos. 21 through 30) in DeLuxe Binder, $18.39.
- ☐ Send Volume 2. ☐ Send Volume 1 ($18.39 each).
- ☐ Send.....SAMS' 1947 AUTOMATIC RECORD CHANGER MANUAL(S) at $4.95 each.
- ☐ Send.....SAMS' DIAL CORD STRINGING GUIDE(S) at $0.75 per copy.

Name.....

Address.....

City.....*State*.....

Are you Building a Business ...or Burning your Bridges?

Would you patronize a dentist who filled your teeth with plaster of Paris?

Would you trust your children's lives to a doctor who prescribed cut-rate pills?

Your business, too, is built on *customer confidence!* And your reputation is too valuable to risk with inferior or unknown products. The cost of the parts you use in the average repair job is insignificant compared with your investment in *your reputation.*

That's why we say—YOUR CUSTOMERS AND *YOUR REPUTATION CAN AFFORD ONLY THE BEST!* . . . SPRAGUE.

CAPACITORS **SPRAGUE** *KOOLOHM RESISTORS

* T.M. Reg. U. S. Pat. Off.

SPRAGUE PRODUCTS COMPANY, North Adams, Mass.

JOBBING DISTRIBUTING ORGANIZATION FOR PRODUCTS OF SPRAGUE ELECTRIC CO.

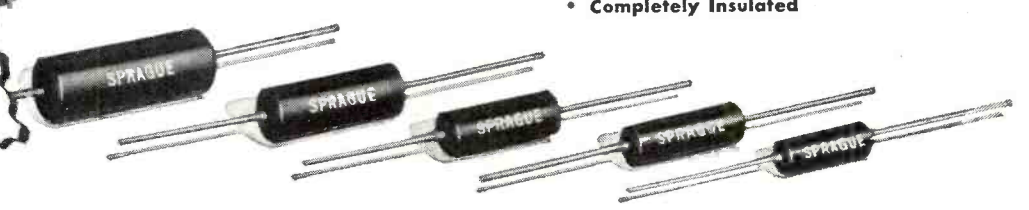
Reach for a SPRAGUE and Know You're Right!

The superiority of the new Sprague type TM High-Temperature Molded Paper Capacitors didn't happen by chance. You can use this better unit in your work today only because of more than four years of intensive research and one of the largest retooling programs in Sprague's history. That's why we can say *"The First Truly Practical Molded Paper Tubulars are Sprague TM's"*—and it is also the reason you can *use them on any job* with confidence and pride.

- **Highly Heat Resistant**
- **Moisture Resistant**
- **Non-inflammable**
- **Conservatively Rated**
- **Small in Size**
- **Mechanically Rugged**
- **Completely Insulated**

UNCONDITIONALLY GUARANTEED!

You can stake your reputation on Sprague replacement parts. If used at rated capacitance and voltage, they are UNCONDITIONALLY GUARANTEED to give satisfactory performance. Insist on Sprague and get the best!



facturers "may exceed 18,500,000, compared with 15,000,000 in 1946, the previous industry record." Forty-eight will have to go some to beat that.

ONE MORE television item that you may have missed and might be of interest. The *Crosley Division* of the *Avco Manufacturing Corporation,* Cincinnati, has come up with a gadget that makes it possible for you to see your home-set television screen without wearing out the rug moving your chair in front of the set. It's called a "Swing-a-View" picture tube. It can be turned from side to side over a sixty degree angle. The gadget is already in quantity production and is scheduled for early distribution in all areas having television service. It enables viewers to swivel the screen so that they may watch the picture directly from any point in a room within a 60 degree arc in front of the receiver.

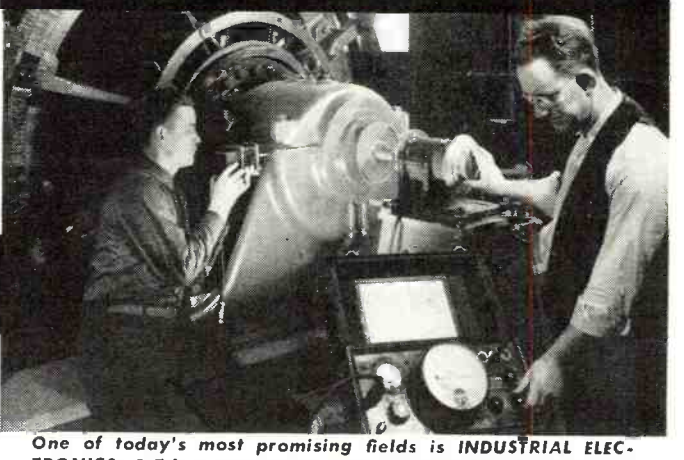
ALL OF WHICH, for our money, isn't quite as interesting as some dope we picked up the other day on a ham station—J2ROC, at Nagoya, Japan. Maybe you've heard of it—it was very much on the air during the Texas City disaster last year. One of Japan's strongest amateur stations, it is operated by hams in the Fifth Air Force. For the job it did in informing U.S. troops with relatives in Texas City, it earned the American Radio Relay Certificate of Merit, but reporting Texas City to Americans in Japan is only one of the many things the little station does. Indeed, it is one of the busiest communications terminals in the Orient, from all we hear. It's pure ham—operated as a spare-time hobby by two Air Force captains—Stanley Rodby and Frank Bowden. They are Rod and Tex to their friends on both sides of the Pacific. In a typical morning, they will complete calls to Tampa, Florida (a worried private-first-class wanting to talk to his sick mother); Chicago (a sergeant who has won a jeep in a raffle and wants his wife to sell the family jalopy before joining him in Japan), and Minneapolis (strictly romance between a Tokyo captain and his bride-to-be).

MOST CALLS are made directly over telephone rather than through a mike at the ham shack. The boys hook the phone directly into their radio transmitter. Thus, when a man in Nayoga wants to talk to his wife in Wabash, Indiana, he phones the ham shack from his office desk and stands by for a hook-up. Sometimes, with a station already alerted on this end of the line, calls go through with a speed rivalling long distance. Helping civilians talk with distant relatives is the same the whole world over at times, if what Rod and Tex report is true. There was the case of the WAC who wanted to talk to her mother, just for the fun of it, and finally they got the call through. Both mother and daughter devoted

(*Continued on page* 140)

ABOVE: TELEVISION offers YOU one of today's thrilling, newer fields with possibilities for a bright and promising future. The above scene shows some of the modern equipment at D.T.I. used in preparing men for TELEVISION.

• Television • RADIO • Industrial ELECTRONICS



One of today's most promising fields is INDUSTRIAL ELECTRONICS. D.T.I. can prepare you for this field — either at home or in our modern Chicago laboratories. See HOW you may get started toward this fascinating work now. Fill in — mail the coupon below today!

Get FREE Facts About YOUR Future in These Fields

SEE HOW YOU MAY MAKE REAL MONEY, HAVE A GOOD JOB, OR A BUSINESS OF YOUR OWN . . .

Mail the coupon below and you will receive, absolutely FREE, facts showing how you may get started toward a good job or a business of your own in RADIO or ELECTRONICS. See how readily you may begin to realize your life-long ambition for a REAL FUTURE. See how you may make your start toward a field that also includes such interesting branches as F-M Radio, Broadcast Radio, Aviation Radio, 2-Way Train Radio, Police-Cab-Truck Radio, Sound Recording.

NO ADVANCED EDUCATION, NO EXPERIENCE NECESSARY

Our Chicago Laboratory and Home Training have been designed to prepare you and to get you started in Radio and Electronics — whether or not you have a higher education or previous experience. Don't delay . . . mail the coupon below today!

With our HOME TRAINING you receive actual radio parts from which you make 133 experiments and build 7 radio receivers . . . plus loose-leaf lessons with fold-out diagrams . . . plus HOME MOVIES to help you learn easier, faster.

2 TRAINING PLANS—*TAKE YOUR CHOICE*

1. You may come to our modern, Chicago laboratories, where you train with the aid of capable instructors and some of the finest Radio-Electronic equipment. We will find comfortable living quarters for you.

2. Or, if you prefer, you may STUDY AT HOME — using modern, commercial-type radio equipment, well illustrated lessons and HOME MOVIES. You can do this in your SPARE TIME, without interfering with your present job.

VALUABLE EMPLOYMENT SERVICE

When you complete either training, our effective Employment Service goes to work for you, to help you get started toward a real future in Radio-Electronics. Don't delay!

MAIL THIS OPPORTUNITY COUPON NOW!

Mr. E. B. DeVRY, President
DeForest's Training, Inc.
2533 N. Ashland Ave., Dept. RN-E4
Chicago 14, Illinois

ACCEPTED FOR G.I. TRAINING

Please show me how I may get started toward a good job or a business of my own in Radio-Electronics.

Name_____ Age_____

Address_____ Apt._____

City_____ Zone_____ State_____

☐ If under 16, check here for special information.

☐ If a discharged Veteran of World War II, check here.

DeForest's Training, Inc.

CHICAGO, ILLINOIS

Associated with the DeVry Corporation
Builders of Electronic & Movie Equipment

Spot Radio News

★ *Presenting latest information on the Radio Industry.*

By FRED HAMLIN
Washington Editor, RADIO NEWS

IF ANYBODY ASKS YOU to guess which is going to grow faster this year —FM or television—you'll probably be nearer right if you answer, "Both." FM is, of course, more nearly established with a wider sector of the public, and growing spectacularly. But some of the things that are happening in television these days make it seem a safe bet to expect anything to happen—and soon. Everybody—including large segments of the public which the industry anticipated it would take years to win—is showing signs of going for video in a bigger and bigger way.

TO PUT IT MORE conservatively, both these branches of the radio industry are unquestionably in for a big year. A broad hint of what's in store for FM was revealed not long ago when the Radio Manufacturers Association, in releasing its final round-up figures for 1947, showed that a total of 1,175,104 FM-AM receivers were produced during the year, as compared with only 181,485 in 1946. FM-AM production shows every sign of going beyond the '47 figure this year, assuring an even wider listener potential. FM stations, keeping pace, are in the four-figure brackets as of the most recent Federal Communications Commission totals—1010 broadcasting stations authorized.

TELEVISION SET production in 1947 was just under the total number of FM-AM receivers made the year before. The '47 television figure was 178,571 as contrasted with 6476 during '46. But by the end of the year—and the trend continues—television set production had jumped from 5437 during January to nearly 30,000 in December. These sets have been accepted so enthusiastically by the public that a parallel rush to FCC for television licenses is now going on. So great are the current demands for broadcast posts that there seems a very real danger there will not be enough spectrum, as now reserved for commercial video, to go around. Nearly one hundred stations are on the air, with as many more applications pending.

AS FOR THE BROADCASTING end of the field—and audience acceptance—a number of surprising things have been happening. First place, Joe Public has decided what he likes and has found ways of seeing it, whether he can afford a set or not. Second place, he's been talking television up among his friends. Programs have also improved. Television is therefore reaching a surprisingly large audience in a surprisingly short time.

INDICATIONS ARE that broadcasters aren't too eager to have the audience grow too rapidly. Few days back, for instance, a big movie house in New York wired radio editors that they were going to telecast boxing bouts from a local arena on a "giant" movie screen. Few days later, editors were informed that the show had been called off. NBC, running the telecast, had said "no" on the grounds that the broadcast was their property and they didn't like the idea. The theater took the ruling without putting up a fight. Could be, another time, another theater would take it to court. But nobody has seemed to want to so far in television history, and if nobody does, you'll see your telecasts, not in a movie, but in a bar or your home.

STRAW-IN-THE-WIND as to television's drawing power is a recent announcement by the Veterans Administration that they are going to use the medium as one means of reaching veterans. This is the first large-scale use of television by a government agency. The Administration has produced five 16-mm. sound film cartoon shorts, ranging from one to three minutes, and prints will be distributed from branch offices.

IN THE EXCITEMENT and headlining being done over FM and television, sight should not be lost of the fact that standard broadcasting is doing nicely, thank you. Better than its precocious kid brothers, if you want to know. FCC reports that the number of authorized AM stations increased by 167 in the last six months of '47, as contrasted with an FM increase of only 92, and TV's jump from 66 to 73—only seven. Boxcar figures featured the year-end RMA AM round-up, for while FM-AM sets were breaking all records with 1,175,104, and television was running up its score of 178,571, the grand total RMA score on all sets was 17,695,677. AM's made up most of the difference. These totals are for RMA manufacturers only. The Association says that total production by all manu-

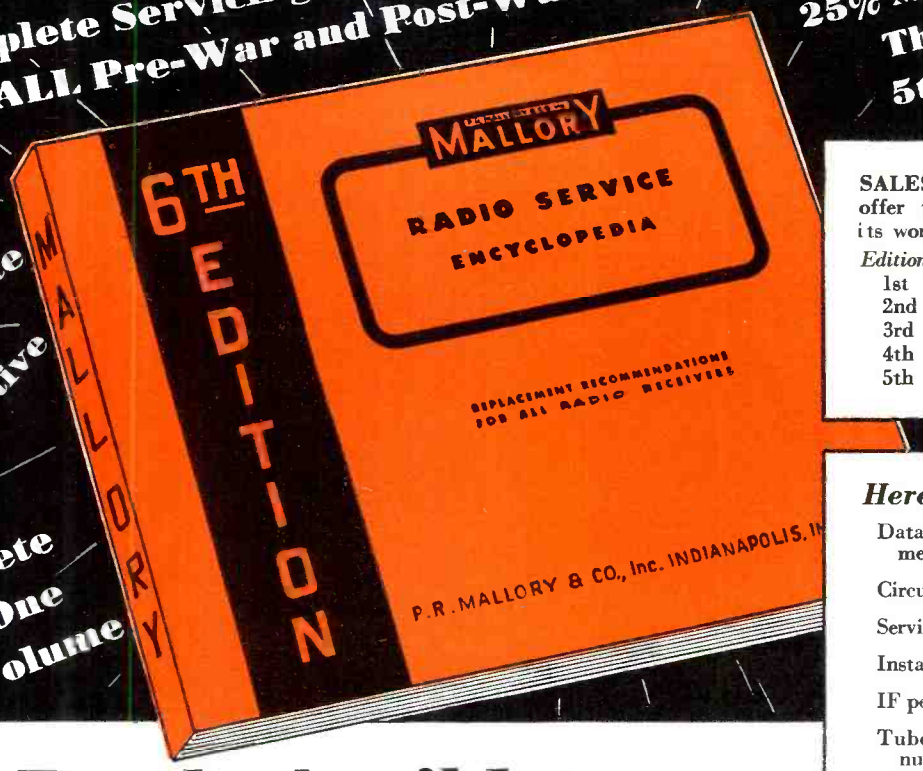
The ONLY Complete Servicing Reference on ALL Pre-War and Post-War Receivers

25% More Listings Than the 5th Edition

Accurate

Authoritative

Complete in One Volume



SALES of previous editions offer the best evidence of its worth.

Edition	*Year*	*Copies sold*
1st	1937	51,000
2nd	1938	25,000
3rd	1939	55,000
4th	1941	60,000
5th	1946	75,000

Here's what you get:

- Data on correct replacement parts
- Circuit information
- Servicing hints
- Installation notes
- IF peaks
- Tube complements and number of tubes
- References to Rider, giving volume and page number

RESERVE YOUR COPY NOW

Ready April 1st— The 6th Edition Mallory Radio Service Encyclopedia

Here it is—up to date—the only accurate, authoritative radio service engineers guide, complete in one volume—the Mallory Radio Service Encyclopedia, 6th Edition.

Made up in the same easy-to-use form that proved so popular in the 5th Edition, it gives you the complete facts on servicing all pre-war and post-war sets . . . volume and tone controls, capacitors, and vibrators . . . circuit information, servicing hints, installation notes, IF peaks, tube complements and number of tubes . . . and in addition, cross-index to Rider by volume and page number for easy reference. NO OTHER BOOK GIVES YOU ALL THIS INFORMATION—that's why it's a MUST for every radio service engineer.

25% more listings than the 5th Edition. Our ability to supply these books is taxed to the limit. The only way of being sure that you will get *your* copy *quickly* is to order a copy today. Your Mallory Distributor will reserve one for you. The cost to you is $2.00 net. It's the buy of the year.

THE MALLORY RADIO SERVICE ENCYCLOPEDIA

Complete—Authoritative—All in One Volume

P.R. MALLORY & CO. Inc.

MALLORY

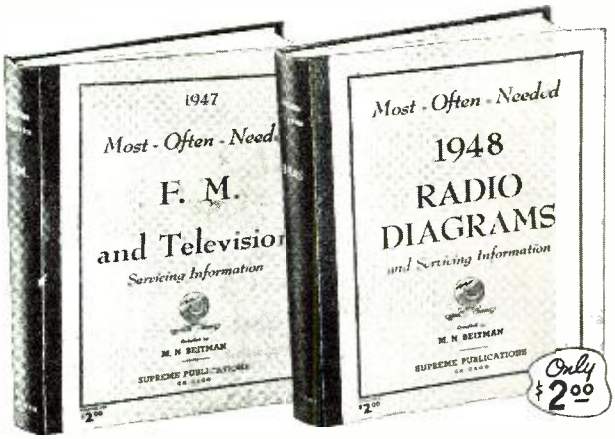
CAPACITORS . . . CONTROLS . . . VIBRATORS . . .
SWITCHES . . . RESISTORS . . . RECTIFIERS . . .
VIBRAPACK* POWER SUPPLIES . . . FILTERS

*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

New SUPREME 1948 and F.M. Manuals



F.M. and Television

Use this new giant manual of factory instructions for trouble-shooting, repairing, and alignment of any 1947-1948 **F.M.** and **Television** set. Covers every popular make, including F.M. tuners. AM-FM combinations, and all types of television receivers. Detailed circuit diagrams, theory of operation, test hints, alignment data, including both **meter** and oscilloscope methods. This is the material you need to fix any modern F.M. or Television set. Don't turn this profitable work away for lack of knowledge and information. Use this newest **Supreme** manual to save time and money on your very next F.M. job. Data presented on 192 large-size pages, 8½ x 11 in. Sturdy, manual-style binding. Special price, postpaid..... **$2.00**

New 1948 Manual

Be prepared to repair quickly all new **1948** receivers. In this big single volume you have clearly-printed, large schematics, needed alignment data, replacement parts lists, voltage values and information on stage gain, location of trimmers and dial stringing, for almost all recently released sets. A worthy companion to the 7 previous volumes used by over 120,000 shrewd radio servicemen. New manual covers models of 42 different manufacturers. Giant size: 8½x11 inches, 192 pages + index. Manual-style binding. Bargain price, only **$2.00**

YOU CAN SERVICE ALL OLDER RADIOS WITH

1947 1946 1942 1941 1940 1939 1926-1938

MOST-OFTEN-NEEDED RADIO DIAGRAMS

Each manual has between 192 and 208 pages of diagrams and service hints: large size, 8½x11". Price, each **$2.00**

DIAGRAMS 240 Pages Price $2.50

Record Changer Manuals

Post-War Models

Service expertly all modern (1945-1948) record changers. Just follow simplified factory instructions to make needed adjustments and repairs. Hundreds of photographs and exploded views; thousands of test hints; service instructions for all popular makes. Large size: 8½x11". 144 fact-filled pages. Available at your jobber or sent postpaid, special price, only.. **$1.50**

Pre-War Models

Just what you need to repair quickly thousands of pre-war (before 1942) automatic record changers, manual units, pick-ups, wireless oscillators, recorders, and combinations. Hundreds of mechanical and electrical diagrams. Instructions for adjustments and repairs. Most popular units of all makes. 128 large pages; size: 8½x11 inches. Price postpaid, only **$1.50**

See Your Radio Jobber or Send Coupon →

Supreme Publications

PUBLISHERS OF RADIO BOOKS, MANUALS, AND DIAGRAMS

9 South Kedzie Ave. • Chicago 12, Illinois

BIGGEST BARGAIN IN RADIO DIAGRAMS

Make these two new mammoth volumes your money-saving source for data on all recently released receivers. Learn about modern circuit developments, be ready to repair any new radio no matter how complex. You pay only $2.00 for each of these large manuals. With these two volumes on your workbench there is nothing else to buy, nothing else to pay — a whole year of service data and radio diagrams yours for a couple of dollars total. Again **Supreme Publications** beats all competition and gives radio servicemen greatest bargains in service information. Read about other volumes for previous years described below at left. ***No-risk*** examination granted to servicemen.

FIND ALL RADIO FAULTS DOUBLE-QUICK

You can speed-up and simplify radio repairs with SUPREME PUBLICATIONS Manuals. Service radios faster, better, easier, save time and money, use these **most-often-needed** diagram manuals to get ahead, earn more per hour. For the remarkable bargain price (only $2 for most volumes) you are assured of having in your shop and on the job, needed diagrams and other essential repair data on 4 out of 5 sets you will ever service. Every popular radio of all makes from old-timers to new 1948 sets, including F.M. and Television, is covered. Clearly printed circuits, parts lists, alignment data, and helpful service hints are the facts you need to improve your servicing ability. Save hours each day, every day, begin to earn more by making repairs in minutes instead of hours. Let these manuals furnish you with diagrams for 80% of all sets. There is no need to spend large sums for bulky, space-wasting manuals, or to buy additional drawings every few weeks; be wise, use **SUPREME Manuals** to get the most in diagrams and service data for the smallest cost.

SATISFACTION GUARANTEED

Select **Supreme** Diagram Manuals and Record Changer Books you want to examine. These manuals pay for themselves with time saved on a few jobs—after that you use them FREE. See listing in left-hand column. Send trial coupon. Use these manuals in your own home or shop for 10 days at our risk. Decide for yourself that **Supreme Publications** are the greatest values in service data. You must be completely satisfied, or return manuals and receive your money back. Write today—24-hour shipping service.

Compiled by M. N. Beitman radio engineer, teacher, author, and serviceman.

Models Made by:
R.C.A., Zenith, Philco, Sears, Fada, Emerson, Belmont, Detrola, Crosley, United Motors, G.E., Westinghouse, Arvin, Majestic, Midwest, Meck, Olympic, Pilot, Stewart-Warner, Admiral, Delco, Stromberg-Carlson, Western Auto Sparton, Motorola, Wards, Gamble, and many others.

NO *RISK* TRIAL ORDER COUPON

SUPREME PUBLICATIONS, 9 S. Kedzie Ave., Chicago 12, ILL.

Ship the following manuals on trial under your guarantee of satisfaction or money-back.

- ☐ New F.M. and Television Manual **$2.00**
- ☐ Post-War Record Changers..... **1.50**
- ☐ Pre-War Record Players & Recorders **1.50**
- ☐ I am enclosing $....., send postpaid.
- ☐ Send C.O.D. I am enclosing $.....deposit.

PRICED AT ONLY **$2** EACH

- ☐ 1948
- ☐ 1947
- ☐ 1946
- ☐ 1942
- ☐ 1941
- ☐ 1940
- ☐ 1939
- ☐ 1926-1938.....**$2.50**

Name:.....

Address:.....

"For Unfailing Dependability Give Me OHMITE"

You can be sure the resistors, rheostats, and tap switches you buy will provide accurate, dependable service if they're *made by Ohmite.* Every Ohmite product is designed and constructed to stand up under severe operating conditions . . . to give extra performance . . . to withstand the effects of shock, vibration, temperature extremes, altitude, and humidity. This *extra* performance is the reason thousands of particular parts buyers are regular Ohmite customers.

● Close Control RHEOSTATS

All ceramic and metal. Winding is permanently locked in vitreous enamel. Metal-graphite contact brush insures perfect contact with negligible wear on the wire. Available in 10 sizes from 25 to 1000 watts.

● Vitreous-Enameled RESISTORS

Vitreous enamel permanently locks and insulates each turn of wire on ceramic core. Prevents shorts, conducts generated heat away. All types and resistance values from 5 to 1500 watts.

● High Current TAP SWITCHES

Compact, dependable, and convenient to operate. Heavy, one-piece ceramic body is unaffected by arcing. Five models, A.C. ratings 10 to 100 amperes.

Write Today for Ohmite Catalog No. 19

Provides 16 pages of useful data on the selection and application of rheostats, resistors, tap switches, chokes, attenuators, and other equipment.

OHMITE MANUFACTURING COMPANY
4883 Flournoy St., Chicago 44, Ill.

Be Right with OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES • CHOKES • ATTENUATORS

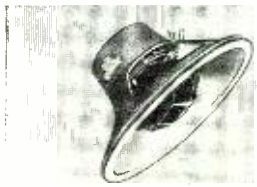
DEDICATED TO THE CONSTANT BETTERMENT OF SOUND

ALTEC LANSING News

ONE STANDARD OF QUALITY ONLY...THE HIGHEST

250 W. 57th ST., NEW YORK 19 • 1161 N. VINE ST., HOLLYWOOD 38

ALTEC LANSING SCIENTISTS DISCLOSE BASIC IMPROVEMENTS IN HIGH QUALITY SOUND REPRODUCTION IN NEW SPEAKERS



NEW 603B MULTICELL DIA-CONE SPEAKER

The new 603B Multicell Dia-cone speaker is as superior to the original 603 Model as the 603 was superior to its competitors. The new 603B has a 30% larger Alnico V permanent magnet; massive circular magnetic circuit; almost 100% increase in acoustic efficiency (2.5 db increase over the 603).

SPECIFICATIONS

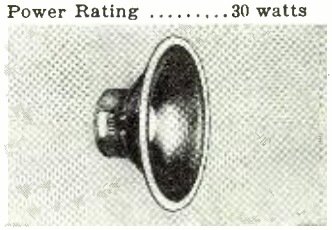
Angle of Horizontal Distribution .....60°
Angle of Vertical Distribution .....40°
Power Rating .....25 watts
Voice Coil Impedance..8 ohms
Required Amplifier Output Impedance....6-10 ohms
Voice Coil Diameter....3"
Weight .....18 lbs.
Speaker Diameter ..... 15-3/16"
Depth .....7"

← NEW MODEL 604B DUPLEX SPEAKER SHOWS REMARKABLE EFFICIENCY AND PERFORMANCE

Authorities on sound quality—the experts in the broadcasting, recording, and motion picture industries—who considered the previous Altec Lansing Duplex speaker (the 604) as the finest two-way speaker unit that science has produced, were literally thunderstruck when they listened to "previews" of the new improved Model 604B. Among outstanding new features are: 1,000 cycle crossover frequency using the new N-1000B network with adjustable high frequency control; an exclusive Altec Lansing development used with the high frequency metal diaphragm to smooth the frequency response beyond belief from 1,000 cycles to 16,000 cycles.

SPECIFICATIONS

Angle of Horizontal Distribution .....60°
Angle of Vertical Distribution .....40°
Power Rating .....30 watts
Network Impedance ...16 ohms
Required Amplifier Output Impedance ...8-16 ohms
Diameter .....15-3/16"
Depth .....11⅛"
Weight .....40 lbs.



NEW MODEL 600B DIA-CONE SPEAKER

"Greater quality per dollar" describes the new low-priced high quality 600B Dia-cone speaker unit. Because of the high efficiency, small space requirements, light weight and superior quality of reproduction, the 600B is ideal for home use, sound reinforcement systems and industrial applications.

SPECIFICATIONS

Power Rating .....20 watts
Voice Coil Impedance..8 ohms
Required Amplifier Output Impedance ...6-10 ohms
Voice Coil Diameter....3"
Speaker Diameter .....12¼"
Depth .....5¼"
Weight .....12 lbs.

NEW 8" MODEL 400B DIA-CONE SPEAKER

A low-priced high quality unit with a much higher efficiency than is found in ordinary 8" speakers: important in use with amplifier capable of delivering only from 5 or 6 watts. Exceptionally high power rating results from Altec Lansing design and use of a large Alnico V permanent magnet.

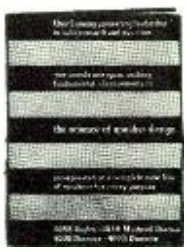
SPECIFICATIONS

Power Rating .....12 watts
Voice Coil Impedance.. 8 ohms
Required Amplifier Output Impedance ...4-8 ohms
Voice Coil Diameter....1¾"
Speaker Diameter .....8¼"
Speaker Depth .....3⅝"
Weight .....4 lbs.

Altec Lansing Corporation, one of the world's largest makers of professional and theatre-type speaker systems, has announced a new, basically improved line of general purpose, high quality speakers. Altec scientists call attention to the fact that these new speakers,—constituting a complete new line—have been fundamentally re-engineered, and are the result of the application of new scientific discoveries resulting from intensive original research in Altec Lansing laboratories; they are *not*, it is emphasized, mere modifications or "reworking" of present models. The new line of speakers is offered "with the fullest conviction that never before has such a superb group of speakers been presented to a discriminating and quality-conscious public."

FREQUENCY RESPONSE CURVES PUBLISHED IN ILLUSTRATED BROCHURE

With the announcement of the new line of speakers, Altec Lansing announces that frequency response curves will be published on all its speakers. These curves are guaranteed to be accurate, dependable and true reproductions, made on production run speakers with equipment used by Motion Picture Research Council for establishing speaker system standards in the motion picture industry.



SEND FOR ILLUSTRATED BROCHURE DESCRIBING THE NEW IMPROVED LINE OF ALTEC LANSING HIGH QUALITY SPEAKERS

NAME.....
BUSINESS.....
ADDRESS.....
CITY.....STATE.....

ALTEC LANSING CORPORATION

USE ADDRESS NEAREST YOU:
250 W. 57th St., New York 19
1161 N. Vine St., Hollywood 38

RCA Laboratories' "Chamber of Silence"—proving ground of tonal quality in radio and television instruments.

Ever hear SILENCE?

You walk into an eerie room. The door swings shut and you're wrapped in a silence so complete that it's an effort to listen. Sound in this vault-like cavern is reduced to the minimum of hearing.

But even *silence* has a sound of its own. Faintly you hear a subdued hiss; sometimes a soft hum. Scientists have suggested this may be the "noise" of molecules hitting the eardrums. Others wonder if it is caused by the coursing of the body's bloodstream.

On the walls, ceiling, beneath the open, grated floor of this RCA sound laboratory, hangs enough heavy rug padding to cover 250 average living rooms. Sound is smothered in its folds—echoes and distortion are wiped out.

When acoustic scientists at RCA Laboratories want to study the actual voice of an instrument, they take it to this room. What they hear then is the instrument itself—and only the instrument. They get a true measure of performance.

Information gained here is part of such advances as: The "Golden Throat" tone system found only in RCA Victor radios and Victrola radio-phonographs . . . superb sound systems for television . . . the true-to-life quality of RCA Victor records . . . high-fidelity microphones, clear voices for motion pictures, public address systems, and interoffice communications.

Research at RCA Laboratories moves along many paths. Advanced scientific thinking is part of any product bearing the names RCA, or RCA Victor.

When in Radio City, New York, be sure to see the radio, television and electronic wonders on display at RCA Exhibition Hall, 36 West 49th Street. Free admission. *Radio Corporation of America, RCA Building, Radio City, N. Y. 20.*

RADIO CORPORATION of AMERICA

RIDER MANUALS *Mean* SUCCESSFUL SERVICING

MANCHESTER-CHANDLER HAS ALL 16
(AND VOL. XVII ON ORDER)

"No Shop Can Give Efficient Service Without . . . These Volumes"

VOL. XVII
(Brings your Rider Manuals up-to-the-minute)
JUST OUT!
1600 PAGES—Plus "How It Works" Book
$15.00 (Less than a penny a page)
Your Jobber is taking orders for DELIVERY NOW!

Watch for Publication Date in Late Spring
RIDER TELEVISION MANUAL

"Rider Manuals give us the authentic data we need to locate quickly trouble in sets brought us for repair. This speed means time and money saved, means Rider Manuals have been a profitable investment for us. We feel no shop can give efficient service without the information contained in these volumes," says G. B. Manchester of the Manchester-Chandler Co., Portland, Ore.

So say successful servicemen everywhere, over whose benches you will find well-used copies of all 16 Rider Manuals. For, during the past seventeen years, money-making shops have depended upon "The World's Greatest Compilation of Radio Servicing Data" for authentic presentations of manufacturers' original servicing data on American-made receivers issued since 1920. This is vital information.

Rider Manuals keep pace with the manufacturers' releases. Volume XVII, just out, contains both FM and AM sets, record changers and wire recorders. The separate "How It Works" book explains theory and complexities of new receivers. Hundreds of Rider-exclusive "Clarified-schematics," time-saving breakdowns of multi-band jobs, are also in Volume XVII.

Nowhere else but in Rider Manuals will you find such coverage!

You NEED ALL 17—ORDER TODAY

VOLUME XVII	$15.00	Record Changers and Recorders	$ 9.00
Volume XVI	8.40	Master Index, (covering Manuals, Vols. I to XV)	1.50
Volume XV	18.00		
Volumes XIV to VII (ea. vol.)	15.00		
Volume VI	11.00		
Abridged Manuals I to V (one vol.)	17.50		

NOTE: Individual Volumes VI, VII and VIII will be replaced after this year by a single Abridged Manual Vol. VI to VIII.

JOHN F. RIDER, PUBLISHER, Inc., 404 Fourth Avenue, N. Y. 16
Export Agent: Rocke International Corp., 13 E. 40th St., N.Y.C. Cable ARLAB

Give Your Shop the Sign of Successful Servicing **RIDER MANUALS**

note the New Look in Power Transformers

Typical Motorola FM two-way radiotelephone receiver utilizing *Sealed in Steel* Chicago Transformers.

With CT's Famous *Sealed in Steel* Construction

The clean, streamlined appearance and compactness of CT's new *Sealed in Steel* construction contribute immeasurably to the trim, precision-like effect of any electronic equipment.

In addition, CT Transformers provide "steel wall" protection against atmospheric moisture, efficient magnetic and electro-static shielding, unsurpassed strength and rigidity to withstand shock and vibration, and unusual convenience of mounting.

Two base styles are available for most of the units in this catalog line, one with clearly identified solder lugs in a phenolic terminal board, the other with RMA color coded leads, stripped and tinned for easy soldering.

The design of these new power transformers assures maximum performance with minimum physical size and minimum temperature rise in accordance with RMA standards.

The wide range of carefully selected ratings achieves maximum flexibility of application, close matching with today's preferred types of tubes, and conformance with all industry standards.

Write direct for catalog illustrating, describing and listing the complete line, or contact your nearest radio parts jobber at once.

PLATE AND FILAMENT SUPPLY TRANSFORMERS

Primary 117 Volts, 50-60 Cycles

Catalog Number	HIGH VOLTAGE SECONDARY A.C. Volts	D.C. Ma.	D.C. Volts Output	FILAMENTS Rectifier Volts	Amps.	No. 1 Volts	Amps.	No. 2 Volts	Amps.
For CAPACITOR INPUT SYSTEMS									
PC-55	270-0-270	55	260	5	2	6.3CT	2	.....	
PC-70	335-0-335	70	320	5	2	6.3CT	3	.....	
PC-85	330-0-330	85	320	5	2	6.3CT	3	.....	
PC-105	345-0-345	105	320	5	2	6.3CT	3.5	.....	
PC-120	375-0-375	120	380	5	3	6.3CT	4	.....	
PC-150	370-0-370	150	390	5	3	6.3CT	4	6.3CT	1
PC-200	385-0-385	200	390	5	3	6.3CT	4.5	6.3CT	1
For REACTOR INPUT SYSTEMS									
PR-55	350-0-350	55	260	5	2	6.3CT	2	.....	
PR-70	425-0-425	70	320	5	2	6.3CT	3	.....	
PR-85	440-0-440	85	325	5	2	6.3CT	3	.....	
PR-105	445-0-445	105	325	5	2	6.3CT	3.5	.....	
PR-120	500-0-500	120	400	5	3	6.3CT	4	.....	
PR-150	505-0-505	150	400	5	3	6.3CT	4	6.3CT	1
PR-200	520-0-520	200	410	5	3	6.3CT	4.5	6.3CT	1
PR-300	550-370-75-0 -75-370-550	300	425	5	6	6.3CT	5	6.3CT	1

Also available in the *Sealed in Steel* constructions:

FILTER REACTORS with current ratings to match power transformers above.

FILAMENT TRANSFORMERS to meet a wide range of modern tube requirements.

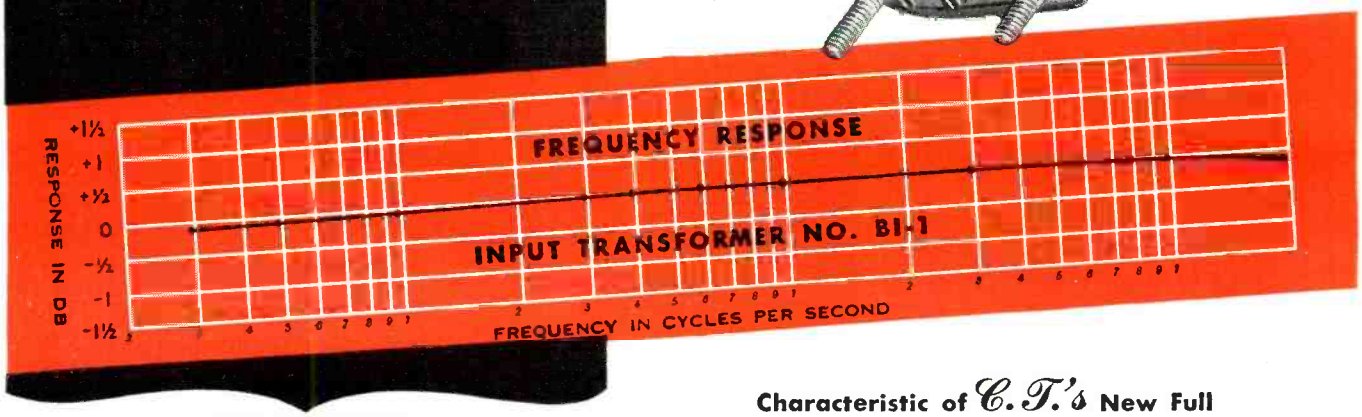
AUDIO TRANSFORMERS — Input, Output, Driver, and Modulation — that provide uniformly high fidelity response in three frequency ranges: 30-15,000 cycles, 50-10,000 cycles, and 200-3,500 cycles.

CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

3501 ADDISON STREET • CHICAGO 18, ILLINOIS

LOOKING FOR HIGH FIDELITY IN AUDIO COMPONENTS?



INPUT TRANSFORMERS

Catalog No.	Application	Impedance Primary—Secondary	Max. Power Level
BI-1	Line to Single or P.P. Grids	*Pri.—600/150 ohms CT *Sec.—50,000 ohms CT	+20 dbm.
BI-2	Line to Single or P.P. Grids	*Pri.—600/150 ohms CT *Sec.—50,000 ohms CT	+20 dbm.
BI-3	Line bridging to P.P. Grids	*Pri.—8,000/6,000 ohms CT *Sec.—50,000 ohms CT	+20 dbm.
BI-4	Line to line	*Pri.—600/150 ohms CT *Sec.—600/150 ohms CT	+20 dbm.
BI-5	Line to line	*Pri—600/150 ohms CT *Sec.—600/150 ohms CT	+30 dbm.
BI-6	Interstage—P.P. Plates to Single or P.P. Grids	*Pri.—20,000 ohms CT *Sec.—50,000 ohms CT	+20 dbm.

OUTPUT TRANSFORMERS

Catalog No.	Application	Impedance Primary—Secondary	Max. Power Level
BO-1	Single Plate to Line	Pri.—15,000 ohms at 0 to 10 ma d-c *Sec.—600/150 ohms CT	+20 dbm.
BO-2	P.P. Plates to Line	*Pri.—20,000 ohms CT *Sec.—600/150 ohms CT	+30 dbm.
BO-3	P.P. Plates to Line	Pri.—5,000 ohms CT *Sec.—600/150 ohms CT	+40 dbm.
‡BO-4	P.P. Plates to Line	Pri—7,500 ohms CT *Sec.—600/150 ohms CT Pri.—10,000 ohms CT *Sec.—600/150 ohms CT;	+43 dbm.
BO-5	P.P. Plates to Line	16/8/4 ohms	+37 dbm.

‡Has tertiary winding to provide 15% inverse feedback.
*Split and balanced windings.

Characteristic of *C. T.'s* New Full Frequency Range Input and Output Transformers

They provide response within ±½ db over the full range from 30 to 15,000 cycles . . . and response within ±1 db up to 20,000 cycles. That's tested performance . . . not *just* a curve.

Their percentage of distortion is exceptionally low over the full range . . . at low as well as high frequencies.

They're *Sealed in Steel* to protect the delicate, fine wire coil windings against corrosion by atmospheric moisture. The drawn steel cases are compact and streamlined . . . help achieve a clean, uncluttered appearance for any gear.

Input units have hum-bucking core construction and additional inner cases of special alloy for hum shielding of −70 dbm or better.

For 250-watt, 1-KW, and 5-KW Transmitters

Matched sets of Driver and Modulation Transformers, and Modulation Reactors, Response within ±1 db over the Full Frequency Range of 30 to 15,000 cycles. Distortion very low . . . well within FCC limits for transmitters.

Distributorships for this new stock line are now being established. For full information, see your radio parts jobber or write direct.

CHICAGO TRANSFORMER
DIVISION OF ESSEX WIRE CORPORATION
3501 ADDISON STREET • CHICAGO 18, ILLINOIS

ALLIED'S NEW FREE 1948 RADIO CATALOG

172 VALUE-PACKED PAGES

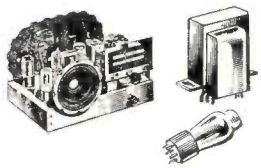
Send for it now!

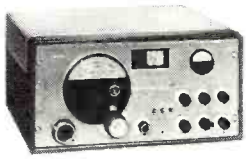
The Preferred Radio Buying Guide

It's off the press—the new 1948 ALLIED Radio Catalog! Get the Radio Buying Guide that's used by thousands of expert servicemen, engineers, soundmen, Amateurs, builders and experimenters. The new ALLIED Catalog—radio's biggest book—brings you 172 pages packed with the widest selections of the newest and finest equipment, at really low, money-saving prices! Here's everything in radio for everyone in radio: new Television and home receivers, packaged Sound Systems and P. A. equipment, latest Amateur receivers and station gear, test instruments, builders' kits, thousands of parts, tubes, tools, books—the world's largest stocks of nationally-known equipment. Take advantage of ALLIED'S speedy, expert shipment and the personal attention of seasoned old-time radio men. Get the details, too, of radio's newest and most liberal Time Payment Plan. Send today for your FREE copy of ALLIED'S newest, greatest Catalog—the preferred Radio Buying Guide!

LARGEST STOCKS • QUICK, EXPERT SERVICE

Get your FREE copy of Radio's most complete Catalog Use the coupon below—NOW!





RADIO'S LEADING BUYING GUIDE!

MORE THAN 10,000 ITEMS

Everything in radio for everyone in radio! Complete lines of all leading makes of parts and equipment—all from one great, centralized source. For newest developments and best values, see your ALLIED Catalog.

TELEVISION & HOME RADIOS

A special selection of outstanding models—table radios, consoles, combinations, FM-AM—*plus* new Television, offered first by ALLIED at real savings. Hand-picked models—the choice of experts!

AMATEUR STATION GEAR

Here's heaven for the Ham! You'll find everything you need for your shack in the new ALLIED Catalog. See *all* the latest releases in receivers, transmitters, parts, station equipment—biggest Ham listings in radio!

NEW P. A. EQUIPMENT

Packaged, ready-to-use Sound Systems; amplifiers *guaranteed for one full year;* everything in speakers, microphones, P. A. accessories, intercom and recording equipment—leading headquarters for Soundmen!

FREE

THE WORLD'S LARGEST RADIO SUPPLY HOUSE . . .

★ **ALLIED RADIO**

Everything in Radio and Electronics

ALLIED RADIO CORP.
833 W. Jackson Blvd., Dept. 1-D-48
Chicago 7, Illinois

☐ Send FREE New ALLIED Catalog.

Name.....

Address.....

City.....*Zone*.....*State*.....

For the RECORD

BY THE EDITOR

TEN YEARS OF PROGRESS

AS WE go to press with this issue, we look back over the past ten years to April, 1938. That was the date that *Ziff-Davis* took over the publishing of RADIO NEWS. It appeared at that time that radio had about reached its ultimate objective as an entertainment medium. The art of television was still in an experimental stage and no one could venture a guess as to when video would become a reality. Early television programs were quite satisfactory, considering that few were engaged in any serious research and those who witnessed those early pictures felt that some day they too would like a television receiver in their homes.

The outbreak of war applied a quick brake to any further development of television except for military purposes. Now, ten years later, we find that the entire radio-electronic industry is beginning to feel the impact from the rapid acceptance of video by the public. It has been reliably predicted that by the end of this year nearly 40% of our population will be within range of at least one television station.

As new transmitters loom on the horizon, more and more service technicians will realize that they have, at their finger tips, a real opportunity to take an active part in the fastest growing industry of our time. We know of several groups of advanced radio technicians who have already formed small groups to handle the demands for installation and maintenance of TV sets in the larger cities such as Chicago, New York, Los Angeles, etc.

We, too, are bending our efforts to satisfy the ever-increasing demand for more and more technical information for our expanding readership.

We recognize the fact that we must, at all times, keep pace with our industry and broaden our service to our readers and advertisers. It is fact, not fancy, that editorial material is appearing each month in RADIO NEWS in ever increasing quantity. We have continuously assigned top quality authors to present specialized material in such a manner as to be of greatest help to the majority of radio-electronic minded readers.

Paper shortages have long prevented us from printing enough copies of RADIO NEWS every month to satisfy an ever increasing readership. This situation has been somewhat relieved. As a result we go to press with a run of over 252,000 copies. This represents about five times the number of copies that came off the presses ten years ago in April, 1938. Of even more importance to our readers and advertisers is that because of their continued interest and support we have been able to give them much more editorial material each month than any other similar publication.

Many new advertisers have come into RADIO NEWS, but the additional number of pages required for these new accounts has resulted in an additional quota of editorial space for new features and departments, such as "Mac's Radio Service Shop." Don't let that title fool you. The series is jam-packed with some well founded advice, not from a fiction writer, but from an established radio serviceman who has learned radio the hard way. Don't miss it!

Our follow-up article on the Recording Amplifier, (page 54, January, 1948, RADIO NEWS) is scheduled for the next issue. We will have a separate Dynamic Noise Suppressor unit all complete and ready for you constructors of audio equipment. And we have improved the circuit of the record-reproduce amplifier as the result of exhaustive tests on all types of records, etc. Watch for the complete data in next month's issue.

Don't miss Milton Kiver's excellent article on TV set comparisons in this issue. You'll be needing such information almost before you realize it.

We have assigned a new series of articles on sound and p.a. to one of the country's outstanding audio engineers. This series will tell you how to select and install every known type of equipment designed for the distribution of sound and how to conduct a profitable business along these lines. This is scheduled to start in an early issue.

There is a definite trend toward custom built tuners and audio equipment in many cities. Many servicemen are already specializing on such installations. Handsome profits may be made from the sale of AM-FM tuners and quality amplifiers. In fact, many new homes are now being built with special provisions for the installation of such equipment. Complete data is now being compiled on a wide assortment of these units and is scheduled to appear soon.

We look forward to other new uses for radio, electronics, television, and facsimile in future years with optimistic enthusiasm. Yes—the vacuum tube will continue to be man's most useful servant. .....O.R.

GET THESE 2 BIG BOOKS FREE..

IF YOU WANT TO LEARN RADIO!

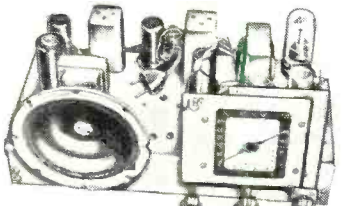
FRANK L. SPRAYBERRY
famous Radio teacher of hundreds of successful Radio men.

I TRAIN YOU *RIGHT* BY SENDING YOU 8 BIG KITS OF RADIO EQUIPMENT INCLUDING A POWERFUL 6 TUBE SUPERHET RECEIVER AND 16 RANGE TEST METER!

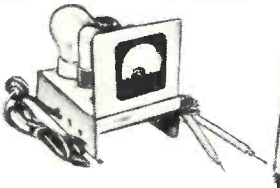
Find out NOW how Sprayberry Training prepares you for a Radio Service Business of your own — or a good pay Radio job. Just mail the coupon for a FREE Sample Lesson and my big FREE book, "How To Make Money In Radio, Electronics, Television." It tells how I train you at home during spare hours by putting you to work building, testing, repairing Radio equipment. The Sprayberry Course teaches you Radio by working with 8 big kits of Radio parts I supply. You build a powerful 6 tube superhet Radio, a 16-range test meter, perform over 175 interesting, PRACTICAL experiments. My lessons are easy and interesting—you need no previous experience in Radio. I start you at the beginning... and give you valuable "bench" experience that sticks with you.

Soon after you start I send you my famous BUSINESS BUILDERS that help you earn EXTRA CASH getting and doing neighborhood Radio Service jobs while learning. You couldn't pick a better time to get into Radio. The Radio Repair Business is booming! Good Radio Service and Repair Shops are needed everywhere as millions of new sets are in use. Trained men are wanted for opportunities in Police, Aviation and Marine Radio, F.M. and Standard Broadcasting and Television. Manufacturers are looking for men who know Radio as production reaches new peaks. GET THE FACTS ABOUT YOUR FUTURE IN RADIO. MAIL the COUPON TODAY for my FREE BOOKS.

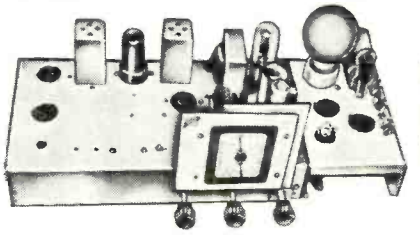
LEARN HOW TO BUILD-TEST-REPAIR RADIOS *By Working with* YOUR HANDS!



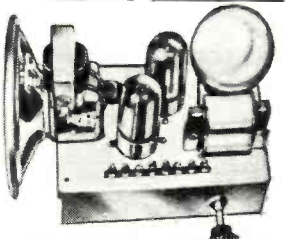
You really learn Radio the PRACTICAL way ... when you build this big, powerful 6-tube Superhet Radio from parts I send you.



give you a fine, moving coil type Meter—with parts for a complete analyzer and Circuit Continuity Tester. "Trouble-shoot" with professional accuracy.



You don't have to buy expensive ready-made equipment. You get valuable experience building this Signal Generator and Multi-purpose Tester.



You construct this rectifier and filter, resistor and condenser tester, and really get on the Practical end of Radio.

Trained Radio men can step into their own profitable Radio Service Shop—or—

New developments are constantly opening new big pay job opportunities in Radio.

LOW COST RADIO TRAINING

STUDY AT HOME IN SPARE HOURS

Sprayberry Training costs suprisingly little! Easy monthly payments, if desired. Everything you need is furnished—nothing else to buy. With Sprayberry Training to back you up, you will be able to step into your own profitable Radio Service Business or go on to a big opportunity in Radio, Electronics or Television. The equipment I send you is yours "for keeps"—to use in your business or job. I have trained thousands of successful Radio men—and I can help you, too. Get the facts about Sprayberry Training—it's your first step to success, security and a bigger income in a field where you'll really enjoy your work. Fill out and mail coupon TODAY. I'll rush my two FREE books to you by return mail.

VETERANS: Approved for G. I. Training under Public Laws 16 and 346.

Sprayberry Academy of Radio
F. L. SPRAYBERRY, President
Room 2548, Sprayberry Bldg., Pueblo, Colorado

RUSH COUPON *Today!*

SPRAYBERRY ACADEMY OF RADIO
F. L. SPRAYBERRY, President
Room 2548, Sprayberry Bldg., Pueblo, Colorado

Please rush my FREE copies of "How To Make Money In Radio, Electronics and Television" and "How To Read Radio Diagrams and Symbols." No salesman will call.

*Name*_____ *Age*_____

*Address*_____

*City and Zone*_____ *State*_____

☐ CHECK HERE IF A VETERAN
(Mail in an Envelope or Paste on Penny Postcard)

amplifier does not possess a bridging transformer. This special pad offers high impedance to the source, generally 20,000 ohms, and presents a lower impedance, usually 600 ohms, to the amplifier input terminals. However, any manner of impedance ratio can be engineered into these pads, in accordance with the equipment requirements. The high degree of isolation thus afforded the main circuit prevents any noise being introduced from the auxiliary amplifier or other device bridged.

In order to properly guide anyone in the choice of an attenuator for a specific application problem, the physical forms in which attenuators are most generally fabricated should be considered. Possibly, because they are an outgrowth of the old rheostats used in the early days of radio, they are most frequently made in a circular form, with diameters varying from 1.75" to 3.5", governed by the mechanical requirements of parts and contact placement. The rotary motion approximates 345 degrees of arc. These are most generally used. However, the comparatively new sector attenuator, illustrated in Fig. 6, has been used in many complex theatre installations (Fig. 1). Straight line motion, ease of controlling more than one unit with each hand, fast adjustment and the ability to gang several for simultaneous operation has made this unit extremely popular. Formerly there was an attempt to translate the rotary motion to a linear one through the use of pulleys and cords, as shown some while ago in a Hollywood mixing and re-recording installation, but this makeshift is no longer necessary. Another very recent use of the sector attenuator was to mount it on the familiar transcription playback machine so the operator could release the cued record and open his gain with the motion of one hand with imperceptible time loss. ABC has made a number of these installations, with great operating success.

Electrically, modern attenuators can be grouped into four main classifications. (Of these, two classes are variations of each other.) These are the ladder, tee, bridged tee, and potentiometer. It may be well to refer to Figs. 2 and 5B, to review the electrical differences among these units. Although at one time or another additional forms of attenuators have been made, these have been discarded as outmoded, because of their performance, now considered inferior. Circuit position is the dominant factor in the selection of the correct attenuator. The salient points are:

The ladder, Fig. 2C, has but one row of contacts and moving arm. It is easy to operate, possesses smooth motion, is quiet electrically and mechanically and relatively low in cost. But since it offers an insertion loss of 6 db., and because this means cutting in half the gain of the source signal, additional amplification is necessary. If the impedance ratio of the ladder can be made 1:2, then the insertion loss becomes 2 db. This change in impedance ratio is also an undesirable factor. A special case of zero insertion loss ladder has been made, but it is costly and mechanically complex, and therefore has not met with wide commercial acceptance.

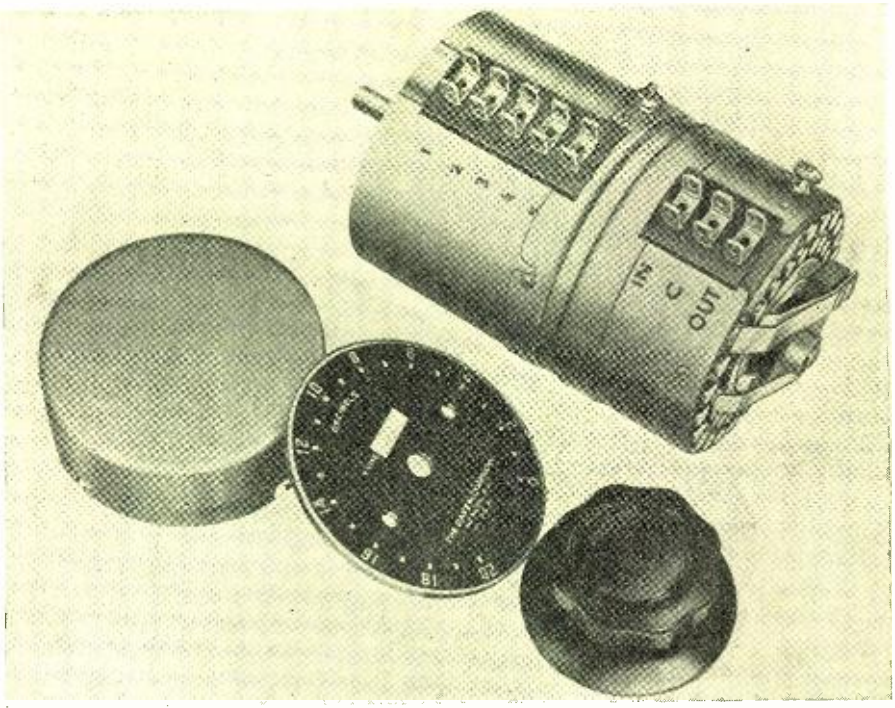
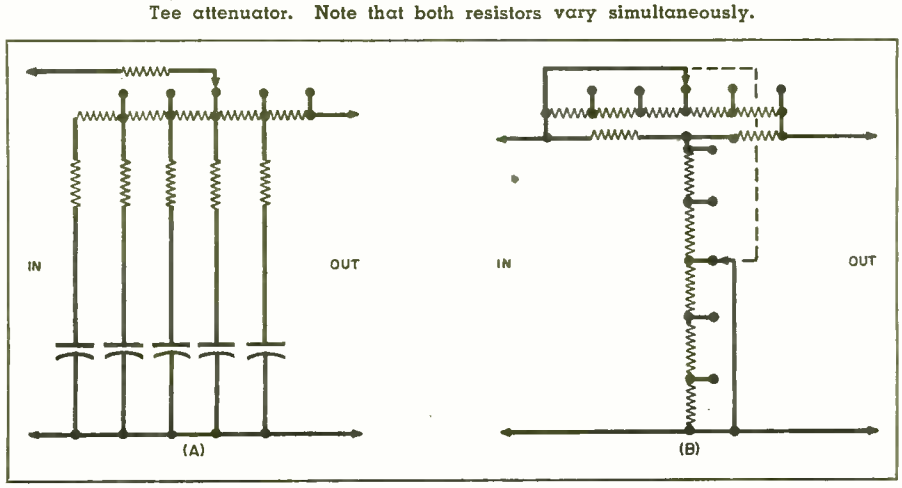


Fig. 4. Daven type LAC 720 tone compensating ladder attenuator. Notice the five extra contacts to convert this unit to a straight ladder if desired.

The tee pad of Fig. 2B requires two or three sets of contacts. The latter is for the pure tee, but no collector rings are used. While it is possibly a bit harder to rotate, the advantages of a zero insertion loss and smoother impedance characteristics favor the selection of this form of control. The bridged tee offers smoother over-all impedance characteristics when the brush shunts a pair of contacts and requires fewer resistors in its construction. Consequently, it is cheaper to make than the tee pad, but the latter is the more accurate and better for the precision measurement of laboratory equipment.

The potentiometer, as its name implies, is a voltage measuring device, and is usually found in high impedance installations. Similar to the ladder in physical appearance (Fig. 2A), these units can be made comparatively economically, commensurate with their accuracy and the smoothness of control they afford. It is apparent that the load side of the potentiometer offers a varying impedance, and unless this can be accepted,

Fig. 5. (A) Tone compensated ladder, simple form. (B) Bridged Tee attenuator. Note that both resistors vary simultaneously.



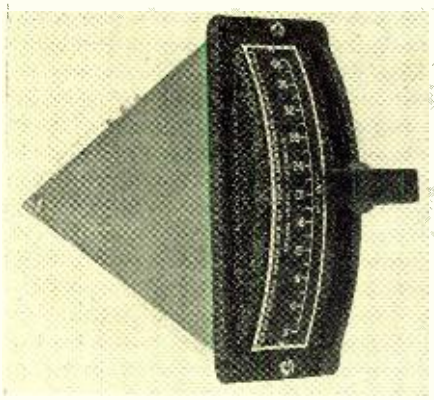


Fig. 6. The Sector or Slide Attenuator introduced by Tech Laboratories. Any electrical configuration can be built in this mechanical form.

its compensated form must be used. However any type of compensation presents serious frequency discrimination even at audio frequencies, due to the series resistors, and the attendant Miller effect in the grid circuit to which it is connected. (See Fig. 7B.)

Fifteen years ago, mixer circuits were almost universally of the low level variety, that is, mixing took place right after the microphone, and before any amplification had been inserted into the system. This was practical then, as most microphones were not of the highest fidelity, possessed higher output than now, and the noises introduced by the mixer were not so noticeable. With the acceptance and universal use of the wide range, high fidelity, low output microphone and transcription reproducer, some form of pre-amplification became essential. Mixer circuits then were moved to a higher level position in the speech input installation, and this is the generally accepted form today. Consequently, we shall consider such mixers here with the exception of those mixers used in some forms of remote broadcasting pickup equipment, where low level mixing still persists, for economy of pre-amplifiers required and power drain upon the battery power supply frequently employed for this form of equipment. The ladder is almost universally used for low level mixing circuits because it tends to be quieter. An attenuator's noise, along with the signal, receives the effect of the full system amplification so consideration must be given to noise characteristics. Today it is possible to make attenuators so quiet that the only noise they introduce is that of thermal agitation of component resistors. Even this is less than that due to thermal agitation tube noises. However, the ladder is also used in high level mixing where cost of components is a consideration and where ease of rotation is desirable. If the mixing installation is a large one, and the inclusion of ladder attenuators will tend to increase the loss of the mixer, then bridged tee pads are to be recommended. They are the better of the two for this service, and frequently are used as master gain controls. But as already noted, in complete console construction master gain control is frequently a potentiometer. Noise voltages introduced by the controls are smaller in high level mixing, and, with a suitable form of internal wiring, the noise can be made to decrease with the signal as added loss is inserted in the circuit.

Perhaps because of the lack of description in the makers' catalogues, a great deal of misunderstanding exists as to what differentiates a linear from a tapered control, and where each should be used.

A linear control is just what its name implies—the loss it introduces is a linear function, and increases an identical amount for each step of rotation. Thus the amount of loss inserted is uniform for each increment of motion of the knob, and the total loss is as stated on the nameplate of the unit. Smooth opening and closing of a program is impossible if the control used has a loss of 40 decibels, and the circuit has a sound level of about 60 decibels above the threshhold of hearing. The first step will be up 20 decibels from silence, clearly an undesirable condition.

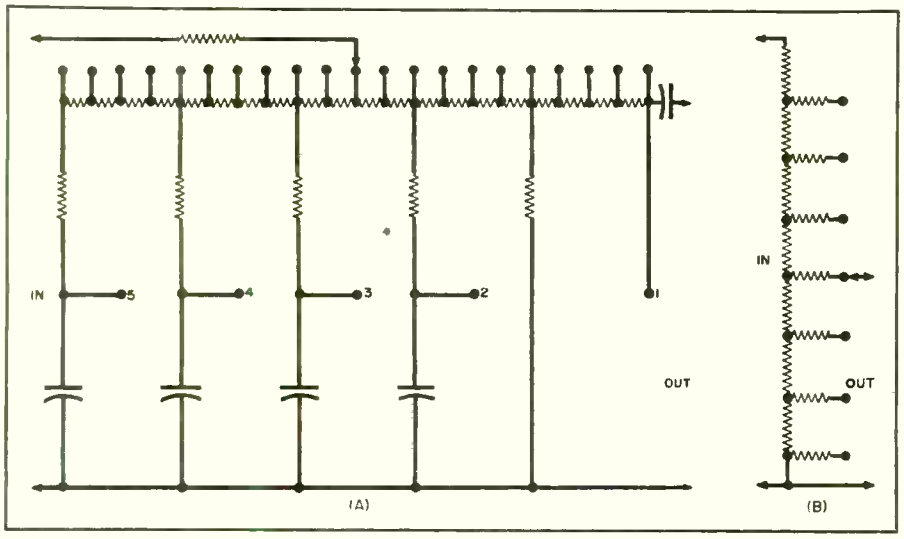
The tapered control, on the other hand, offers a uniform amount of attenuation per step for approximately 70-75 per-cent of its travel, and then increasing amounts for each extra step of attentuation, so that the over-all loss it is possible to introduce into the circuit is far and above that of a similar linear control of like number of steps and loss per step. Electrical smoothness of operation of the controlled circuit is thus afforded, without any sudden jump from no signal to one of appreciable level. It should be mentioned here that while tapered controls of only 20 steps are quite common, smoother operation, especially on tones of long sustained duration is afforded by controls of 30 or more steps. Thus, in selecting controls for a deluxe mixer, the control having the greater number of steps is more than proportionately desirable.

While the master gain control has usually been selected from among the linear controls offered, the writer from his years of operational and consulting experience recommends that this too be tapered, with one exception, and that is for the system master in network operation, where this control is used only to compensate for line level losses. All studio masters should be tapered so that the mixing operator can then open or close his show with a multiplicity of microphones in use at their preset levels without having to manipulate a number of controls simultaneously. Those stations and studios that have followed this recommendation are more than pleased with the operating facility it provided.

What is probably the next most confusing problem in selecting an attenuator is what loss per step to buy. This is not a problem simply solved. It involves many factors. Still some points can be mentioned for guidance. The over-all gain of the amplifiers installed, the level of the sources being mixed and the outgoing level, whether feeding a line or a recording head all bear on this problem. It can be stated that generally the low cost mixer can be designed with controls of the tapered variety offering loss of

(*Continued on page 21*)

Fig. 7. (A) Electrical connections of the LAC 720 shown in Fig. 4. (B) Schematic of the compensated potentiometer. Build-out resistors keep total impedance constant.



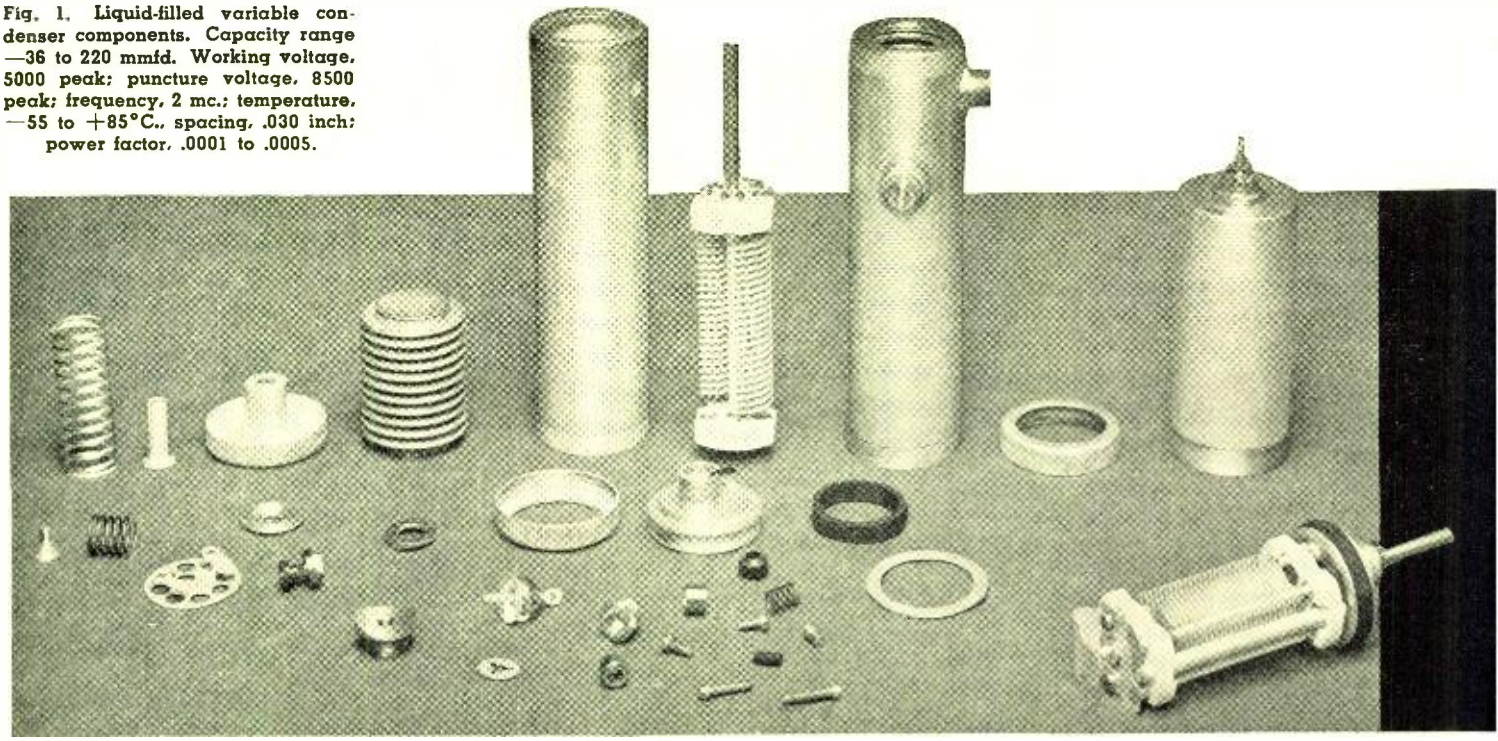


Fig. 1. Liquid-filled variable condenser components. Capacity range —36 to 220 mmfd. Working voltage, 5000 peak; puncture voltage, 8500 peak; frequency, 2 mc.; temperature, —55 to +85°C., spacing, .030 inch; power factor, .0001 to .0005.

Liquid Dielectrics for Variable Condensers

By Sidney Wald
Aviation Equipment Engineer, RCA

Results of tests and recommendations concerning the use of liquid dielectrics in variable capacitors.

IN 1924 a Bureau of Standards publication commented on the desirability of utilizing oil as a dielectric for high power variable capacitors. The reference stated that ". . . using ordinary petroleum oils about doubles the capacity. Condensers with oil as a dielectric are very well suited for power condensers. The breakdown voltage is very high, dielectric and brush losses low, and on account of the high dielectric constant of some oils, it is easy to get a large capacity in moderate volume."

While this statement is undoubtedly true under certain conditions, the rigors of most practical applications have seriously limited the use of variable capacitors with liquid dielectrics. Questions of operating frequency, temperature range, losses, and maintenance have in general remained indefinite, and a host of misconceptions as to the electrical properties of various liquid insulators have become the basis of much skepticism as to their practicability and utility in radio frequency condensers.

There are several fields of electrical engineering wherein the use of petroleum oils has been developed to a high level. The use of oil in circuit breakers, switches, insulating bushings, transformers and high voltage cables has been thoroughly discussed in the literature. However, all of the applications referred to are limited in operating frequency to several hundred cycles. Moreover, the oil in many cases has been used as a cooling medium (transformers) or an arc quenching medium (circuit breakers and switches). In some applications of power-engineering, oils are used in high voltage underground cables to reinforce the insulating properties of paper as a dielectric and to increase the breakdown potential of the cable. Examples have been cited where oil-filled cables are being operated at voltages up to 130 kv. In all of these low frequency power applications, permittivity has been unimportant except as the lower values would be more desirable to reduce the displacement current.

In the electronics field various dielectric liquids are used as saturants and fillers for paper capacitors. Three types of liquids in general use include mineral oil, castor oil, and chlorinated diphenyl compounds. These capacitors have not been used or recommended for critical tuning applications or at radio frequencies. They are used as low frquency by-pass and buffer capacitators where the principal requirements are high capacity and high dielectric strength. For example, castor oil filled capacitors may lose as much as 20 per-cent of their capacity when the temperature drops to —50° C. Pyranol capacitors suffer a loss of capacity at low temperatures.

The principal advantage of the Pyranol type of liquid is its non-inflammability. Neither castor oil nor the chlorinated compounds are suitable for exacting or critical applications due to their rapid change of electrical and physical constants with temperature and frequency. It may be noted in passing that oil-filled paper capacitors are not self-healing, that is, the first flash-over destroys the unit.

Variable Air Capacitors

This form of capacitor for radio frequency resonant circuits has been the accepted standard of excellence up to

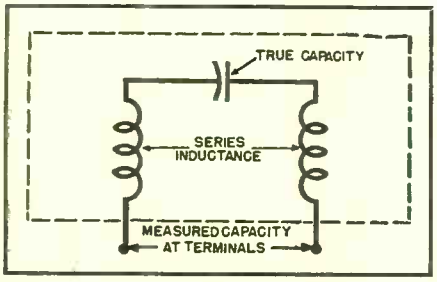


Fig. 2. Equivalent circuit of test capacitor.

and including the present state of the art. Some of the more familiar advantages of the air capacitors are:

1. Stability of capacity with changes in temperature, pressure, humidity, composition of air, frequency and applied voltage.
2. Extremely low power loss or very high Q (over 10,000). The power loss of an air capacitor is not due to the loss in the air dielectric but to the parts involved in mechanical construction such as plates, supports, solid insulation and terminals.
3. Low cost and ease of fabrication.
4. Self-healing after breakdown.

The disadvantages include low capacity for a given size, and relatively low breakdown voltage gradient. (For large spacings, this voltage is approximately 31 kv. (max.) per centimeter at sea level. This reduces to about 6 kv. per centimeter at 40,000 feet of altitude at room temperature.)

For airborne communication transmitters, variable tuning capacitors are required in the frequency range of 1 to 20 megacycles. These units must be small in size and weight, have relatively high capacity and withstand high r.f. voltages at altitudes up to 50,000 feet. Capacitors with air dielectric become extremely large and heavy for this application. It is, of course, commercially feasible to construct high pressure variable air capacitors to withstand high voltage, but these units are bulky and again have a very poor capacity/size ratio. Generally, compressed gas capacitors require intermittent pumping to maintain the required pressure.

Since liquid dielectrics possess the desirable electrical characteristics of high capacity per unit size together with high dielectric strength for short gaps, they would appear to be a good solution to the aircraft condenser problem.

In order for variable tuning capacitors to function properly in modern high altitude aircraft, they must be capable of maintaining constant capacity, low loss, high dielectric strength, and long life under the following conditions:

1. Temperature range of —55°C. to +85°C.
2. External barometric pressure from sea level to that existing at 50,000 feet altitude.
3. Humidity variations up to temporary immersion in salt water.
4. Frequency range from 1 to 10 mc. (for present requirements).
5. Capacity up to 600 micromicrofarads.
6. High current carrying ability (up to 20 amps. r.m.s.).

There are many liquid dielectrics capable of fulfilling some of these conditions, but usually they are deficient in one or more of the remaining requirements. In terms of physical properties of liquids, the specifications call for a freezing or pour point well below —50°C. and low vapor pressure at +85°C.

The liquid should be non-inflammable or possibly no more dangerous to handle than ordinary kerosene. The flash point should not be under 100°F. Finally, the material should be non-toxic and capable of being maintained at elevated temperatures for long periods of time in a hermetically sealed enclosure.

The most desirable fluids would be those with low permanent dipole moment and high permittivity (large induced dipole polarization). This combination would yield a liquid having little temperature sensitivity and good dielectric constant with low power factor over a wide frequency range. Additional requirements are, of course, low freezing point, low coefficient of volumetric expansion, high boiling point, and negligible reaction with the shaft seal in the hermetically sealed container.

The most common group of substances meeting the above requirements and which are liquid at ordinary temperatures are the petroleum hydrocarbons.[8] These liquids are of two distinct origins. One group is derived from naphthenic crude petroleum, the other from paraffin crudes. In general, the pour point (low temperature solidification) of the naphthenic distillates is much lower than that of the paraffin base distillates. Consequently, other factors being equal, it is more desirable to utilize the former for low temperature work.

Petroleum distillates have the additional advantage of being composed principally of mixtures of saturated hydrocarbons, few double bond carbon atoms being available to take on oxygen or other elements. Prolonged heating at about 100°C. in contact with air will cause these liquids to oxidize slowly. In order to prevent all oxidization and deterioration the liquid must completely fill a hermetically sealed container with no exposure to atmospheric oxygen. Units which are not subject to vibration or overturn (i.e. for stationary use) may employ an inert gas such as nitrogen in contact with the fluid.

Liquids like Pyranol, styrene monomer, castor oil, halowax oil, and chlorinated naphthalene were considered unsuitable for various reasons such as high freezing point, thermal instability at prolonged high temperatures, or excessive variation of dielectric constant with changes in ambient temperature.

Since some of the most important requirements are mechanical in nature, a large group of liquids was immediately excluded. All liquids to be checked electrically must have a pour point below —50°C., and not more than about 125 mm. vapor pressure at 85°C.

After selection of the liquids to be tested, they must each be processed or purified to make them useful as dielectric liquids. There are three distinct factors involved in processing the fluid.

1. Removal of solids, such as lint, fibers, and colloidal particles.[9]
2. Removal of moisture (colloidal and dissolved water.

Table I. Physical properties of various dielectric fluids.

Name	Supplier	Distill. Range°C.	Flash Pt. °C. Tag Closed Cup	Aniline Pt. °C.	Specific Gravity	Pour Pt. or Freezing Pt.	Vol. Coeff. of Expansion/°C (—55 to + 30) (+ 30 to + 85)
10-C Transil Oil. Mineral Ins. Oil—Light..	General Electric	250-400	135			—40°C.	0.0008 0.00107
Univolt No. 35....	Sun Oil Co.		132			—45°C.	
T-76 Oil....	Std. Oil of N.J.		149			—40°C.	
Sun Spirits. Special Heavy Spirits No. 58....	Socony Vac. N.Y. / Sun Oil Co. / Atlantic Ref. Co.	149-207 / 186-235	104 / 38 / 64	49 / 60	0.811 / 0.811	—55°C.	
Fluid No. 500 5 centistokes....	Dow-Corning Chemical Co.	B.P. 120 at ½mm.	316 no effect on rubber or elastomers		0.918	—70°C.	0.001095 at 3°0C.
Instrument Oil "A"...	Gulf Refining Co.		135			—50°C.	0.000656 0.000704

3. Elimination of dissolved gases (including air and CO_2).

Tests Performed

1. Spark-over voltage at approximately 2000 kc. vs. temperature at constant pressure. Comparison of 60 cycle and r.f. values.
2. Q vs. frequency at room temp.
3. Q vs. temp. at 2 and 9 mc.
4. Dielectric constant vs. temp.
5. Dielectric constant vs. freq.

Test Methods

In order to arrive at the dielectric constant and losses of a liquid dielectric, it is necessary to utilize the liquid as a filler in a parallel plate air capacitor whose characteristics are known. In this case a type APC (brass plates, silver plated) *Hammarlund* double bearing capacitor with dry capacity of approximately 106 $\mu\mu$fd. and 0.025 to 0.030 inch spacing was chosen. This capacitor was installed in a pint-size glass mason jar fitted with mycalex lid and neoprene lid gasket. Besides the capacitor terminal studs, the lid contained a neoprene bushed hole for a thermometer. See Fig. 3.

A *Boonton* Type 160A Q meter was the basic measuring instrument used to determine the losses and dielectric constant of the various insulating liquids.

In order to secure controlled temperature variation, the test capacitor with fluid and thermometer immersed is set in a "dry ice" bath until the indicated fluid temperature is below −55°C. Then the test capacitor is checked on the Q meter while the temperature rises slowly to the ambient value.

For temperatures between ambient (25-30°C.) and 85°C., a thermostatically controlled *Weber* oven is used to bring the test cell up to the high temperature. The jar is removed from the oven, transferred to the Q meter, and measurements made as the temperature falls to the ambient value.

Formulas

In using the Q meter to determine Q and dielectric constant K the Q meter is resonated at 2 mc. with a test coil whose Q is about 250. Readings C_1 and Q_1 are recorded. The test capacitor is connected across the capacity terminals, and the Q meter is again tuned to resonance.

New readings of Q_2 and C_2 are recorded.

$$Q_x = \frac{C_1 - C_2}{Q_1 - Q_2} \times Q_2 \times \frac{Q_1}{C_1} \quad \ldots\ldots \quad (1)$$

where $Q_x = Q$ of unknown liquid and capacitor assembly. The dielectric constant K of the liquid is:

$$K = \frac{C_1 - C_2}{C_o} \quad \ldots\ldots\ldots \quad (2)$$

where C_o = dry capacity of the test cell.

Due to the unavoidable series distributed inductance of the test capacitor, high frequency measurements are in error to a certain degree because of approach of series resonance. In order to correct for the inductance of the capacitor and leads, we make use of the equivalent circuit shown in Fig. 2.

The inductance of the capacitor is found by short circuiting the plates at the center and measuring the inductance in series with a larger standard coil. Then:

$$L_s = \frac{2.53 \times 10^{10}\,(C_1 - C_2)}{f^2\, C_1\, C_2} \quad \ldots\ldots \quad (3)$$

where:

L_s = series inductance microhenries

$C_1 = Q$ meter setting with L_s shorted out ($\mu\mu$fd).

$C_2 = Q$ meter setting with L_s in series with larger coil ($\mu\mu$fd).

f = frequency (kc.).

Once the residual inductance L_s is known, the true capacity may be obtained from the apparent measured capacity by:

$$Xc_1 = Xc_2 + X_L \quad \ldots\ldots\ldots \quad (4)$$

where:

X_{c1} = true capacitive reactance

X_{c2} = measured capacitive reactance

X_L = inductive reactance of capacitor = L_s

$C_1 = 1/X_{c1}$ = true capacity

If it is desirable to arrive at the true Q of the liquid rather than the resultant of the liquid and container and capacitor, the following formula may be used:

$$Q_2 = \frac{Q_1\, Q_3}{Q_1 - Q_3/K} \quad \ldots\ldots\ldots \quad (5)$$

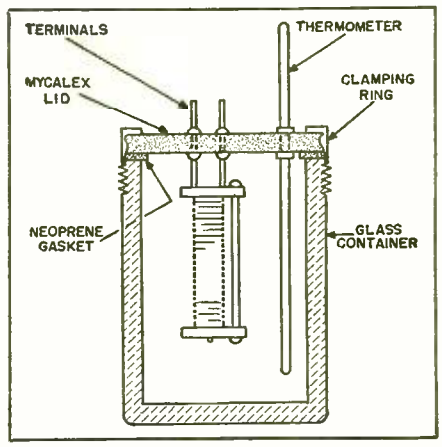


Fig. 3. Test Capacitor.

$Q_1 = Q$ of empty test capacitor in container (corrected for inductance of leads)

$Q_3 = Q$ of filled capacitor (corrected for inductance of leads)

K = true dielectric constant of liquid (checked at a frequency less than 1/10 of the resonant frequency of the filled unit)

Q_2 = true Q of liquid.

For a low loss test capacitor this correction will be small and is given here if extreme accuracy in the determination of Q is required.

The apparent high frequency Q of the filled capacitor is in error (too low) because of the effect of the inductance of the leads. This is an appreciable error and must be corrected to obtain the true value.

The true high frequency Q of the capacitor is:

$$Q_{hf} = \frac{Q_m}{1 - \omega^2 LC} \quad \ldots\ldots\ldots \quad (6)$$

where:

Q_{hf} = true Q of capacitor at a frequency approaching natural resonance

(*Continued on page 25*)

Table III. Tabulated results of tests at 9 mc. except for 4 columns at right, which are at 2 mc. Q values given are for the complete assembly.

Liquid	Measured Dielectric Constant at 25°C.	Change of K from −55°C. to +85°C. Percent Based on 25°C.	Measured Q at			Minimum Q at Temp. Stated, °C.	Q at 2 mc. (Measured)			Minimum Q (2 mc.) at Temp. Stated, °C.
			−55 C	+25 C	+85 C		−55 C	+25 C	+85 C	
Atlantic Special	2.10	−11	660	650	720	620 at −40				
Heavy Spirits Sun Min. Ins. Oil Light	2.30	−6	230	450	670	150 at −10	230	1400	1800	100 at −25
GE 10−C Transil Oil	2.26	−7	200	470	560	130 at −15				
Esso Univolt No. 35 Oil	2.26	−7	300	450	580	120 at −25				
Gulf Instrument Oil "A"	2.25	−6.5	280	550	610	190 at −15	300	2600	Over 4000	200 at −30
Dow-Corning Fluid No. 500 5 cs. Viscosity	2.77	−23	236	785	900	236 at −55	650	3500	Over 6000	650 at −55

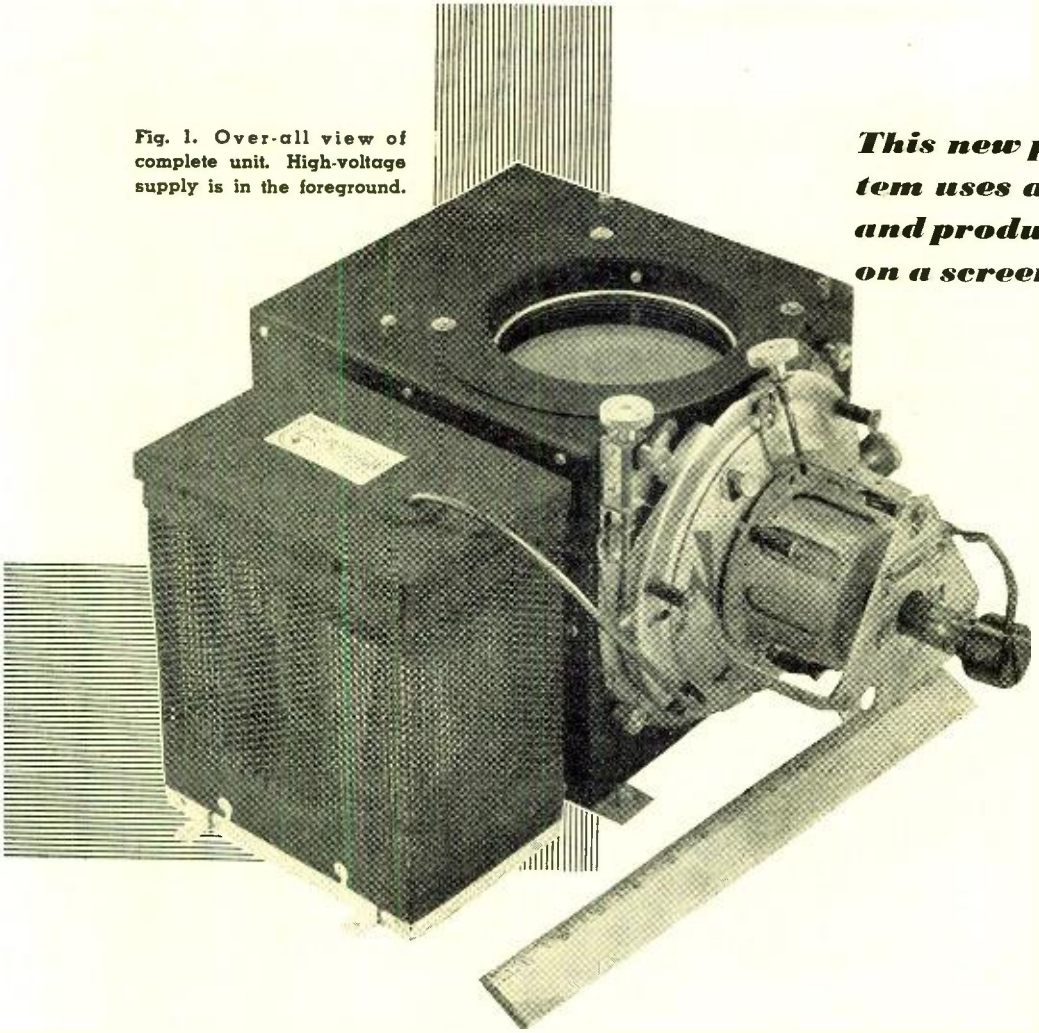


Fig. 1. Over-all view of complete unit. High-voltage supply is in the foreground.

This new projection television system uses a 3 inch cathode-ray tube and produces a picture 12x16 inches on a screen 31 inches from the lens.

PROTELGRAM-
A New Projection Television System

A COMPACT, light weight, efficient projection television system producing a clear 12 x 16 inch image from a 1.4 x 1.86 inch picture on the face of a new magnetic 2.5 inch cathode-ray tube was shown for the first time in this country at the New York Radio Engineering Show. Designated by the trademark *Protelgram*, the system consists of three small units: a short cathode-ray tube 3NP4, a metal optical box with focusing and deflection coils, and a high-voltage power supply. The system originated in the *Philips Research Laboratories* in Holland, and was further developed in the Engineering Laboratories of *North American Philips* in this country.

By using a high-perfection 2.5 inch cathode-ray tube with very small spot size and an efficient fine grain phosphor screen, *Protelgram* makes it possible to manufacture projection-type television sets which are considerably less complex than other projection systems used so far and to incorporate a 12 x 16 inch television picture in relatively small cabinets. A resolution of 450 lines on the 12 x 16 inch viewing screen with a contrast ratio of 30:1 and a highlight brightness of 45 foot-lamberts produce an image of extremely pleasing quality. The color of the picture is an agreeable white which stands up very well under average ambient lighting conditions.

One of its major features is that the system can be driven by a normal 10BP4-type 10 inch direct-viewing chassis, with little or no alterations, but with considerable economy.

This development will make large size television pictures an actuality for the average manufacturer in the near future.

In general, *Protelgram* can be driven from a chassis designed to operate a 10BP4-type, 10 inch, direct-viewing, cathode-ray tube at 9 kilovolt second-anode potential, provided that an input power of 50 milliamperes at 350 volts d.c. and 1.2 amperes at 6.3 volts a.c. (which may usually be obtained from a 10BP4-type chassis) is available for the high-voltage unit.

The following components usually required for a 10BP4-type, 10 inch, direct-viewing set are not needed or already contained in the *Protelgram* system:

Focus coil
Deflection coil
Ion trap circuit and its d.c. supply
10BP4 tube socket and wires
10BP4 high-voltage cable

9-kilovolt high-voltage supply with rectifier tube, filter capacitor and so-called "kick-back" winding, or such components as might be used for a separate r.f.—or pulse-type high voltage supply

Miscellaneous mounting provisions for 10 inch tube

Tube-mask and safety glass.

Depending upon specific circuit properties, other simplifications or economies can be obtained. *Protelgram* is designed to comply, to the greatest extent, with standard circuit practice.

The application of the *Protelgram* system is considerably less complex than with other projection systems. This is reflected in appreciable cost reduction in complete projection-type receivers. The physical size, light weight and ease of mounting allow a reduction in cabinet size and permit great flexibility of cabinet design.

Description

The "projection box" (Fig. 5) serves to enlarge the 1.4 x 1.86 inch picture, available on the face of the projection tube, to a size of 12 x 16 inches on the viewing screen. Means are provided for alignment of the projection tube with respect to the optical elements within the projection box. Dimensions are 14 inches long, 9 inches wide and 9 inches high; the projection tube (including its socket) extends approximately 3 inches beyond the 14 inch dimension of the projection box. Simple mounting brackets are provided. Special provisions for adjustment of the projection box with respect to the cabinet, which might be required in some special cases, are not supplied. A throw distance of 31 inches

from the corrector lens, which is part of the projection box, to the viewing screen is required. This light throw forms an elongated projected beam with a circular base of 4.5 inch diameter at the corrector lens and a rectangular base of 12 x 16 inches at the viewing screen, for which unobstructed clearance is needed. The projected beam may be folded by the use of one or more auxiliary plane cabinet mirrors. The optical elements consist of a circular concave mirror of 6 inch diameter with a radius of curvature of 200 mm., a corrector plate with an effective aperture of 4.5 inches and a plane mirror.

Focusing and deflection coils are an integral part of the *Protelgram* projection box and are supplied with it. A nominal value of 1000 ampere-turns is required for the focusing coil. Two types of coils are available, the series and the shunt. For the series, $r = 300$ ohms and $i = 120$ ma, $\pm$ 10%; for the shunt type, $r = 11{,}200$ ohms and $i = 20$ ma, $\pm$ 10%. Focusing coil leads of standard length are 36 inches long.

Approximate deflection yoke specifications are, for horizontal deflection, $L = 8.5$ millihenry and $r = 15$ ohms; for vertical deflection, $L = 50$ millihenry and $r = 65$ ohms. The deflection angle is 40 degrees.

Description of the 3NP4

Sealed to the 2.5 inch face of the 3NP4 (Fig. 4) is a plate of optically correct special glass which is not discolored by the low intensity, soft x-radiation caused by the 25 kv. electron bombardment. The tube, a triode of five-prong base, requires a special socket. Tube length is 10.5 inches, diameter of the neck is 0.875 inches. The neck withstands 25 kv. strain and does not accumulate disturbing static charges. Near the face of tube is a glass cup, which surrounds the second-anode contact, and into which fits a molded thermo-plastic cable terminal carrying the 25 kv. potential.

An aluminum coating on the phosphor screen increases light output and prevents ion spots, eliminating the need for an ion trap. This fine grain screen gives off a pleasant white light with a color temperature of approximately 6200 degrees Kelvin, which is highly satisfactory under average ambient lighting conditions. The second-anode inside coating covers most of the cone. The outside Aquadag coating is grounded and serves as a static shield. Capacitance between the two coatings serves as the final filter capacitor for the 25 kv. unit.

The average beam current is approximately 90 microamperes. Highlight peaks reach 500 microamperes and higher. Spot size remains substantially constant at approximately 0.003 inch, even with a peak brightness on the tube face of 3000 foot-lamberts.

For focusing, a 1000 ampere-turn coil is used; deflection coils are of standard electrical specifications. Total deflection angle is 40 degrees and full deflection can be obtained with the excitation required to deflect a 10BP4-type, 10 inch, direct-viewing cathode-ray tube operated at 9 kv. Approximately 50 volts peak to peak is required to drive the picture grid. The filament operates at 6.3 volts, 0.75 ampere.

The 25 kv. High-Voltage Unit

The compact high-voltage power supply (Fig. 2) has great stability and no r.f. radiation. It occupies a space 8½ x 4½ x 7 inches.

Mounted on the 7 x 4.5 inch chassis of the unit are a 6SR7 (duplex-diode triode), a 6BG6G (beam power amplifier), circuit components and a sealed transformer assembly. The sealed transformer assembly contains the following components, which are impregnated and

(*Continued on page* 27)

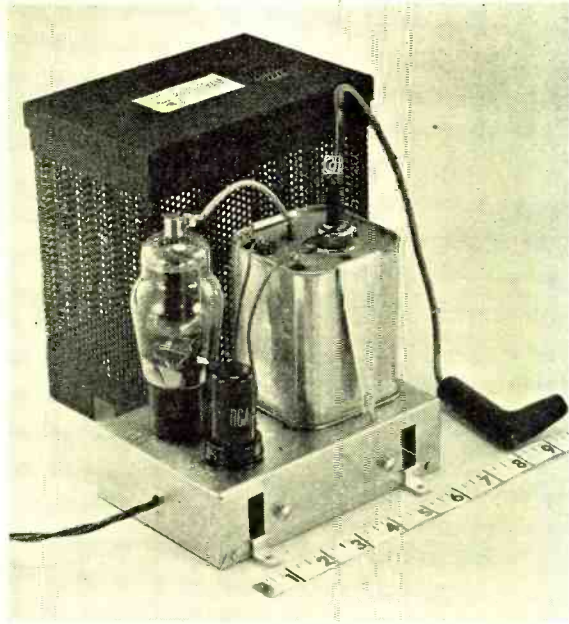


Fig. 2. Cover has been removed to give closer view of the new stable 25 kv. high-voltage second anode supply.

Fig. 3. Alignment assembly of the new Norelco Protelgram television system has adjustments which align tube in the optical system. A 3NP4 tube is used.

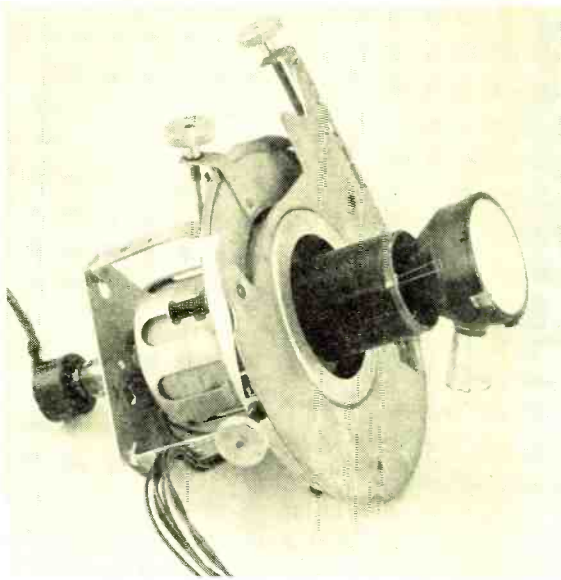
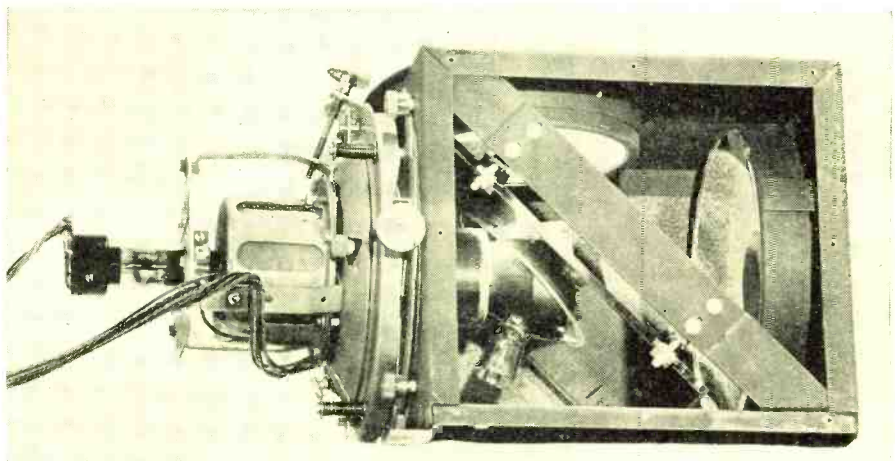


Fig. 4. The new 2½ inch magnetic cathode-ray tube, type 3NP4. Picture size is 1.4 inches by 1.86 inches.

Fig. 5. Inside view of the optical unit with alignment assembly inserted. Note optical triangle formed by the spherical mirror, the plane mirror with an elliptical hole providing clearance for the tube face, and the corrector lens.



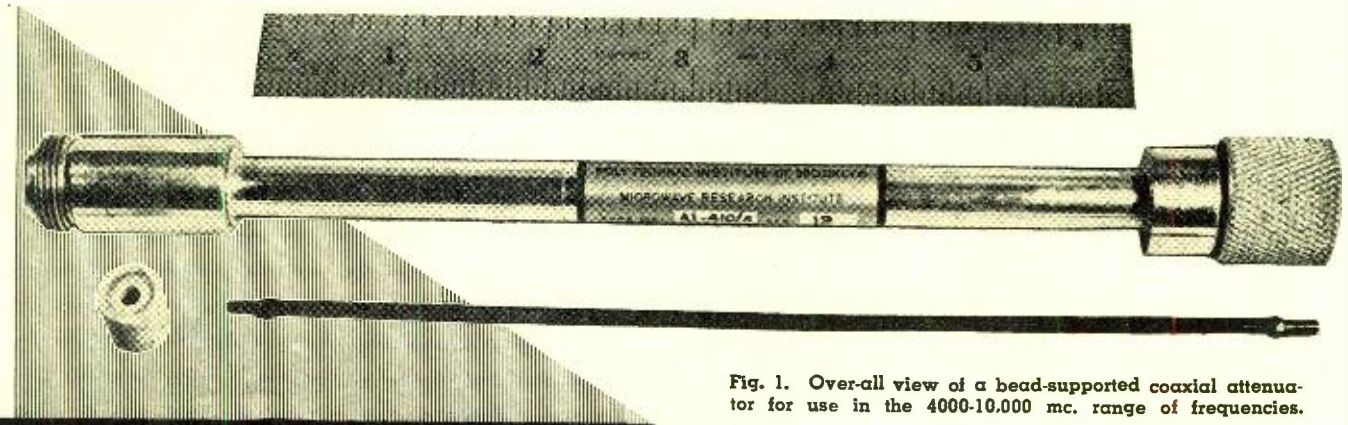


Fig. 1. Over-all view of a bead-supported coaxial attenuator for use in the 4000-10,000 mc. range of frequencies.

Bead-Supported Coaxial Attenuators

By

HERBERT J. CARLIN and JOHN W. E. GRIEMSMANN

Microwave Research Institute of the Polytechnic Institute of Brooklyn.

Theory, design, and construction of coaxial attenuators for the 4000 to 10,000 mc. band. VSWR is held to a very low value.*

ENERGY dissipating broad band coaxial attenuators may be made at microwave frequencies by utilizing a metallized resistance film for the inner conductor. The metallized films used are thin compared with the depth of penetration insuring essentially uniform current distribution through the thickness of the film at microwave frequencies, and permitting application of the distributed parameter solution for transmission lines in the design of the attenuator units[1]. The metallic film is shown formed on a glass tube in Fig. 3.

As will be evident later, the section of coaxial line having the resistive metallic film is characterized by a complex characteristic impedance and propagation constant which are functions of the resistance per unit length of the metallic film. This resistance per unit length, however, is independent of frequency, thus permitting prediction of performance from calculations based on audio frequency resistance measurements. Special techniques have been developed for calculation of the microwave performance using approximate expressions for the complex propagation constant and characteristic impedance.

In order to insure broad band operation of the complete attenuator up to frequencies of 10,000 mc., where even short lengths of line are an appreciable fraction of a wavelength, special couplings and bead supports were devised which allow the unit to terminate in type *N* jack pins and plugs, without the introduction of large components of reflection.

The continuous film attenuator consists of a single section of metallized glass. The ends of the film are connected to high conductivity platinized collars to which bullets are soldered so that the unit may be inserted as the center conductor of a coaxial casing. Fig. 3A illustrates the construction of the attenuator insert.

The constants which characterize such a lossy transmission line are:

R = total resistance of the lossy film
r = resistance per unit length $= R/l$
L = inductance per unit length
C = capacitance per unit length
g = leakance per unit length, assumed zero
l = total length of lossy film

The characteristic impedance of the continuous film section is given by:

$$Z_c = \sqrt{\frac{r + j\omega L}{g + j\omega C}} = \sqrt{\frac{L}{C}}\sqrt{1 - jX}$$

$$= Z_o\sqrt{1 - jX} \quad \ldots\ldots\ldots \quad (1)$$

where:

Z_c = lossless characteristic impedance of the section
X = a wavelength variable $= r\lambda/2\pi Z_o = R\lambda/2\pi Z_o l$
ω = radian frequency $= 2\pi v/\lambda$
v = velocity of propagation

The propagation constant is:

$$\gamma = \sqrt{(r + j\omega L)(g + j\omega C)}$$

$$= j\frac{2\pi}{\lambda}\sqrt{1 - jX} = \alpha + j\beta \quad \ldots\ldots \quad (2)$$

where:

α = attenuation constant in nepers per unit length
β = phase constant in radians per unit length

If $\delta = Re\sqrt{1 - jX}$ (Re = real part)
$\sigma = -Im\sqrt{1 - jX}$ (Im = imaginary)

then:

$$\frac{Z_c}{Z_o} = \sqrt{1 - jX} = \delta - j\sigma \quad \ldots\ldots \quad (3)$$

$$\gamma = \frac{2\pi}{\lambda}(\sigma + j\delta) \quad \ldots\ldots\ldots \quad (4)$$

The total attenuation of the continuous film attenuator neglecting mismatch losses is therefore given by:

$$\alpha_T = \alpha l = \frac{2\pi\sigma l}{\lambda} \quad \ldots\ldots\ldots \quad (5)$$

For the ideal attenuator, α_T should be independent of frequency, or the ratio σ/λ is required to remain constant. This condition cannot be completely realized over very broad frequency bands but may be closely approached under proper design conditions. To indicate these, a useful approximation may be employed for $\sigma = -Im\sqrt{1 - jX}$.

$$\sigma \doteq aX(1 - bX^2) \quad \ldots\ldots\ldots \quad (6)$$

*This work was done under contract NObs-28376 between the Microwave Research Institute of the Polytechnic Institute of Brooklyn and the U.S. Navy Bureau of Ships. This paper was presented at the 1947 National Electronics Conference in Chicago.

where, for $0<X<2$, $a=0.452$, $b=0.0362$.

Using the approximation of Eqt. (6) in Eqt. (5), the total attenuation is given by:

$$\alpha_T \doteq \frac{aR}{Z_o}(1-bX^2) \quad \ldots\ldots\ldots \quad (7)$$

If the parameters of design and frequency limits of operation are chosen so that X is small, Eqt. (7) indicates that the attenuation will be nearly constant over the frequency band and equal to a nominal value:

$$\alpha'_T \doteq \frac{aR}{Z_o} \quad \ldots\ldots\ldots\ldots \quad (8)$$

The second term of Eqt. (7) is responsible for the variation in attenuation. Using Eqt. (8), this may be written:

$$bX^2 = b\left(\frac{R\lambda}{2\pi Z_o l}\right)^2 = b\left[\frac{\alpha'_T}{2\pi a(l/\lambda)}\right]^2$$

$$= \text{constant} \times A_\lambda{}^2 \quad \ldots\ldots\ldots \quad (9)$$

where $A\lambda$ is the nominal attenuation per unit length, the latter measured in wavelengths:

$$A_\lambda = \alpha'_T/(l/\lambda) \quad \ldots\ldots\ldots \quad (9a)$$

Therefore, to realize a small attenuation spread over the frequency limits of operation, the design parameter, $A\lambda$, must be small, and hence the longer the maximum wavelength and the higher the nominal attenuation, the greater must be the length of the unit. Essentially, this sets an upper limit of attenuation, and a lower limit of frequency for this type of attenuator since it is mechanically undesirable to increase the length of the metallized-glass insert beyond a value of 6" to 8".

It is important that the reflections introduced by the junction of the lossy film section and the main transmission line be small, so that matched conditions be maintained as closely as possible. The reflection at the junction of two transmission lines is given by:

$$K_T = \frac{Z_o - Z_{load}}{Z_o + Z_{load}} \quad \ldots\ldots\ldots \quad (10)$$

The assumption is now made that the attenuation of the length of lossy film is great enough so that the input impedance is the same as that of an infinite length of lossy line, or identical with the characteristic impedance Z_o. Utilizing this in conjunction with Eqt. (10) and the usual transmission line impedance relationships, the expression for the total reflection at the input terminals of a continuous film attenuator becomes:

$$K_T = \frac{\alpha_T\lambda}{4\pi l}\left[\epsilon^{\,j\left(\frac{\alpha_T}{2\pi l}+\frac{\pi}{2}\right)} - \epsilon^{-2\alpha_T}\,\epsilon^{-j\frac{2\pi l}{\lambda}}\right] \quad \ldots\ldots\ldots \quad (11)$$

The second term within the bracket of Eqt. (11) represents the contribution to the total reflection by the back end of the attenuator. The effect of this component is usually small, since its magnitude is reduced by an exponential factor of twice the total attenuation of the insert. If then this second term is neglected, the reflection may be simplified to:

$$|K_T| = \frac{\alpha_T\lambda}{4\pi l} = \frac{1}{4\pi}\frac{\alpha_T}{(l/\lambda)} = \frac{1}{4\pi}A_\lambda \quad (12)$$

Eqt. (12) indicates that for the reflection factor to be small, the wavelength variable $A\lambda$ must be small. This is the same conclusion arrived at from the previous study of attenuation spread with frequency. Therefore, both from the standpoint of low attenuation variation with respect to frequency, and low reflection factor, with frequency band and maximum mechanical length specified, an upper limit is placed on maximum allowable total attenuation.

Reference to Eqt. (12) indicates that the mismatch of a single film attenuator increases with $A\lambda$. The latter is inversely proportional to frequency, so that maximum reflection for a given unit occurs at the low frequency end of the band. Therefore, in order to improve over-all broad band performance, it becomes desirable to apply some method of compensation which will correct for the high standing wave ratio which occurs at the longer wavelengths. This compensation was introduced by adding, as a portion of the pad, lengths of low attenuation resistive sections. These were arranged symmetrically at either end of the main section of attenuating film as shown in Fig. 3C.

The short length of matching section causes an additional component of reflection, which arises at the junction of the matching and main films. This is adjusted to combine with the other components of reflection present so that minimum standing wave ratio occurs near the low frequency end of the band. The resultant VSWR spectrum curve is of the type shown in Fig. 3D.

This method of compensation can be analyzed quantitatively by considering the total reflection at the input end of the attenuator. If relatively high loss is assumed in the main attenuating film, that is between the points x_2 and x_3 of Fig. 3C, the total reflection factor at the input end may be written as:

$$K_T = \left[\frac{\alpha_{T1}\lambda}{4\pi l_1}\,\epsilon^{\,j\left(\frac{\alpha_{T1}}{2\pi l_1}+\frac{\pi}{2}\right)}\right] + \left(\frac{\alpha_{T2}}{l_2} - \frac{\alpha_{T1}}{l_1}\right) \times \frac{\lambda}{4\pi}\,\epsilon^{-\alpha_{T1}}\,\epsilon^{\,j\left(\frac{\alpha_{T1}+\alpha_{T2}}{2\pi(l_1+l_2)}\lambda - \frac{4\pi l_1}{\lambda} + \frac{\pi}{2}\right)} \quad (13)$$

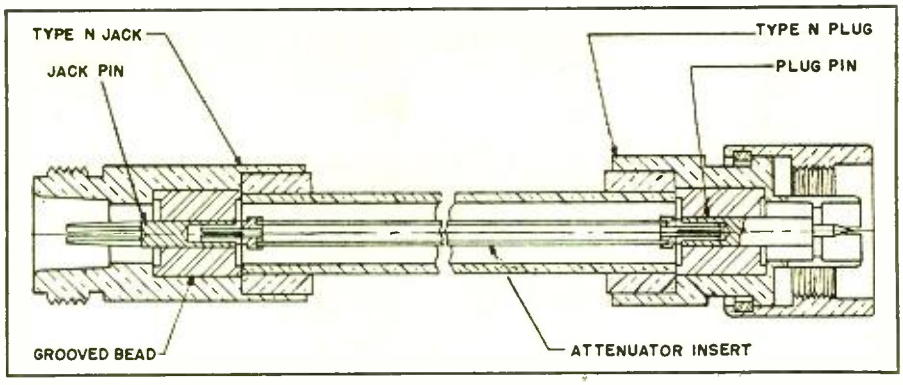
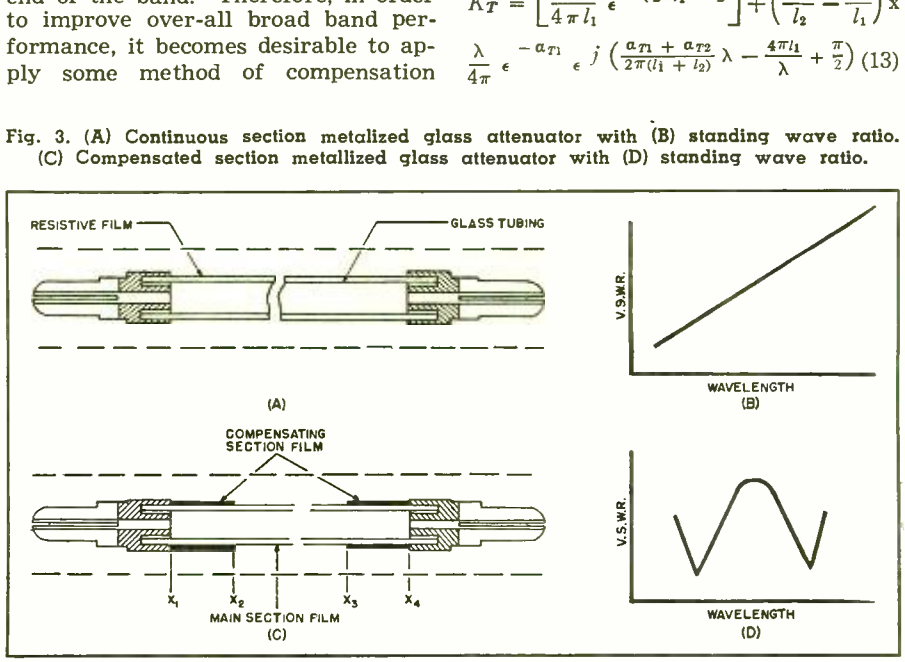


Fig. 2. Cross-section of coaxial attenuator for the frequency band at 4000-10,000 mc.

Fig. 3. (A) Continuous section metalized glass attenuator with (B) standing wave ratio. (C) Compensated section metallized glass attenuator with (D) standing wave ratio.



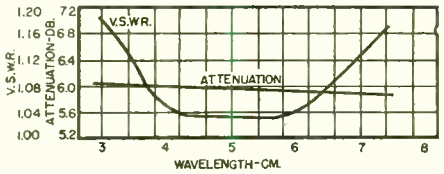


Fig. 4. Attenuation and voltage standing wave ratio for a 6 db. metallized glass attenuator plotted against wavelength.

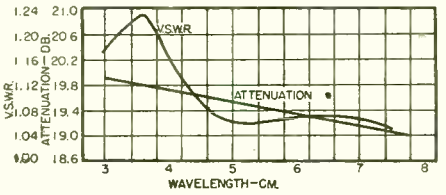


Fig. 5. Attenuation and VSWR of a 20 db. metallized glass attenuator.

l_1 = length of compensating film
l_2 = length of main attenuating film
α_{T_1} = total attenuation introduced by a compensating section
α_{T_2} = total attenuation introduced by main section.

The second term of Eqt. (13) is the reflection introduced by the junction of main and compensating sections of film at the point x_2 of Fig. 3C. Since the attenuation of the compensator, α_{T_1}, is small, this second term is comparable in magnitude to the first and may be adjusted to cancel the initial term. The condition for such a zero in total reflection is that the two terms be equal in magnitude and 180° out of phase. That is:

$$\frac{\alpha_{T1}}{l_1} = \epsilon^{-\alpha_{T1}\left[\frac{\alpha_{T2}}{l_2} - \frac{\alpha_{T1}}{l_1}\right]} \quad . \quad . \quad . \quad . \quad (14)$$

and

$$\frac{4\pi l_1}{\lambda_n} = \left[\frac{\alpha_{T1} + \alpha_{T2}}{l_2} - \frac{\alpha_{T1}}{l_1}\right]\frac{\lambda_n}{l_1} + (2n+1)\pi \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

$n = 0, 1, 2, \ldots$

From Eqt. (15) it is seen that when $K_T = 0$, l_1 is somewhat greater than an odd multiple of a quarter wavelength. For small values of attenuation, l_1 approaches this value closely, or:

$$l_1 = \frac{2n+1}{4}\lambda_n \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

Eqt. (16) may be considered only a rough estimate at the higher values of attenuation, but a useful one for qualitative analysis.

From the above discussion it is clear that the advantage of matching sections for broad band operation is that instead of monotonically increasing the reflection versus frequency function of the single section attenuator shown in Fig. 3A, a characteristic may be obtained which has one or more minima, as shown in Fig. 3D. Since the continuous film attenuator has a maximum reflection at the low frequency end of the band, a minimum is introduced near this frequency and the length of compensating section designed accordingly, using Eqt. (16) as a rough guide.

Fig. 3D shows a maximum in the VSWR characteristic near midband. It is important to determine the approximate frequency and magnitude of this point. Such a maximum will result when the two terms of Eqt. (13) are in phase. This occurs at an approximate wavelength:

$$\lambda_m = 2ml_1, \; m = 0, 1, 2 \quad . \quad . \quad . \quad . \quad . \quad (17)$$

Substituting this in Eqt. (13) for $m = 1$, a simple expression for maximum reflection is obtained:

$$|K_m| = \frac{\alpha_{T1}}{\pi} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

Thus the attenuation of the compensator should be small for low values of $|K_m|$. To determine the length of the main section, Eqt. (14) may be rewritten as:

$$l_2 = \frac{\alpha_{T2}}{\frac{\alpha_{T1}}{l_1}\left(1 + \epsilon^{-\alpha_{T1}}\right)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (19)$$

l_1 is determined by the required zero in reflection, and since α_{T_1} must be small for low maximum reflection factor, $|K_m|$, the denominator of Eqt. (19) is small, or other things being equal a low maximum reflection demands a long length of main section, l_2.

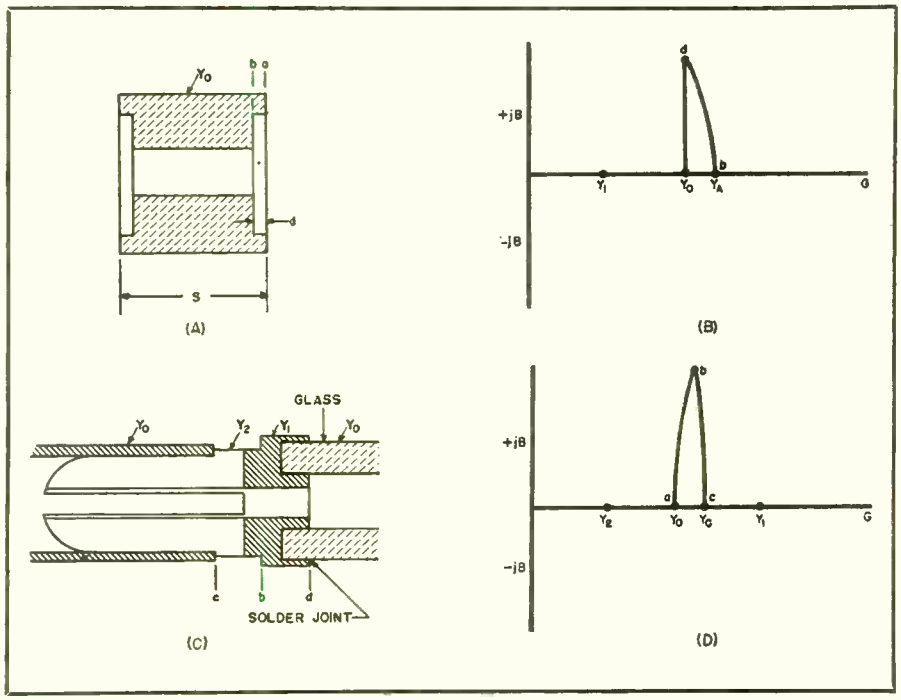
An approximate design procedure may be summarized as follows:

1. With the band limits specified, determine the length of compensating film, l_1, by Eqt. (16) with $n = 0$, and λ_n chosen near the low frequency end of the band. For frequencies of 4000-10,000 mc. λ_n = 7.0 cm. The exact determination of this design point is somewhat more involved than given here. Further details are given in a companion paper.[1]
2. Determine the attenuation of the compensating section by inserting the maximum permissible value of reflection in Eqt. (18).
3. The attenuation of the main section is found by subtracting the total compensator attenuation from the required total attenuation. Thus $\alpha_{T2} = \alpha_T - 2\alpha_{T1}$.
4. The length of main section l_2 is now given by Eqt. (19).
5. The resistance of the main and compensating sections can be ascertained from the values of α_1 and α_2 by using Eqt. (7).

Although both the continuous film attenuator and the compensating attenuator have similar attenuation-frequency curves, and a similar design criterion in that long length makes for improved performance, for a given mechanical length and frequency band the compensating section attenuator will be superior in operation, with respect to mismatch. Thus the metallized-glass insert of a 20 db. attenuator designed as a 6" continuous film gave a theoretical maximum VSWR of 1.20. This was not considered sufficiently low, since with the addition of couplings the mismatch would be too great. The same total length of insert designed as a compensated section unit had a maximum VSWR of only 1.10. However, since the continuous film inserts are easier to build, they are preferred where

(*Continued on page* 29)

Fig. 6. (A) Grooved bead with (B) reactive cancellation. (C) Bullet for attenuator insert and (D) bullet shoulder cancellation. (C) and (D) are admittance diagrams.



Delay Lines for Pulse Applications

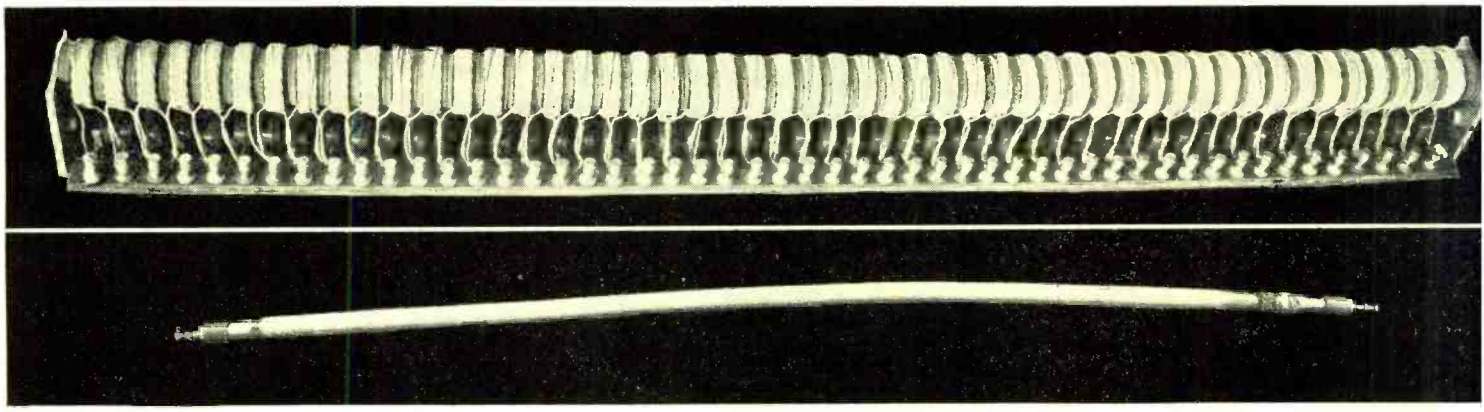


Fig. 1. (Top) Typical artificial line using multilayer "universally" wound coils to achieve a higher delay per unit length than the single layer type. Fig. 2. (Bottom) Typical video delay cable.

By SIDNEY MOSKOWITZ and JOSEPH RACKER

Federal Telecommunication Laboratories

Part IV of this series covers the design and construction of delay networks in common use.

THE articles presented heretofore in this series covering the design of amplifiers[1] and shapers[2] were, in general, characterized by the fact that basically familiar circuits were used, modified to permit pulse transmission. These circuits, on the whole, employ standard, commercially available components. This will not be true of the subject matter to be covered in this article. Delay lines are not standard items and must usually be designed to meet a specific requirement by the engineer. Hence the importance of this article.

Delay lines are used to perform many special operations on pulse voltages. In some applications, such as electronic computers, pulses must be stored for a given period of time in order to permit the operation of circuits which require a finite time for their actuation. This is done by utilizing a circuit which has a definite period of transmission between its input and output. The pulse is then said to be delayed and the circuit is called a delay or storage network.

Delay circuits are also employed to measure time intervals and form pulses in radar applications; provide channel separation in time sequence in multiplex communication systems; and for synchronization of sweep circuits in oscilloscopes.

Several types of delay lines have been evolved. Pulse delays of the order of a thousandth of a microsecond may be accomplished through the use of conventional transmission lines, usually coaxial cable. In the range of 0.01 to 100 microseconds, either a variation of the coaxial cable or an artificial line consisting of m-derived filter sections may be used. Above this range up to several thousand microseconds, the pulse may be delayed by transmitting it via supersonic waves through a liquid or solid medium.

From the above, it is obvious that a review of transmission line theory would be helpful in understanding pulse delaying storage circuits. The characteristics of a transmission line that are of interest are the characteristic impedance, cut-off frequency, attenuation and time delay.

The characteristic impedance of the line, sometimes referred to as the natural, iterative, or surge impedance, is usually denoted by Z_0 and expressed in ohms. If a line is infinitely long, its input impedance will be equal to Z_0. The input impedance will also be equal to the characteristic impedance for a finite line terminated in an impedance equal to Z_0.

In terms of the electrical constants of the line, the characteristic impedance is equal to:

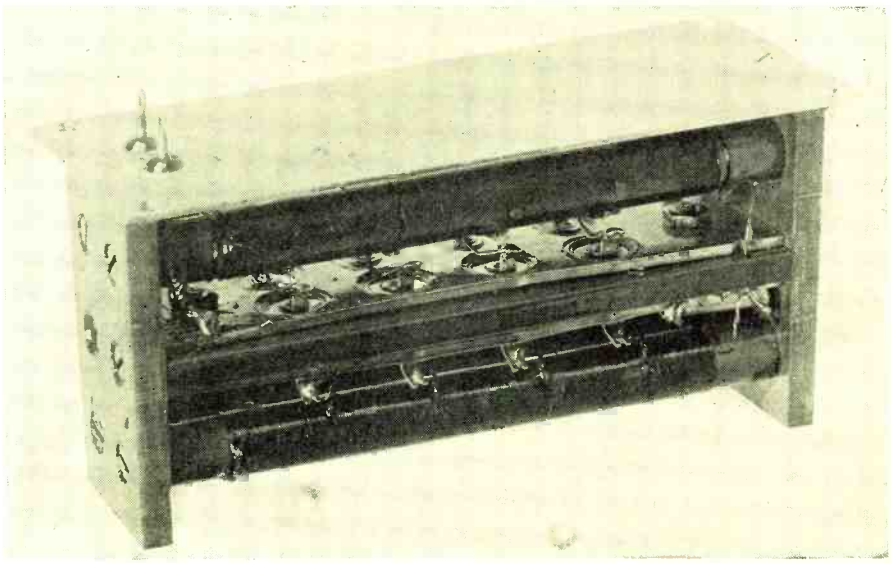
$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}} \text{ ohms} \quad \ldots\ldots \quad (1)$$

where:

R is resistance in ohms per unit length

L is inductance in henrys per unit length

Close-up of a lumped line using the single-layer, continuously wound coil.



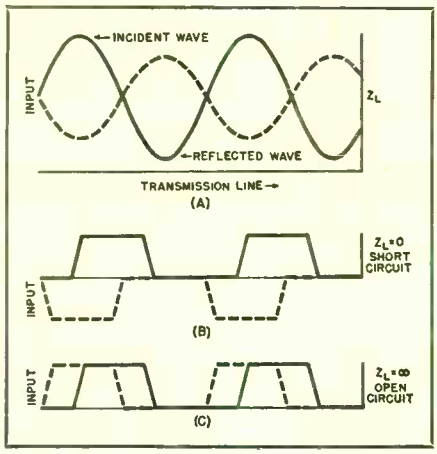


Fig. 3. Types of voltage distributions produced on a transmission line due to different load impedances.

C is capacitance in farads per unit length

G is conductance in ohms per unit length

From this relationship it can be seen that the characteristic impedance is essentially equal to $\sqrt{L/C}$ and is independent of frequency if $\omega L \gg R$ and $\omega C \gg G$. This will generally be the case for all radio frequencies and for all but the lowest audio frequencies. At the frequencies where R is comparable to ωL and G is comparable to ωC, the characteristic impedance varies with frequency and approaches $\sqrt{R/G}$ as the frequency approaches zero. It should be noted that if R/L is equal to G/C, the characteristic impedance is a pure resistance, equal to $\sqrt{L/C}$, at all frequencies and the line is said to be distortionless.

Knowledge of the characteristic impedance is necessary for determining the magnitude and phase of volages reflected from the termination of the line. The vector ratio of the incident wave voltage to that of the reflected wave (see Fig. 3A), known as the coefficient of reflection, is given by:

$$K = \frac{Z_0/Z_L - 1}{Z_0/Z_L + 1} \quad \ldots\ldots\ldots\ldots \quad (2)$$

where K is the coefficient of reflection.

Thus if a line is shortcircuited at the output, $Z_L = 0$, K is then equal to -1. This means that the voltage is completely reflected but in negative polarity as shown in Fig. 3B. If the line is open, $Z_L = \infty$ (infinity), and $K = 1$ so that the voltage is completely reflected in the same polarity (Fig. 3C). For the case $Z_L = Z_0$, $K = 0$ which indicates that no reflection occurs.

The second important parameter of a transmission line is its attenuation. The attenuation has been determined to be the real part of the following expression:

$$\alpha = \text{Real part of } \gamma = \text{Real part of } \sqrt{(R+j\omega L)(G+j\omega C)} \quad (3)$$

where α is the attenuation in nepers per unit length and γ is the propagation constant.

At very low frequencies the attenuation is minimum and equal to $\sqrt{R/G}$. This attenuation increases with frequency for $\omega L \gg R$ and $\omega C \gg G$, it becomes:

$$\alpha = \frac{R}{2Z_0} + \frac{GZ_0}{2} \text{ nepers per unit length.} \quad (4)$$

where Z_0 is equal to $\sqrt{L/C}$.

The first term in this expression represents the attenuation due to losses in the conductors. The resistance, R, increases with frequency due to the skin effect in accordance with the following expression:

$$R_{ac} = \frac{83.2\sqrt{f}\,10^{-9}\,R'}{d} \text{ ohms per cm} \quad (5)$$

where:

f = the frequency in cycles per second

$R' = \dfrac{\text{resistivity of conductor}}{\text{resistivity of copper}}$

d = the diameter of conductor in cm.

The second part of Eqt. (4) is the loss due to the dielectric. Here again the loss increases with frequency since G is equal to:

$$G = \omega CP \text{ mhos per cm} \quad \ldots\ldots \quad (6)$$

where P is the power factor of the dielectric.

Of course L and C may also vary with frequency. However these effects are usually small compared to the variation in R and G and can be neglected in the calculation of the attenuation. It should be noted that for the special case where R/L is equal to G/C, the attenuation is independent of frequency and is equal to $\sqrt{R/G}$.

The imaginary part of Eqt. (3) represents the phase constant of the line. For $\omega L \gg R$ and $\omega C \gg G$, the phase constant becomes:

$$\theta = \omega\sqrt{LC} \quad \ldots\ldots\ldots\ldots \quad (7)$$

where θ is the phase constant.

Thus for such a transmission line, the angle of transmission delay is proportional to frequency. The time delay, T, is related to the angle, θ, by:

$$T = \theta/\omega \text{ seconds per foot} \quad \ldots\ldots \quad (8)$$

so that $T = \sqrt{LC}$.

This means that for lines in which $\omega L \gg R$ and $\omega C \gg G$, the time delay is independent of frequency and therefore no pulse distortion, due to non-uniform phase response, will occur.

It is known that the phase velocity, v, of the wave traveling through a uniform line must be:

$$v = \frac{1}{T} = \frac{1}{\sqrt{LC}} = \frac{c}{\sqrt{\mu\epsilon}} \text{ ft. per sec.} \quad (9)$$

where:

μ is the permeability of the material

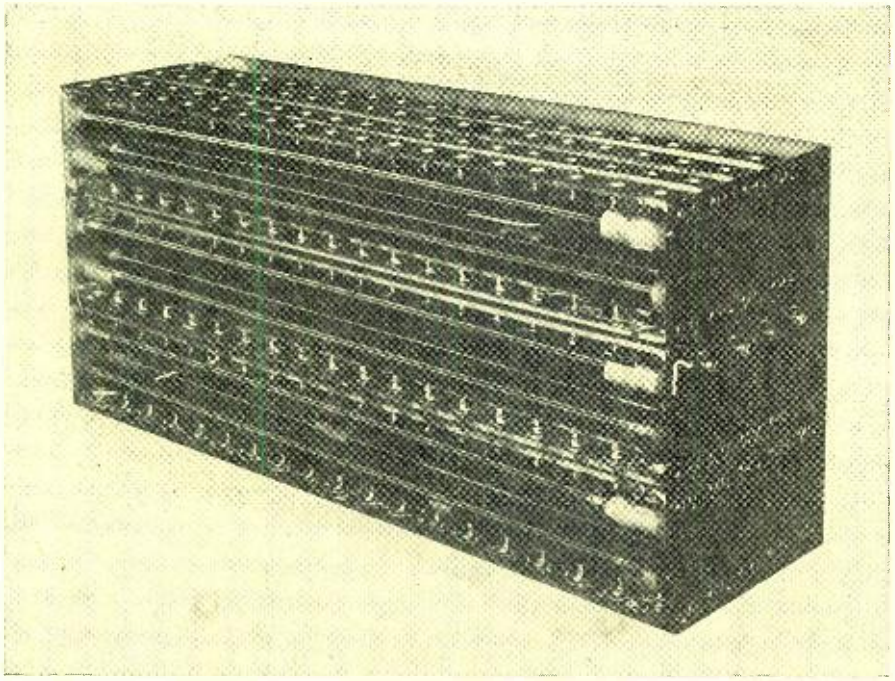
ϵ is the dielectric constant

c is the velocity of light.

It is the property of the electromagnetic field that, for a dissipationless, uniform line in free space, L and C are so related that their product is constant and the phase velocity is equal to the velocity of light (or μ, ϵ are equal to 1). The time delay of these lines would therefore be equal to:

$$T = \frac{1}{c} = .0011 \text{ microsecond per ft.} \quad (10)$$

Typical artificial delay line using a continuously wound coil.



The use of a dielectric other than air to separate the conductors of the line decreases the velocity of propagation and therefore increases the time delay by a factor of $\sqrt{\epsilon}$. One of the most common insulators is polyethylene whose dielectric constant is approximately 2.25. The time delay of a polyethylene insulated line is therefore:

$T = .0017$ microseconds per ft. . . . (11)

Special Delay Lines

It was noted above that a delay of only .0017 microseconds per foot is obtained with polyethylene lines. It would be impractical to use these lines for delays of the order of microseconds since prohibitively long lines would be necessary. Consequently lines with more delay per unit length are required. There are a number of ways in which this can be accomplished.

One method would be to increase the delay of a coaxial cable by winding the inner conductor around the core in a manner similar to a solenoid. There are two possible explanations for the increase in delay. The first is that the inductance per unit length has been increased and since delay is equal to $\sqrt{LC}$, the delay has been increased. LC in this case is not a constant since the line is no longer a uniform line.

Another approach is that the velocity of propagation remains the same; however, the wave now follows the inner conductor around the core rather than traveling in a straight line as before. Thus if there are n turns per foot and the diameter of the core is d, the distance the wave travels for each foot of cable is approximately (for $n \gg l$):

$l = n \pi d$ feet . . . . . (12)

where l is the length of the inner conductor.

Thus the delay of the line is increased by $(n\pi d)$ or is equal to, for polyethylene coaxial cable:

$T = .0017\ n \pi d$ microsec. per ft. . . (13)

This latter "rule of thumb" formula provides a very good first approximation particularly when the spacing between the inner and outer conductor is not large. However, it should be noted that this delay is also proportional to $\sqrt{\mu\epsilon}$. In fact, insulators with higher dielectric constants (Saran) and cores with higher permeabilities (iron) are often employed to increase the delay.

There are two commercially available delay lines. One is the spiral delay line manufactured by *Federal Telephone and Radio Corporation.* The appearance and construction of

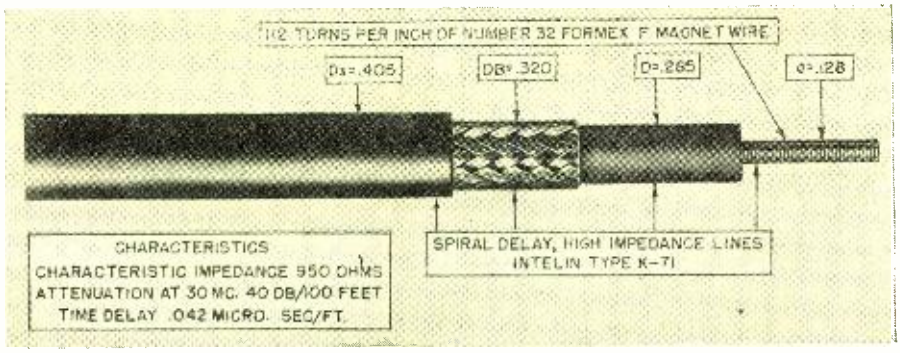


Fig. 4. Spiral delay cable.

this cable is exactly similar to that of a solid dielectric coaxial cable. The only difference is that the inner conductor is a helix of enameled wire closely wound over an insulating core as shown in Fig. 4. The time delay of this cable has been determined to be:

$$T = \frac{4.75 \times 10^{-4}\ \pi\ n\ a\ \sqrt{\epsilon}}{\sqrt{\log_{10} D / d}}\ \mu\text{sec./ft.} \quad . \quad (14)$$

where:

n = the turns per foot

a = diameter of inner conductor from wire center to wire center in inches

D = outer diameter over dielectric

d = diameter over inner conductor.

The characteristics of *Federal's* K-71 spiral delay line are as follows:

Turns per inch—112

Overall diameter—0.405 inch

Characteristic impedance—950 ohms

Capacitance—44 $\mu\mu$fd./foot

Time delay—0.042 μsec./ft.

The other commercially available delay cable is the video delay line (shown in Fig. 2) developed by *General Electric.* This line consists of an inner conductor wound around a flexible insulating core of polyvinylidene chloride ("Saran") about 0.19" in diameter. A layer of insulating tape serves as a dielectric between the conductors of the line. The outer conductor is a braid of insulated wires connected together at one end of the line. A cotton covering and an outer shell of polyvinyl tubing complete the line. The delay of this line has been determined to be:

$$T = 7 \times 10^{-5}\ n\ D\ \sqrt{D/s\epsilon}\ \mu\text{sec. / ft.} \quad . \quad . \quad (15)$$

where:

n = the turns per foot

D = the diameter of the line

s = the separation between inner and outer conductor.

A typical video delay line has the following characteristics:

Turns per inch—277

Characteristic impedance—1100

Capacitance—42 $\mu\mu$fd./inch

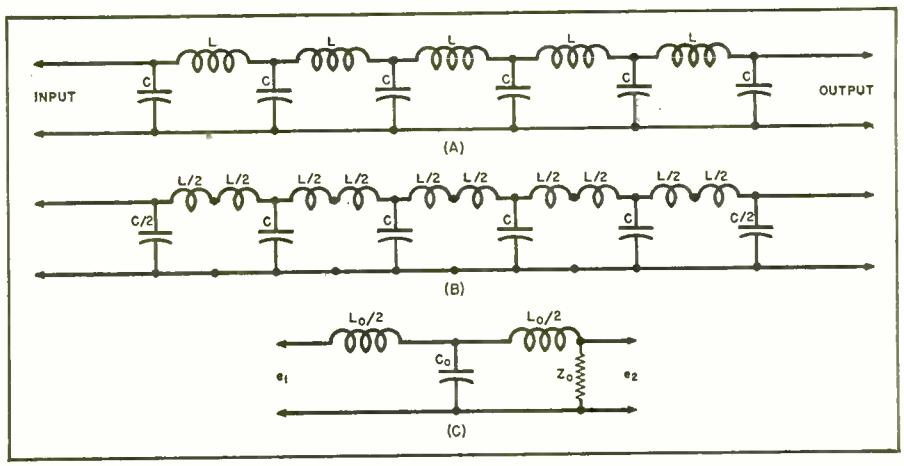
Time delay—0.55 μsec/ft.

It should be noted that the inductance of these lines varies appreciably with frequency. A number of factors contribute to this variation among which is the fact that as the wavelength along the line becomes short, an out-of-phase coupling between successive turns exists which may result in a material decrease in effective inductance. This change in inductance, of course, causes the delay to become a function of frequency also. Fig. 6 shows the delay error vs. frequency of a cable with a solenoid type of inner conductor.

Lumped Lines

For delays of the order of 10 microseconds, or when low characteristic impedances are required (both the spiral and video delay lines have high

Fig. 5. Schematic and one cell "constant k" prototype of a lumped line.



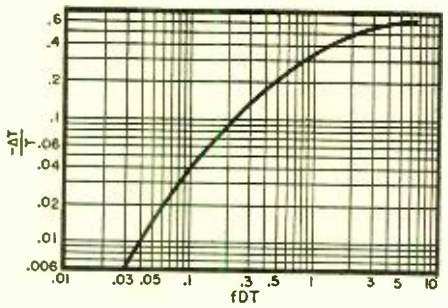


Fig. 6. Delay error as a function of frequency, low-frequency delay, and line diameter.

characteristic impedances), a lumped-constant, sometimes called artificial, line can be utilized. These lines employ coils and condensers in a manner which simulates a transmission line. Either a single section lumped line may be used or a large number of cascaded sections. In designing these lines we are interested in maintaining the phase delay proportional to frequency (time delay independent of frequency), develop a maximum delay per section (except for special cases), and keep the attenuation as low as possible. The characteristic impedance is also of prime importance but its optimum value varies for different applications.

Theory of Lumped Lines

The configuration of coils and condensers shown in Fig. 5A which make up an artificial line can be considered to be a ladder of four terminal networks (Fig. 5B), each four terminal network consisting of a "constant K" type, T network terminated in the characteristic impedance of the line as shown in Fig. 5C. If we place a voltage e_i across the input of this network, the output voltage, e_2, will be equal to:

$$e_2 = e_i\left[1 - 2\left(\frac{\omega}{\omega_0}\right)^2 + j2\left(\frac{\omega}{\omega_0}\right)\left(1 - \left(\frac{\omega}{\omega_0}\right)^2\right)\right]^{-1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

where $\omega_o = 2/\sqrt{L_oC_o}$ is 2π times the cut-off frequency, f_o, and ω is the angular frequency of e_i

When $\omega/\omega_o \ll 1$, this equation reduces to:

$$e_2 \approx \left(1 - j\,\frac{2\,\omega}{\omega_0}\right) e_i = e_i\,\epsilon^{-j2\omega/\omega_0} \quad . \quad . \quad (17)$$

This latter relationship between e_2 and e_i indicates that the output voltage is the same as the input voltage except that it is delayed in phase by an angle equal to $2\omega/\omega_o$. The time delay of this network is, as previously indicated by Eqt. (8), the phase delay divided by the angular frequency or:

$$T = \frac{2\omega}{\omega_0} \cdot \frac{1}{\omega} = \frac{2}{\omega_0} = \frac{2}{\sqrt{L_0C_0}} \quad . \quad . \quad . \quad (18)$$

It is thus seen that if the network is designed to have a much higher cut-off frequency than the highest frequency applied to it, the input wave will be delayed by a period, equal to T, without any appreciable distortion.

This requirement of $\omega \ll \omega_o$, however, makes this circuit impractical since the delay of each four terminal network or cell is inversely proportional to the cut-off frequency and is therefore very low. Furthermore, the more cells that are used, the higher the cut-off frequency since any distortion that does occur within one cell, for a given f_o, is multiplied with each additional section. In order to maintain the same over-all distortion, the cut-off frequency must consequently be increased by a factor approximately equal to $\sqrt[3]{n}$, where n is the number of sections used.

In designating the four terminal network shown in Fig. 5C as one cell of the artificial line shown in Fig. 5A, it was assumed that there was no mutual coupling between successive coils. However, if these coils are mutually coupled, as shown in Fig. 8A, the resulting four terminal network takes the form of an m-derived filter as shown in Fig. 8B. With this type of a network, it is possible by proper selection of m, to pass without distortion frequencies that are a much higher percentage of the cut-off frequency than is possible with the use of the "constant K" type of network.

It can be shown that the ratio of output voltage to input voltage of an m-derived filter is approximately:

$$e_2/e_i = 1 - \epsilon^{j\theta} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18a)$$

when θ, the phase constant is equal to:

$$\theta = 2 \arcsin \frac{m\,x}{\sqrt{1 + x^2\,(m^2 - 1)}} \quad . \quad . \quad . \quad (19)$$

where x is equal to ω/ω_o.

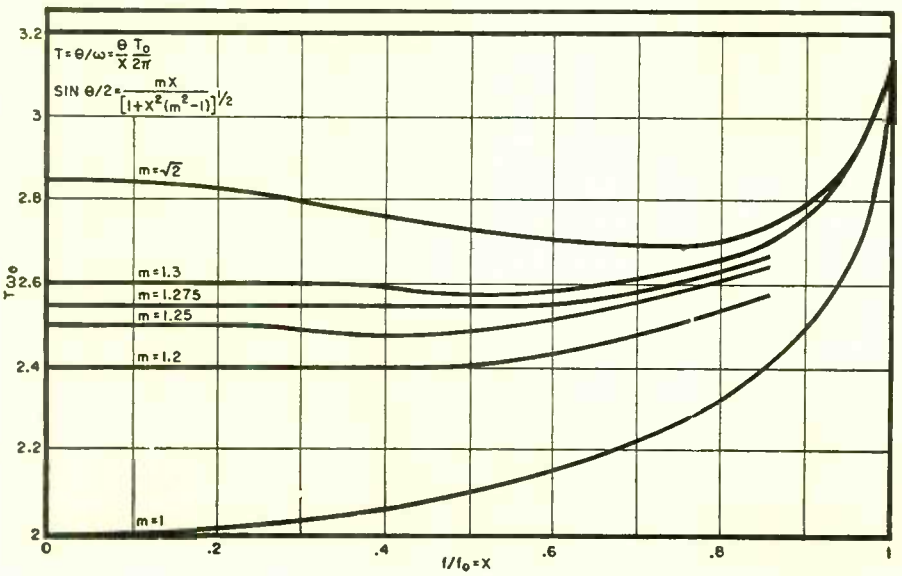
The time delay, T, can then easily be found by dividing θ by ω. Fig. 7 plots $T\omega_o$ versus $= (\omega/\omega_o)$ for different values of m greater than one. From this figure it can be seen that when $m = 1.275$, the delay is most nearly constant over the longest per-cent of the cut-off frequency, i.e. about 75 per-cent. For this reason, $m = 1.275$ is the value chosen in the design of these lines. From this graph it can also be seen that the time delay over the range where it remains nearly constant with frequency is equal to:

$$T = 2m/\omega_0 = 0.404/f_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

for $m = 1.275$.

It should also be noted that $m = 1$ corresponds to the "constant K" network.

Fig. 7. Delay vs. frequency curve for different values of m greater than 1.



Design of Lumped Lines

With the determination of the optimum value of m, the design of the lumped lines can be undertaken. The problem involved consists of selecting and spacing $L/2$ and C of Fig. 5B in such a manner that the circuit becomes equivalent to the network shown in Fig. 8B, with $m = 1.275$. The elements comprising the m-derived network are related to those of the "constant K" prototype by the following expressions:

$$L/2 = (1 + m^2)\,L_0/4m = .52\,L_0 \quad . \quad . \quad . \quad (21)$$

$$C = m\,C_0 = 1.275\,C_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (22)$$

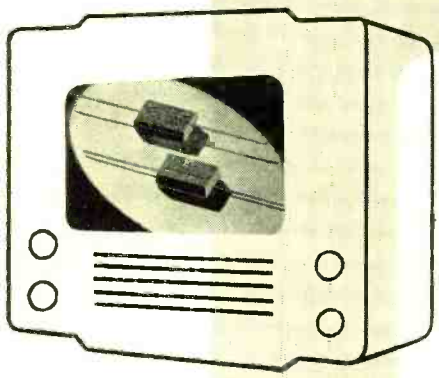
$$M = -(1 - m^2)\,L_0/4m = 0.013\,L_0 \quad . \quad (23)$$

where M is the mutual coupling.

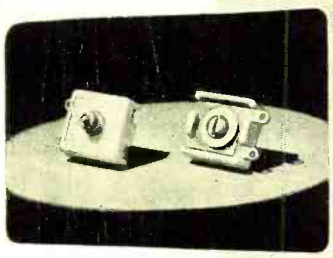
From these equations for $L/2$ and M, the coefficient of coupling, k, between two series coils can be given as:

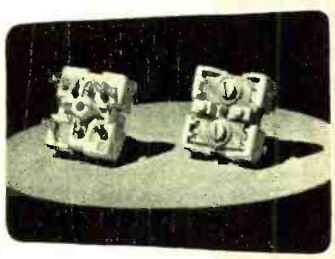
$$k = \frac{M}{L/2} = \frac{-(1 - m^2)\,L_0/4m}{(1 + m^2)\,L_0/4m} = -\frac{(1 - m^2)}{(1 + m^2)} = 0.12 \quad . \quad . \quad . \quad . \quad . \quad (24)$$

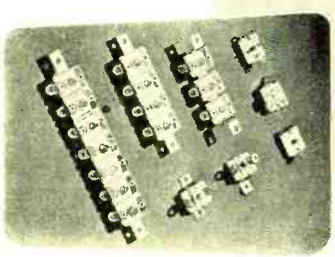
(*Continued on page* 30)



A GOOD TRADEMARK *is* BUT A REFLECTION OF *many* OTHERS







WHEN a manufacturer puts his trademark on a product, he not only expresses pride in his own workmanship, but also his confidence in the trademarks of those who have contributed vital parts to its manufacture. For instance — on capacitors he recognizes the El-Menco branding as his assurance of trustworthy performance under all operating conditions.

JOBBERS & DISTRIBUTORS
Arco Electronics,
135 Liberty St., New York, N. Y.
is Sole Agent for El-Menco Products

Foreign Radio and Electronic Manufacturers communicate direct with our Export Department at Willimantic, Conn., for information.

Write on firm letterhead for samples and catalog.

THE ELECTRO MOTIVE MFG. CO., Inc., Willimantic, Conn.

MOLDED MICA **El-Menco** MICA TRIMMER
CAPACITORS

NEWS BRIEFS

NEW PHYSICS LAB FOR SYLVANIA

The first of a series of modern research labs for *Sylvania Center*, Bayside, N.Y., will be completed this fall. Fully equipped for scientific research in fluorescent lighting, radio, radar, television and the general electronics field, the lab will cost about $900,000. In addition to the physics lab there will be others for metallurgical research,

chemical research, electrochemical research and advanced product development. The project, when finished, will be the first campus type scientific research center in the corporate limits of New York City.

"ELECTRONIC TRACKS" FOR AIRCRAFT

An air navigation and traffic control system, called Tricon, is being developed by *General Electric* engineers at Electronics Park, Syracuse, N.Y. Using triple coincidences of pulses as the base of the system, a master station and "slave" units, a 50-mile section can be scanned with triple coincidence about once a second. An airplane in the area continually establishes its position by means similar to the block system in railroading. The master station thus has complete data on a given sector and transmits the information to the instrument panel of each aircraft in the area. Lights corresponding to commands "turn left," "hold," etc., can also be flashed.

ROYALTY-FREE PATENTS

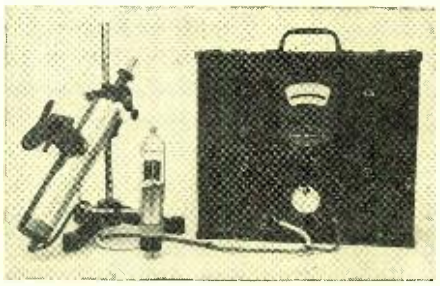
Sixty patents on the production and use of electrical apparatus have been released for unrestricted licensing by the *Office of Alien Property, Department of Justice*, Washington 25, D.C. Some of their most important applications were formerly limited by pre-war patent agreements. They are now available on a royalty-free, non-exclusive basis for an administrative fee of $15. The patents can be used in the fields of prime movers and their accessories, control of electricity for light, heat, power and traction purposes, and in steam turbines, reduction gears, condensing plants, heat exchangers and certain types of pumps. The list of patents is available without cost and copies of the patents may be purchased for $.25 from Commissioner of Patents, Washington 25, D.C.

CHICAGO I.R.E. CONFERENCE

The annual Chicago I.R.E. Conference will be held on April 17 at the Illinois Institute of Technology. It will be an all-day affair featuring exhibits of new commercial products and a presentation of technical papers which should be of interest to all radio and electronic engineers within a 500-mile radius of Chicago. The registration fee is $1.50 and further information may be obtained from Lloyd Hershey of the *Hallicrafters Co.*, 4401 W. 5th St., Chicago, Ill.

MEASURING OZONE

Variation in the total amount of ozone in the stratosphere has a direct correlation with latitute and season, and different types of air masses show variations in ozone content, which are associated with their origin or movement. However, there is no proof of direct relationship between ozone variations and current weather conditions. But if such correlations do exist, ozone data may become useful in weather forecasting.



A technique of measuring the total ozone of the stratosphere has been developed by the *National Bureau of Standards*, Washington 25, D.C. Ground-based equipment employing a photocell and selected filters makes use of photo-tubes sensitive to ultraviolet radiation. Ozone, strongly absorbent within a specific region, affects the spectral distribution of sunlight reaching the earth's surface. When transmittances of the filters are measured for sunlight, the observed value depends upon solar energy distribution, and therefore is a function of the amount of ozone within the beam of sunlight under study.

940-960 MC. FM EQUIPMENT

Final development of FM studio to transmitter link equipment for 940 to 960 mc. has been announced by *Radio Engineering Laboratories, Inc.*, 35-54 36th St., Long Island City 1, N.Y. This equipment consists of a transmitter, receiver, monitor, transmitting and receiving antennas with their supporting structures, and a supply of transmission line. It is the result of a program of studio to transmitter link design, accelerated by demand of broadcasters for equipment capable of operating in the band allocated by the F.C.C.

NEW LITERATURE

Voltage Regulators

A complete series of papers analyzing applications, circuits, and construction of electronic a.c. voltage regulators and Nobatrons has been released for free distribution by *Sorensen & Company, Inc.*, 375 Fairfield Avenue, Stamford, Conn. The pamphlets, compiled and written by the chief engineer and the project engineer of the company, have, for the most part, been published in electronic journals.

Phenolic Bobbins

Mayfair Molded Products Corp., which specializes in volume production of small phenolic pieces, has put out a pamphlet describing standard sizes of molded phenolic bobbins which are now available. They are manufactured by using stock molds. Inquiries should be addressed to 4440 North Elston Ave., Chicago 30, Ill.

Par-Metal Products

Par-Metal Products Corp., 32-62 49th Street, Long Island City 3, N.Y., has released a booklet which presents a complete description of cabinets, chassis, panels, racks and accessories as applied to electronic apparatus. Catalogues may be obtained by writing to the firm.

Erratum: In the March issue, p. 24, was an item describing the Western Electric Intermodulation Distortion equipment. The last line of this item should read "Output levels range between 23 and minus 44 dbm. at 600 ohm output impedance." Since this item was published, the equipment has been improved and now is capable of being used down to minus 105 dbm.

Attenuators

(*Continued from page* 6)

2 db. per step, and a master gain control of 1.5 to 2 db. per step. When it is possible to engineer the more flexible system, and for all network and similar stations, the mixing controls are best selected to offer 1.5 db. per step with at least 30 steps of control, and a similar master, or one of even 45 steps is to be desired. The system master is never more that 1.0 db. per step, with 0.5 db. quite frequently found. In all recording installations, where a most careful control of the sound level must be maintained to prevent over-cutting into adjacent grooves, a master gain of 0.5 db. per step is a prerequisite.

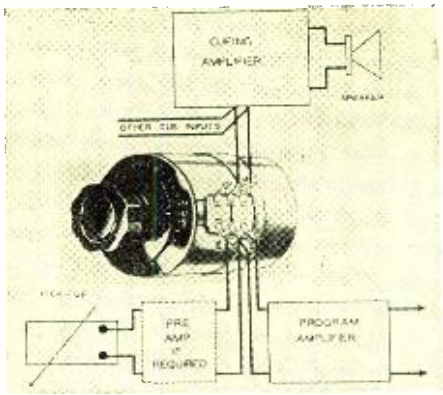


Fig. 8. The Daven Cueing Attenuator, and its proper schematic for wiring.

For monitoring amplifiers and those used in p.a. work, a control as coarse as 3 db./step is allowable, and is good engineering practice. For audiometric and laboratory work, the decade attenuator is selected, with two bridged tee pads connected in tandem to afford control of 1 db. per step for a total of 110 db.

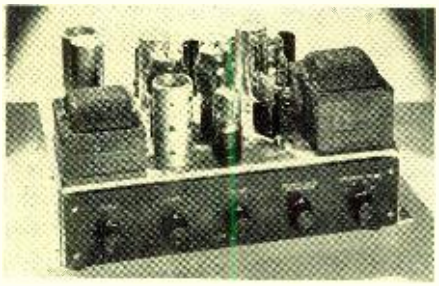
From many contacts in this field, the writer became aware that some means of cueing a record, or an incoming program source without throwing a switch would be a great boon to the broadcast mixing operator. Any saving of time and manual effort in this work is very desirable. Accordingly, during his tenure with the *Daven Co.*, this control was suggested to them. The operation of this unit (illustrated mechanically and electrically in Fig. 8) is quite normal, with the exception that a detent is applied at the off position. To cue the incoming source it is merely necessary to continue the counterclockwise rotation, whereupon the source is automatically transferred, without loss, to a separate contact. Any reasonable number of cue contacts can be multiplied to the input of a single cueing amplifier. This control allows performance of another very important function, transferring a microphone from the main system to a reverberation chamber, then restoring it to straight use, all without switching operations. Other uses will become apparent to the designer of speech input equipment. Its wide commercial acceptance by the trade will soon require its incorporation on any studio facilities offered to the broadcast station field by equipment manufacturers.

In closing this first part, some mention of the cost of the attenuators involved in a speech system seems in order. Generally speaking, they represent between 25 per-cent and 35 per-cent of the total cost of components of such an installation, so the engineer building his own gear can be guided accordingly. Whether the ladder or tee pad will be selected is a matter of both cost and amount of mixing loss that can be tolerated. With the present day use of silver alloy contacts, selected resistance wire or carbon resistances, proper soldering and quality control, the noises introduced by the controls themselves are in the order of 140 db. below a zero reference level of 6 milliwatts. Consequently the engineer must base his selection and choice of controls upon the needs of his system, as to amount of attenuation and fineness or gradation of control, and upon the amount of impedance change that can be tolerated.

NEW PRODUCTS

LABORATORY AMPLIFIER

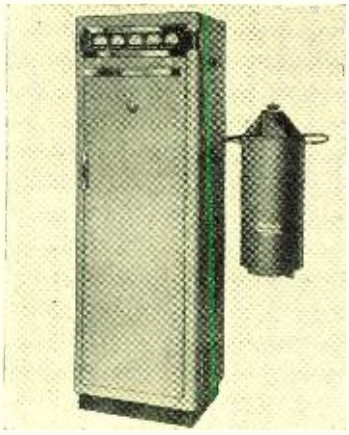
A laboratory amplifier incorporating the Scott dynamic noise suppressor is now being manufactured by *H. H. Scott, Inc.*, 385 Putnam Ave., Cambridge, Mass. Supplied with a matched variable reluctance pickup cartridge, the unit provides a complete phonograph system except for turntable and loudspeaker.



There is a 20 watt output with less than two per-cent distortion. Maximum frequency range exceeds 20,000 cycles—with the dynamic noise suppressor, response is flat to 10,000 cycles and extends to 16,000 cycles. Independent tone controls allow boost or attenuation at either end of the frequency range, and a whistle filter is provided for AM reception.

PRECISION CHANNEL LIMITING

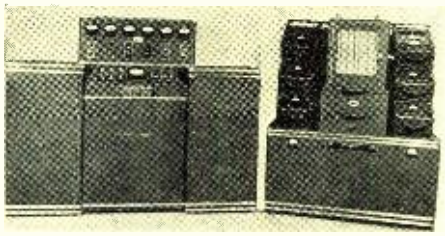
Precision channel limiting without cutting the channel width and sacrific-



ing high signal to noise ratio is accomplished by a high band pass filter of the cavity resonator type to suppress interference. The development of the cavity brings the principles of *Motorola Inc.'s* "Precision Selectivity" receiver system into the r.f. carrier system frequency of the 152-162 mc. band. The cavity resonator is designed to permit two transmitters to operate from a single antenna when channels are separated by 1 mc. or more. When used with receivers it will eliminate interference of high signal intensity from nearby stations. Inquiries should be addressed to 4545 Augusta Blvd., Chicago 51, Ill.

MULTICHANNEL DATA RECORDER

An electronic-magnetic multichannel data recorder has been developed by the *Cook Research Laboratories*, 1457 Diversey Parkway, Chicago 14, Ill. It is applicable to the recording of test or performance data of any kind that can be picked up electrically or audibly by a magnetic recorder. Specifications include an over-all drift of less than 2



per-cent and an over-all interpretation accuracy of ± 2 per-cent. Tape capacity is thirty minutes and the shock acceleration handling capabilities go up to 75 G's.

DISTORTION AND NOISE METER

The *Specialty Division of the General Electric Co.*, Electronics Park, Syracuse, N.Y., has produced a distortion and noise analyzer, type YDA-1, for broadcast, television, research, and developmental applications. The unit will measure percentage distortion down to 0.1 per-cent, measure the hum or noise in an audio signal, act as a high sensitivity vacuum tube voltmeter, and perform as a frequency meter over the range of 50-15,000 cycles. Weighing approximately 45 pounds, it is 21 x 10½ x 15 inches.

NEW POTENTIOMETER

Newest in the line of precision variable resistors produced by the *Technology Instrument Corp.* is the type RV3-5 potentiometer. It has standard features of precious metal contacts, two rotor take-off brushes, continuous 360 degree rotation, precision resistance

winding, and dust proof construction. The important improvement is the reduction in overall depth, measuring 15/16 inches. The power rating is 5 watts and it is available in nine standard resistance values ranging from 100 ohms to 50,000 ohms. Detailed information is available by writing to the manufacturer at 1058 Main St., Waltham 54, Mass.

LABORATORY MONITOR

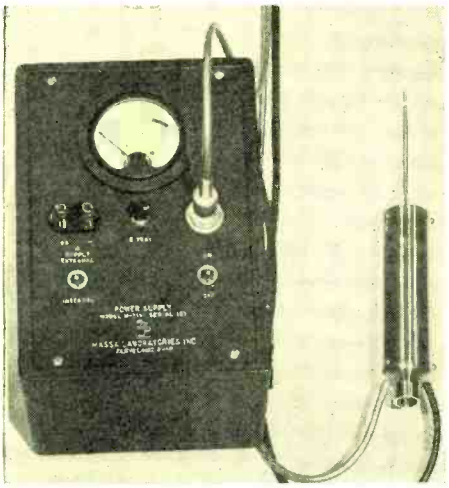
Model Su-3 has recently been developed by *Tracerlab, Inc.* for specific use as a routine contamination monitor in radio activity laboratories. It is a small, compact portable a.c. operated counting rate meter of moderate accuracy, with three full scale meter ranges of 200, 2000 and 20,000 counts per minute. It comes complete, equipped with a thin mica window, sensitive Geiger tube, enclosed in a probe connected by a four foot length of shielded

cable. Further data is available from the laboratory at 55 Oliver St., Boston 10, Mass.

SOUND PRESSURE MEASUREMENTS

Absolute sound pressure measurements can now be made over the complete audible and ultrasonic frequency range to 250 kc. Model GA-1005, manufactured by *Massa Laboratories, Inc.*, 3868 Carnegie Ave., Cleveland 15, O.,

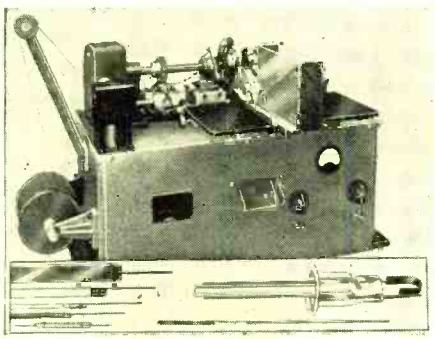
combines a standard microphone, a shock mounted preamplifier with a 25 foot output cable and a power supply unit and batteries for such measurement. Diffraction errors are completely eliminated beyond 20 kc. because the



microphone diameter is only ⅛ inch. Other data is available on request.

AUTOMATIC WELDER

An electronic welding and timing device is the newest machine designed to cope with the small, light parts difficult to process manually. In addition to decreasing the necessary amount of labor, the welder reduces shrinkage. Assemblies or small parts are fed to a



turret either by hand or automatically from a hopper. Components can be shaped so that welded parts leaving the machine are ready for assembly into the final product. The manufacturer is *Tweezer-Weld Corp.*, 1060 Broad St., Newark, N.J.

EL-3 EQUALIZER

A new EL-3 Equalizer has been developed by *Radio-Music Corporation,* Port Chester, N. Y. Designed for simplified operation plus fine reproduction, it affords high quality tone reproduction with both Vertical and Lateral recordings.

The EL-3 Equalizer uses one arm for Vertical and one arm for Lateral only on one turntable, or separate tables, by connecting both arms to the Equalizer. Switching the EL-3 Equalizer from Vertical equalization to Lateral allows changing from one arm to the other. At the same time, correct equalization is thrown in.

Both the RMC Vertical and Lateral reproducers can be replaced by the RMC universal head on either or both units.

For further information write to *Radio-Music Corporation,* Port Chester, New York, for Bulletin EL3-44.

SMOOTH POWER MOTOR

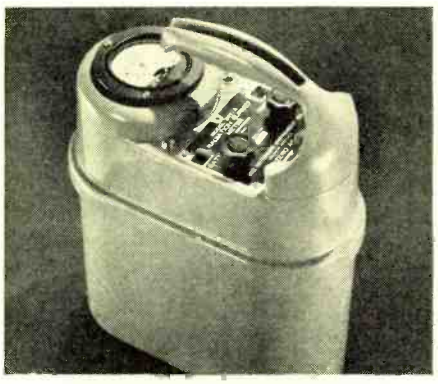
Redesigned to meet increased power requirements of wire and tape recording units, a RM-4 smooth power motor for general small motor applications was announced by the *General Industries Co.,* Elyria, Ohio.

The new model includes the addition of a bottom motor cover and special locating and locking means for both top and bottom covers, which assures high accuracy in alignment of rotor within the stator bore. Combined with dynamic balancing of each rotor, these features result in greater freedom from vibration, minimum noise and magnetic field radiation.

The motor is compact 3⅜ x 3⅜ x 2⅞-inches over the main body of the motor, and weighs 4½ pounds. It is a four pole, shaded pole induction motor, designed for 60 cycle a.c. operation at 115 volts.

GAMMA RADIATION METER

A gamma ray meter of the ionization chamber type, combining stable operation with rugged construction, has been designed primarily for field surveys. The portable meter has four ranges of



sensitivity and is calibrated to read in roentgens over full scale readings of 2.5, 25, 250 and 2500 milliroentgens per hour. The case is watertight and the entire unit hermetically sealed. A color code is provided with the range switch for visual indication of the range at

(*Continued on page* 26)

Television

LARGE SCREEN TELEVISION

Projection television featuring a variable size picture that can be increased to theatre screen dimensions has been developed by *Tradio, Inc.*, As-

bury Park, N.J. It includes an aluminum screen, a projection unit mounting of tube and lens and a control unit housed in a compact rack case; the whole known as Tradiovision. The control unit may be completely divorced from the projector, making it possible to hook up several projector units to one master control.

TELEVISION CAMERA

A streamlined fifty-six pound television camera, believed to be the lightest television camera ever built for studio applications, has been developed by the Transmitter Division of the *General Electric Company's* Electronics Department at Syracuse, N. Y.

Equipped with a turret of three lenses, the new camera is mounted on a mobile dolly and may, because of its weight and specially designed head, be operated with fingertip control. Though the camera is designed primarily for studio work, it may be adapted to operate over greater distances with a telephoto lens.

The camera will produce acceptable pictures at 50-foot-candles and f/3.5. Smaller stop openings may be used for greater depth of focus if 100-200 foot-candles are supplied. The unit employs an optical view-finder.

REFLECTIVE TYPE OPTICAL SYSTEM

Television screen images having six to seven times the illumination that can be transmitted by the highly efficient f/2 lens system are being reproduced by a reflective type optical system. Concave spherical glass reflectors, machine pressed in cast iron molds like oven glassware, have an important part in solving the problem of transmitting enough light from the cathode ray projector tube to the screen for good visibility and satisfactory magnification. Such reflectors, made by *McKee Glass Co.*, Jeannette, Pa., have recently been incorporated in television sets for commercial and home use.

DUAL ICONOSCOPE FILM PICKUP

The *Television Equipment Division* of *Allen B. du Mont Labs, Inc.*, 42 Harding Ave., Clifton, N.J., announces the dual iconoscope film pickup system. Housed in metal cabinets, the units are floor-

mounted or mounted on a track attached to the wall, allowing rapid positioning. The control console is built in sections, all units being mounted on sliders which facilitate access to components, tubes and wiring. The controls on the panels are laid out in four arcs and the over-all frequency response is flat up to 6 megacycles, permitting excellent picture resolution.

TV RECORDING CAMERA

Eastman Kodak Co., Rochester 4, N.Y., announces a 16 mm. motion picture camera for recording television programs on film. The first of its kind, it produces movies directly from the face of the monitoring "picture tube" in a television broadcasting station. Developed in collaboration with the *NBC* studio at station WNBT and the *Allen B. du Mont* studio at station WABD, it is expected to facilitate reuse of programs, keeping records for legal use, and rebroadcasting for a potential film network of television.

BEYOND HORIZON TELEVISION

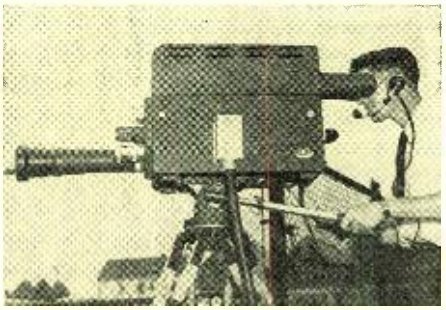
Expansion of television service to communities beyond the horizon, and even to homes in valleys cut off by mountains from the primary transmitting antenna, has been proven practicable by tests conducted recently by Station WBRE of Wilkes-Barre, Pa., with the cooperation of NBC and RCA Victor.

Television signals picked up by a mountain-top antenna from the WNBT transmitter in New York, 105 miles away, were successfully amplified and carried by an RCA microwave television relay system to six RCA Victor television receivers in the WBRE booth at the Wyoming Valley Parade of Progress in the Field Artillery Armory at Kingston.

The Wilkes-Barre experiment constituted a pioneer test of repeater-type television station operation, and was one of the first in which microwave relay equipment was used to carry television "over the hump" by beaming it from an elevated receiving antenna down to receivers or a rebroadcast transmitter in an area ringed by mountains.

ORTHICON CAMERA

Developed and manufactured by *Allen B. du Mont Laboratories, Inc.*, 2 Main Ave., Passaic, N.J., a new image-orthicon camera features a super-sensitive image-orthicon pickup tube, a lens turret of four lenses of various focal lengths and controls concentrated at the rear of the camera. It also in-



corporates the electronic viewfinder, wide voltage control, and an intercommunication system for the studio or outside crew. Further information on the television camera may be secured by writing the laboratory.

G-E TELEVISION TRANSMITTER

General Electric, Electronics Park, Syracuse, N. Y., has developed new television transmitters, types TT-6-A

(*Continued on page* 28)

Liquid Dielectrics

(*Continued from page 9*)

$\omega = 2\pi f$ (where f is the frequency of measurement, cycles)

L = series inductance of leads

C = true capacity (corrected for series resonance effect)

Q_m = apparent high frequency Q (as measured on Q meter).

Results of Tests

When properly processed, all fluids tested are able to withstand 8500 volts (peak) at 2500 kc. This measurement is made with an APC type capacitor having a gap between plates of 0.025 to 0.030 inches at an ambient temperature of 25°C. Repeated flashovers when voltages in excess of 8500 are applied cause no damage if severe arcing is not permitted to take place. Thus if the circuit is protected by a limiting device, the capacitor may withstand an indefinite number of individual breakdowns without permanent injury.

When the capacitor is initially placed in service one or two preliminary sparks may be observed to take place at lower potentials than noted above. However, these breakdowns are harmless and are part of a process known as cataphoresis. This has been noted by many observers.[11] It seems that residual impurities are cleaned up by the action of the electric field.

It is found that liquids which have not had all moisture removed suffer a reduction in dielectric strength below a temperature of 0°C. A small amount of moisture in the liquid will cause spark-over at 8500 volts in the above gap. Moisture has very little effect from 0°C. to +85°C.

Although liquids are commonly assumed to be incompressible, it has been found that the dielectric strength varies to a large degree with the external pressure. Removable of atmospheric pressure by means of a vacuum pump applied to the test capacitor caused the breakdown voltage to decrease from 8500 to 3000 volts. According to Schwaiger, the breakdown voltage of oil increases about 90kv/per cm. per atmosphere. It is thus very desirable to maintain a pressure in the capacitor no lower than atmospheric and if possible to increase the value to the maximum practicable.

The addition of water (2 drops to 1 pint of fluid) has the effect of reducing the breakdown strength from 8500 volts across 0.025 gap to 6000 even after the mixture is thoroughly agitated to simulate distributed moisture. This test is performed above 0°C.

After the addition of two drops of water as above, a pinch of dust was sprinkled into the liquid, and the mixture agitated to distribute to impurities. The dielectric strength fell from 6000 to 2800, showing that the dust problem is normally much more important than the moisture problem. With the addition of 15 pounds per sq. inch of pressure, the breakdown was decreased to 4300 volts.

Due to the number of variable factors involved in the processing and handling of dielectric fluids it is desirable to have the actual working voltage of the capacitor far below the ultimate strength of the dielectric. It is intended to operate a capacitor with 0.025 to 0.030 spacing at 2500 peak volts. This gives a factor of safety of about 5 to insure reliability under any condition of operation. Schwaiger[9] recommends a maximum working gradient of 50 kv. per centimeter.

The selection of any one liquid for a given application will in general be a compromise depending upon the particular application. For example, the most desirable liquid considering losses and capacity would undoubtedly be the *Dow-Corning* Fluid No. 500. However, inspection of the percent capacity change over the operating range will prevent the use of this material unless the temperature can be kept constant.

The ordinary transformer oils, of which 10-C Transil Oil is a good example, has one outstanding disadvantage, namely, in the temperature range 0 to −30° C., the Q falls to an extremely low value. This would be detrimental to the operation of transmitting equipment since the power output will decrease. While it is possible that the internal heat generated due to the increased loss would tend to correct this condition, the time taken for the Q to recover may be excessive. Of the mineral oils, *Gulf* Instrument Oil "A" represents the best material of those tested. Its usefulness is impaired by the low value to which Q falls at low temperatures.

REFERENCES

1. *Bureau of Standards circular No. 74.*
2. *GE Review, April 1928, "Liquids as Insulators."*
3. *F. W. Peek, "Dielectric Phenomena in High Voltage Engineering," Chapter on Oil.*
4. *M.I.T. Report V, February 1944 "Tables of Dielectric Materials," Contract OEMsr-191.*
5. *M.I.T. Progress Report, Dec. 1942 on Dielectric Materials for Ultra-High Frequency.*
6. *A. Gemant, "Liquid Dielectrics," John Wiley, 1933.*
7. *Attwood, "Electric and Magnetic*
8. *"Industrial Petroleum Naphthas," Gulf Refining Co.*
9. *Schwaiger, "Theory of Dielectrics," page 41, John Wiley, 1932.*
10. *Selas Corporation of America, Phila., Pa., booklet on "Physical Separations of Immiscible Fluids Through Porous Materials by Means of Surface and Interfacial Tension."*
11. *Pender-McIlwain, "Handbook for Electrical Engineers," Liquid Dielectrics.*
12. *Dielectric Phenomena II, "Electrical Discharges in Liquids," S. Whitehead, 1928. Ernest Benn, Ltd., London.*

Personals

CHARLES FRANCIS ADAMS, JR. has been elected president of *Raytheon Manufacturing Company*, Waltham, Massachusetts. He replaces Laurence K. Marshall, who has been elected chairman of the board. Mr. Adams was a director of *Raytheon* for several years prior to entering the Naval Service during the war. He has been a director since May, 1946 and executive vice-president since May, 1947.

E. G. F. ARNOTT has been appointed assistant director of research for the *Westinghouse Lamp Division*. He joined the company in 1932 after being an instructor of physics at Princeton for two years, and has been a factory engineer in electronic tube manufacturing, an electronic engineer, and later a member of the research staff. Mr. Arnott is a specialist in the study of gas discharges for fluorescent lamps and electronic tubes.

DONALD H. COOPER, staff member of *NBC* station WRC in Washington, D.C. since 1928, has been appointed chief engineer. He is responsible for all *NBC* Washington broadcasting plant facilities and the engineering staff of WRC, WRC-FM and television station WNBW. Mr. Cooper is a graduate of the George Mason School and Loomis Radio School and was formerly employed by the *Independent Wireless Co.* and the *RCA Marine Division.*

R. P. LAMONS has joined the *Federal Telephone and Radio Corp.* as the District Representative for broadcast equipment. His territory will cover Illinois, Indiana, Michigan, Ohio, Kentucky, Minnesota, Wisconsin, Missouri and Kansas. Mr. Lamons was formerly associated with the *Western Electric Co.*, in radar equipment and with the *Andrew Corp.* as Eastern Representative. He is a graduate of the Illinois Institute of Technology.

DONALD W. PUGSLEY, designing engineer for *General Electric* television receivers, was awarded honorable mention as "an outstanding young electrical engineer" by Eta Kappa Nu, electrical engineering fraternity. The award is based on accomplishment in engineering, social, and community activities as well as cultural and educational endeavors. Mr. Pugsley has been associated with the *General Electric Company* for thirteen years.

IRVIN R. WEIR has been named the new designing engineer of the transmitter division of *General Electric* at Electronics Park. Formerly section engineer, with complete responsibility for engineering and drafting activities at the Syracuse plant during the war, he will now be in charge of the design of all Transmitter Division products. Mr. Weir entered the employ of the company in 1921 and is a senior member of the Institute of Radio Engineers.

New Products

(*Continued from page* 23)

which the survey meter is set. *Victoreen Instrument Co.*, 5906 Hough Ave., Cleveland 3, O., designed and manufactures the tool.

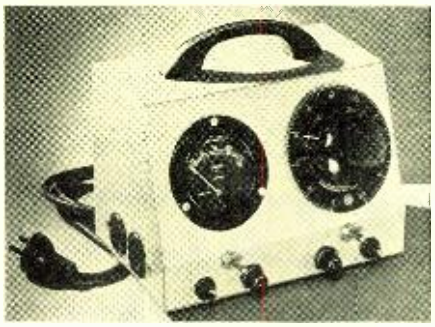
DEPTH SOUNDER

Trident Products, Inc., 110 W. Alameda St., Burbank, Cal., announces a new all electronic depth sounder designed for commercial craft and yachts

of moderate size. As many as five repeaters may be connected to the master indicator and the sounder may be operated from 6, 12, 32, or 110 volts d.c. Power drain is 30 watts and depths to 100 fathoms, or 600 feet, are continuously indicated on a large indirectly illuminated scale.

PORTABLE VOLTAGE CONTROL

Completely self-contained, measuring 9 x 8 x 7 inches and incorporating a 405 watt variable auto-transformer and a 0-150 voltmeter, this new portable voltage control is suitable for laboratory control or research work. Four plug-in load receptacles eliminate the need for tedious wiring jobs which would ordinarily be necessary in improving a hook-



up of variable auto-transformer, voltmeter and load. The instrument is produced by *Andrew Technical Service*, 111 E. Delaware Pl., Chicago 11, Ill.

TEMPERATURE CONTROLS

A series of inexpensive temperature controllers has been designed recently. Only a small portion of current is allowed through the heating elements, enough to maintain definite temperatures, no resistance is used—so no cur-

rent is wasted. Available with or without pyrometers, these stepless input controllers are suitable for electric and gas furnaces, ovens, pots and similar

applications. Inquiries should be directed to the *K. H. Huppert Co.*, 6830 Cottage Grove Ave., Chicago 37, Ill.

POWDER-IRON PRODUCTS

A variety of powder-iron cores, core assemblies, coil assemblies and filter units in several types are being offered by *Lenkurt Electric Co.*, 1115 County Rd., San Carlos, Calif. The firm specializes in parts requiring extreme temperature and magnetic stabilities, emphasiz-

ing production control. Parts can be supplied in any powder desired, but three standard materials are listed: they cover frequency ranges of 100 cps. to 90 kc., 50 kc. to 5 mc. and 1 mc. to 200 mc.

REGISTRATION CONTROL

A registration control for use with packaging machines using web-fed wrappers has been developed by the *Ripley Co., Inc.*, of Middletown, Conn. It is said to be so sensitive that correction in the positioning of wrapping material is possible on low color contrasts as red or brown on yellow.

The control consists of a scanner and amplifier and built-in relay with connections provided so that the cam on the feed of the packaging machine automatically corrects the position of the label whenever the web of material gets out of register due to slippage or stretching. Because of the sensitive circuit, the same method of scanning may be used for opaque, translucent or transparent material. The control operates at 750 per minute with correction on any sequence of registration marks such as every 5th, 10th, etc.

Protelgram

(*Continued from page* 11)

sealed under high vacuum: three special miniature rectifier 1Z2 diodes, transformer coil, high-voltage condensers and core pieces of "Ferroxcube," Philips' newly developed low loss magnetic material.

The triode section of the 6SR7 acts as a 1000 cycle sawtooth oscillator and drives the 6BG6G. This 6BG6G is biased near cutoff and produces 1000 cycle peak voltages in the plate circuit, which is part of the high-voltage transformer primary. The 1000 cycle 6BG6G plate pulses, which are almost equal to its maximum emission, start a 25 kc. train of damped oscillations because the transformer is tuned to approximately 25 kc. The first oscillation peaks of about 8.5 kv. charge the tripler circuit filter condensers and are rectified by the three rectifier-diodes. By connecting the 8.5 kv. output of each rectifier stage in series, 25.5 kv. is obtained.

Filaments of the three rectifier tubes, requiring 0.5 watt each, are fed by subsequent oscillation peaks from three separate secondary windings.

Part of the 25 kc. voltage is used as a negative feedback voltage which, after rectification by the two diode sections in the 6SR7, is supplied to the 6BG6G control grid. Thus, the amount of current through the high-voltage transformer primary can be controlled to improve the external 25 kv. regulation characteristic.

Three input connection wires are required for ground, filament, and 350 volt B supply.

Input requirements call for a heater supply of 6.3 v. a.c. at 1.2 a., one side grounded, and a plate supply of 350 volts at 50 ma, with 150 microamperes high voltage drain.

Typical output performance figures, with constant input supply voltages are 25.5 kv., ± 2 kv. at no load, a voltage drop of less than 600 v. at 60 microamperes drain and less than 1200 v. at 125 microamperes drain.

The high voltage unit can be mounted in various specific positions (according to manufacturer's mounting specifications for the 6BG6G) within a distance from the second-anode contact of the 3NP4 tube in the projection box, which is limited by the length (15 inches) of its insulated second-anode connection cable.

Television

(*Continued from page* 24)

and TT-6-B with a 5 kw. visual transmitter and a 2½ kw. aural transmitter, incorporating the well known phasitron modulator, for operation on television channels 1 through 13. Both transmitters meet or exceed the present FCC and RMA standards.

MULTIVISION VIEWERS

The problem of a clear, comfortable view of television at a distance has been solved by *Industrial Television, Inc.*, 359 Lexington Ave., Clifton, N.J. They have produced a unit called multivision

viewer, a large-screen viewer which can be attached to a small-screen receiver, thus avoiding the cost of a large receiver. One or more viewers can be attached, and the remote control permits the unit to be in the most advantageous position.

TV ANTENNAS

A solution to the problem of apartment house owners and their tenants who want good television reception without spoiling the appearance of the apartment house roof is offered by the Engineering Department of the Radio Manufacturers Association in a booklet released recently.

The proffered solution, the booklet explains, "has been found in a Distribution System which uses an antenna or combination of antennas, an amplifier, cables, and an outlet box for each apartment.

"The antennas are mounted on the rooftop and are oriented or 'sited' at the time of installation so as to give the best reception for each station in the vicinity. Where strong signals from the transmitter are available—such as might be the case in the center of a city—or where there are only a few receivers drawing from the system, amplifiers may not be required.

"Individual apartments are connected to the system or the amplifier, if one is being used, by means of a low-loss transmission line connected through conduit to the various apartments, each equipped with a connection box similar to an ordinary wall outlet."

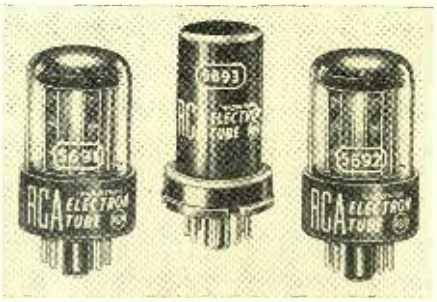
NEW TUBES

RCA TUBES

SMALL ELECTRON TUBES

RCA's new "Special Red" tubes, 5691, 5692, 5693 are small type tubes specifically designed for those industrial and commercial applications requiring tube features of exceptional uniformity and stability and rigidity of characteristics to resist shock and vibration. The "girder" construction holds internal elements rigidly in adjustment, and a prolonged seasoning process minimizes changes in characteristics during operation. The tube has a minimum life specification of 10,000 hours, or about 14 months of continuous round-the-clock service.

The "Special Red" tubes are recommended, in general, as replacements for the 6SL7-GT, 6SN7-GT and 6SJ7. A technical booklet, RSB 1000, providing detailed descriptions and operating data for the tubes, is available upon request



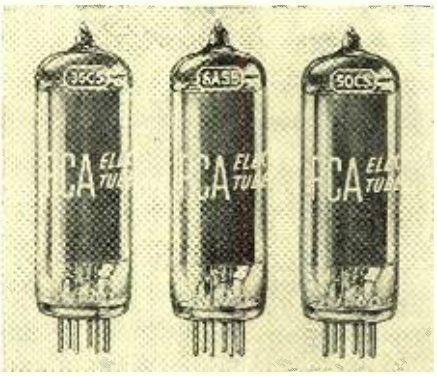
from the *RCA Tube Department, Commercial Engineering Section*, Harrison, N.J.

TUBE SOCKETS

Electronic tube sockets for transmitting and industrial tubes have been made available by the *Tube Division of General Electric Company's Electronics Department* at Schenectady, N.Y. The sockets, in a wide range of sizes, include panel-mounted and chassis mounted styles and are built to NEMA specifications. The body is molded in one piece from BM120 black bakelite, with barriers for insulation and creepage paths. Contacts are constructed from phosnic bronze, with four lines of contact for the length of the whole pin.

MINIATURE TUBES

Three new tubes, the 6AS5, 35C5 and the 50C5 are being produced by *RCA*. The 6AS5 is intended for use in the output stage of low-cost automobile and a.c. operated receivers. It is capable of delivering 2.2 watts at the relatively

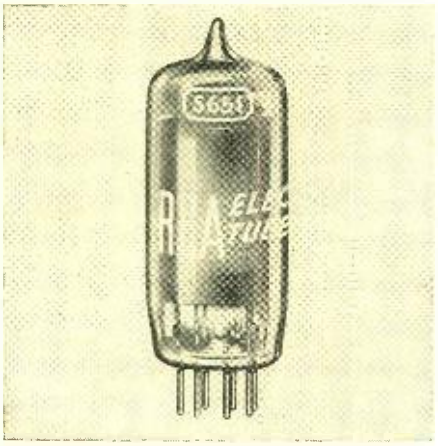


low plate and screen voltages of 150 and 110 volts, respectively.

The 35C5 and 50C5 are intended for use in the output stage of a.c.—d.c. receivers. They are designed with high power sensitivity and high efficiency, being capable of providing 1.5 watts and 1.9 watts, respectively, with 110 volts on plate and screen.

VOLTAGE-REFERENCE TUBE

The 5651 is a miniature, voltage-reference tube of the cold-cathode, glow-discharge type, designed for extreme voltage stability. Voltage fluctuation at any current value within the operating-current range of 1.5 to 3.5 milliamperes is less than 0.1 volt. The 5651 main-



tains a d.c. operating voltage of approximately 87 volts, this characteristic being essentially independent of ambient temperature. More information can be obtained from the *RCA Tube Department*, Harrison, New Jersey.

APRIL

1-3 incl.—**AIEE** Great Lakes District Meeting, Des Moines, Iowa.

7-9, incl.—**Midwest Power Conference,** Stevens, Hotel, Chicago.

17—**Chicago IRE Conference,** sponsored by the Chicago Section of the Institute of Radio Engineers; to be held at the IIT campus.

24—**Television Conference,** sponsored by the Cincinnati Section of the Institute of Radio Engineers.

26-28 incl.—**IRE-RMA Spring Meeting** on Transmitters, Syracuse Hotel, Syracuse, N. Y.

28-30 incl.—**AIEE** North Eastern District Meeting, New Haven, Conn.

MAY

11-14 incl.—**Radio Parts and Electronic Equipment Conference and Show,** Stevens Hotel, Chicago.

22—**New England Radio Engineering Meeting** sponsored by North Atlantic Region of IRE, Hotel Continental, Cambridge, Mass.

21-25 incl.—**AIEE** Summer General Meeting, Mexico City, Mex.

SEPT.-OCT.

Sept. 30-Oct. 1-2 incl.—Pacific Electronic Exhibition, Biltmore Hotel Ballroom, Los Angeles, Calif.

* * *

MONTHLY MEETINGS

Institute of Radio Engineers, Chicago Section. Don Haines, Secretary, CAPitol 6500.

Dinner, 6:00 P.M., Bolling's Restaurant, ground floor of the Engineering Building, 205 W. Wacker Drive. Price $1.75 per plate. Call Don Haines for reservations. Program, 7:15 P.M., Engineering Auditorium, second floor of the Engineering Building.

April 17—Annual Chicago IRE Conference, see announcement above. This Conference takes the place of the regular meeting.

American Institute of Electrical Engineers, Chicago Section. F. D. Troxel, Secretary, FRAnklin 7130.

Program, 7:00 P.M., 6th floor Assembly Hall, Civic Opera Building, 20 N. Wacker Drive.

April 22—Electronics Group—"Fluorescent Lamps and Electronic Behaviour" by Charles Stover, District Engineer, Midland Sales District, *G.E. Co. Lamp Dept.*, Chicago, Ill.

Bead-Supported Atten.

(*Continued from page* 14)

tolerances permit. The insert used for the 6 db. attenuator is of the continuous film design (see Fig. 4). The 20 db. unit, whose performance curves are shown on Fig. 5, is a compensated film design. All are 6" in over-all length of insert.

In order to allow widest general application of the attenuators and yet permit broad band coverage, special type *N* couplings were employed with a jack situated at one end and a plug at the other, as shown in Fig. 2. The couplings will mate with standard Army-Navy type *UG* 21 *B/U* and *UG* 23 *B/U* couplings, but require special bead supports in each of the mating units in order to give the desired broad band performance.

The cross-section of the "grooved" bead support is shown in Fig. 6A. For the major section of the bead length, *S*, the ratio of outer to inner diameter is arranged to give the same characteristic impedance for this dielectric filled line as for the standard lossless line. The outer diameter of this bead, however, is greater than the inner diameter of the outer conductor of the casing, resulting in the appearance of field distortion and added lumped capacitance [2] at the metallic discontinuity in the outer conductor. This is evident from an inspection of Fig. 2. These capacitive discontinuities are responsible for sizeable mismatch in the neighborhood of 10,000 mc. To compensate for this effect, grooved bead sections of thickness, *d*, acting effectively as inductances, are arranged to cancel the reactance produced by the discontinuity at each end of the bead. The scheme for this cancellation is shown in the admittance locus of Fig. 6B. The discontinuity capacitance represented by the length $Y_o d$ is cancelled by a short travel, *db*, in the grooved section which is a transmission line of lower characteristic admittance, Y_1. The remaining mismatch produced by the admittance *Ya* is a very small fraction of the discontinuity susceptance. Since the length, $Y_o d$, varies linearly with frequency and the length, *db*, nearly so, this cancellation is very broadband.

Fig. 6C illustrates the bullet used to terminate the attenuator insert. Section *ab* of this bullet is greater in diameter than the main line in order to permit the metallized-glass to be slipped in and soldered securely. Although the capacitive discontinuity is small, this oversized section represents a line whose characteristic impedance differs from Z_o, the lossless characteristic impedance of the main line. Hence, a mismatch is introduced which is especially noticeable at 10,000 mc.

Cancellation of this effect is accomplished by a neighboring reduced diameter section, *bc*. The admittance locus trace is shown on an exaggerated scale in Fig. 6D. The length of arc *ab* which is the result of the enlarged section of characteristic admittance Y_1 is cancelled by the length of arc *bc* resulting from the reduced diameter section of relatively low characteristic admittance Y_2. This cancellation is also inherently broad band, since the length of traces *ab* and *bc* vary in a similar manner as the frequency changes.

The complete mechanical design of an attenuator insert and casing for the frequency band 4,000-10,000 mc. is shown in Fig. 2. The attenuations of the units designed by the procedure outlined in this paper are 3, 6, 10, and 20 db. All inserts fit interchangeably in the casing of Fig. 2.

Figs. 4 and 5 show the experimentally determined attenuation and VSWR characteristics of two of these units. The variation in attenuation for any of the units is less than 0.012 db. per db. of nominal attenuation, per cm. of wavelength band spread. In no case does the VSWR measure more than 1.30 over the entire band. It will be noted that the VSWR curves only

roughly follow the theoretical shape indicated by Figs. 3B and 3D. This is mainly due to the effect of the type N couplings and .bullets discussed earlier in this paper. The effect of these components is emphasized at the high frequencies where the VSWR curve shows peak values for all the units.

REFERENCES:

1. *Griemsmann, J.W.E., "Metallized Film Coaxial Attenuators," a paper presented at the Rochester Fall Meeting of the I.R.E.*
2. *Whinnery, Jamieson, and Robbins, "Coaxial Line Discontinuities," Proceedings of the I.R.E., Vol. 32, No. 11, Nov. 1944.*

Delay Lines

(*Continued from page* 18)

L_o and C_o are determined from a knowledge of the required characteristic impedance, which is equal to $\sqrt{L_o/C_o}$, and the cut-off frequency, which is equal to $0.404/\sqrt{L_oC_o}$. The characteristic impedance of the line is selected so that it matches the circuit in which it is to be used. Where there is an option the characteristic impedance should be made as low as possible. This follows because the lower L is, or conversely the higher C can be made to give a particular $\sqrt{L_oC_o}$ value, the smaller the size and attenuation of the line. For generally the higher L is the greater the size and attenuation of the line, while the value of C, within reasonable limits, has very little effect upon either of these two parameters. Consequently C_o is made as large as possible being limited, for any given f_o, by the required characteristic impedance.

The cut-off frequency is determined from the knowledge of the pulse shape. It was shown in a previous article that a "rule of thumb" method for calculating the bandwidth or maximum frequency of a pulse is to set the maximum frequency equal to $1/2t_1$, where t_1 is the build-up time. The cut-off frequency of the network is then set at 1.33 to 2 times $\sqrt[3]{n}$ times the maximum frequency.

To review briefly, the following are the design formulae for an m-derived type of artificial line for $m = 1.275$:

$$T = 0.404/f_o \quad \text{(a)} \qquad L_o = Z_o/\pi f_o \quad \text{(b)}$$
$$C_o = 1/\pi f_o Z_o \quad \text{(c)} \qquad L = 1.04\,L_o \quad \text{(d)}$$
$$C = 1.275\,C_o \quad \text{(e)} \qquad M = 0.013\,L_o \quad \text{(f)}$$
$$k = 0.12 \quad \text{(g)} \qquad n = T'/T \quad \text{(h)} \qquad (25)$$

where T' is the total delay

From experience, the following procedure has been developed for the design of this type of line.

1. A suitable value of characteristic impedance is chosen, consistent with the circuit requirements.

2. From a knowledge of the pulse shape, for which the line is to be used, the maximum frequency to be transmitted is determined. The cut-off frequency of a line cell is then taken to be from 1.33 to 2 times this maximum frequency.

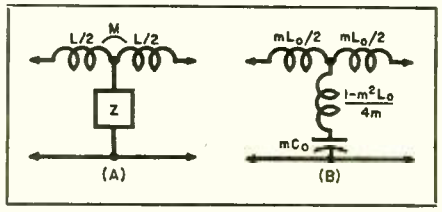


Fig. 8. Single cell of a lumped line which has mutual coupling between successive coils. Takes form of an m-derived filter.

3. From the calculated value of f_o, the delay of one cell of the line is determined by means of Eqt. (25a).

4. The number of cells necessary to provide the total delay is found from Eqt. (25h). The cut off frequency of each cell must then be multiplied by $\sqrt[3]{n}$. This, of course, reduces T so that additional cells may be required. This process is repeated until a value of f_o, consistent with bandwidth and total delay requirements, is found.

5. From Eqts. 25, the constants of the line are calculated. Since only standard values of capacitors can be used, the nearest standard value should be chosen, after which revised values of L_o and Z_o are calculated.

6. Both ends of the line should be terminated in a half pi section with m equal to 0.6. However, reasonably good termination may be obtained by terminating the ends with capacity equal to $C/2$.

Construction of the Line

For lines having small delay or lines with a low characteristic impedance (less than 1000 ohms), and high cut-off frequency, where physical size is not the prime consideration, the inductive portion may be made up of a single layer, continuously wound solenoid. For longer delays it may be more convenient to make up the inductance in the form of a multilayer coil usually wound in the universal manner.

The formula for the number of turns, N, necessary to provide a given inductance, L, for a single layer solenoid is:

$$N = \left(\frac{42.9L}{a}\right)^{1/2} \qquad (26)$$

PHOTO CREDITS

Pages
3.....Altec Service Corp.
4, 6.....Tech. Laboratories
5, 21.....The Daven Company
7.....Radio Corporation of America
10, 11....N. American Philips Co., Inc.
12.....Polytechnic Inst. of Brooklyn
15 (top, bottom), 16, 17.....Federal Telecommunication Laboratories
15 (lower top)....General Electric Co.

where L is the inductance per cell in microhenrys and a is the radius of the coil form in inches.

In order to achieve the proper coupling between coils so that k equals 0.12, the condition that l/d equals 1.7 must be satisfied, where l is the length of one cell inductance and d is the diameter of the coil form.

For multilayer coils, the number of turns may be found from:

$$N = \left(\frac{30.8L}{D}\right)^{1/2} \qquad (27)$$

where D is the inside diameter of the coil, i.e., the diameter of the rod on which the coils are to be mounted. Both the width and the height of the coil winding should be equal to $D/2$. The number of turns per square inch of coil area may be found in the wire tables given in electrical handbooks.[3,4] The wire size is chosen from these tables to fit into the required space. If the wire size given is impractical, then the value of D must be changed accordingly.

The coils should be spaced on the supporting rod in such a manner as to make the coupling coefficient between successive coils equal to 0.12. This value may be found by measuring the inductance of one coil with the adjacent one first open circuited, and then short circuited. The spacing is adjusted until:

$$\frac{L_{sc}}{L_{oc}} = 0.986 \qquad (28)$$

where L_{sc} is the short circuited inductance and L_{oc} is the open circuited inductance.

When the proper spacing is determined, spacers having a thickness equal to the coupling distance may be made and used as guides for the coils to be mounted on the rod.

Attenuation in Lumped-Constant Delay Lines

The attenuation of a lumped-constant line is not an important parameter as long as the number of cells is not large. However, when the line consists of more than about fifteen cells, the attenuation may become an important factor in the design and operation of the line. Attenuation in a line may be due to several causes, i.e., losses due to wire resistance, losses in the condensers, and losses in the coil core material. At the usual pulse frequencies, the dielectric losses may be neglected, and in fact, for frequencies up to 15 mc., experience indicates that any losses that do occur are nearly entirely due to the d.c. resistance of the wire.

As in Eqt. (3), the attenuation is the real part of the propagation constant, and from this we may derive that:

$$\alpha = 1.91 \frac{}{f_0}\left(\sqrt{1+1/Q^2}-1\right)^{\frac{1}{2}}$$

nepers per cell . . . . . (29)

where $Q = 1.42 \frac{\omega L_0}{R_{dc}} = \frac{\omega L(1+2k)}{R_{dc}}$

L is the inductance of one cell and R_{dc} is the d.c. resistance of one cell.

The value of Q may be found in terms of the number of turns, N, characteristic impedance, Z_0, and the cut-off frequency, f_0, from:

$$Q = 1280 \frac{F^3\sqrt{n(Z_0/f_0)}}{R_n} \quad . . . . . (30)$$

where R_n is the resistance per 1000 feet of wire.

If Q is large compared to 1, which is usually the case, then Eqt. (29) reduces to:

$$\alpha = 0.00106 \frac{R_n}{\sqrt[3]{N(Z_0 f_0^2)}} \quad . . . . . (31)$$

From this equation it can be seen that at high frequencies, where Q is large, the attenuation is constant and depends upon the wire size used.

In designing the line, a cut-and-try method is used. The values of L and C are calculated, after which a size of wire is chosen to fit the required physical dimensions of the line. The attenuation of the line is then calculated. If it is excessive, a larger wire size is chosen. To use this wire, the physical dimensions, characteristic impedance, or cut-off frequency must be changed to be consistent with the other electrical requirements of the line.

Supersonic Delay Lines

At the present time, pulse delays greater than 100 microseconds are difficult to obtain by purely electrical circuits because of the large physical size that such a line assumes. It is conceivable, however, that improvements in high dielectric materials will make the development of such long delay lines practical.

An alternative method of obtaining long delays is to transform the electrical pulse into a supersonic wave, in the form of compressional vibrations, which travels through the medium with a relatively low velocity. The delay per unit length of the medium will thereupon be relatively high.

The velocity of propagation of a supersonic wave is given by:

$$v = \sqrt{E/P} \quad . . . . . (32)$$

where E is the Young's modulus of the medium, and P is the density of the medium.

It should be noted that an analogy exists between the electrical and acoustical lines with the inductance and capacitance being replaced by the reciprocal of Young's modulus and the density.

The acoustical lines are also analogous to the electrical ones in that the same parameters are of importance, i.e., delay time, characteristic impedance, attenuation and cut-off frequency. Unfortunately this art has not progressed to the point where complete design equations have been evolved and frequently a cut-and-try method provides the best approach.

A supersonic delay line consists of a transducer, which converts the electrical energy to acoustical energy, a medium through which the compressional vibrations travel, and another transducer which reconverts the acoustical energy to electrical energy. As may be expected, the maximum conversion efficiency is obtained when the transducer impedance matches the line impedance.

There are a number of transducers and mediums that can be used. The most common of these is the mercury-quartz combination in which the quartz transducer has a high acoustical impedance approximately equal to the mercury medium. Consequently adequate coupling is readily obtained.

The time delay of mercury lines is given by the following expression:

$T = (17.42 + 0.0052\,^{\circ}C)$ microsec./in. (33)

where °C is the temperature of the mercury in °C, so that at 20°C., the delay per inch of a mercury line is 17.52 microseconds. The variation of delay with temperature may be objectionable in some applications, in which case the mercury lines must be kept at a constant temperature by carefully controlled thermal devices.

The theoretical determination of the attenuation of mercury lines cannot be readily made since the causes of this attenuation are not completely understood. It is known, however, that the losses due to the medium alone increase as the square of the frequency. In addition, there are other effects such as the "wall effect" which increases the attenuation as the square root of frequency and inversely as the diameter of the mercury tube. In a typical 0.25" diameter mercury delay line, the attenuation is .27 nepers per foot.

The line is so constructed as to avoid reflections at the ends. This is achieved by inserting a material such as lead or ceramic at the ends of the tube containing the mercury (behind the quartz plates).

The disadvantage of mercury lines lies in the fact that an elaborate construction is necessary, and once constructed only a single value of delay may be obtained from it; that is, it cannot be tapped or shortened. Recent investigation into the use of magnetostrictive effects, i.e., contraction and expansion of a metallic rod in accordance with a voltage applied across a coil surrounding the rod, for obtaining supersonic waves, indicates that this type of line may be more flexible. The delay of these lines can be adjusted to suit individual applications and may be tapped with ease.

BIBLIOGRAPHY

1. *Moskowitz and Racker, "Pulse Amplifier Design," Radio-Electronic Engineering Feb. 1948, p. 14.*
2. *Moskowitz and Racker, "Pulse Shaping Circuits," Radio-Electronic Engineering March, 1948, p. 14.*
3. *Henney, K., "The Radio Engineering Handbook," McGraw-Hill, 1941, p. 10-13.*
4. *"Reference Data for Radio Engineers," Federal Telephone and Radio Corporation, 1946, p. 35, 126.*
5. *Moskowitz and Racker, "Pulse Techniques." Radio-Electronic Engineering, Jan. 1948, p. 7.*
6. *Saarbacher and Edson, "Hyper and Ultrahigh Frequency Engineering," John Wiley and Sons, 1944, p. 328.*
7. *King, Mimno, and Wing, "Transmission Lines, Antennas, and Wave Guides," McGraw-Hill Book Company, 1945, p. 13.*
8. *Terman, T. E., "Radio Engineers Handbook," McGraw-Hill Book Company, 1943, p. 175, 227.*
9. *Sharpless, T. K., "Design of Mercury Delay Lines," Electronics, Nov. 1947, p. 134.*
10. *Ridenour, L. N., "Radar Systems Engineering," McGraw-Hill Book Company, 1947, p. 667.*
11. *Grieg and Moskowitz, "Pulse Time Multiplex Broadcasting on V.H.F.," Proc. of N.E.C., vol. 2, Oct. 1946.*
12. *Grieg and Racker, "Microwave Radio Links," Signals, Nov. 1947, p. 5.*
13. *Zimmermann, K. H., "Spiral Delay Lines," Electrical Communications, Sept. 1946, p. 327.*
14. *Blewett and Rubel, "Video Delay Lines," Proc. IRE, Dec. 1947, p. 1580.*
15. *DiToro, M. J., "Phase and Amplitude Distortion in Linear Networks," Proc. IRE, Jan. 1948, p. 24.*

An Answer to Your Needs!

REVISED EDITION
NOW AVAILABLE!

RADIO TEST INSTRUMENTS

by Rufus P. Turner
Consulting Engineer, RADIO NEWS

TELLS HOW TO CONSTRUCT, CALIBRATE, AND USE ELECTRONIC AND RADIO TEST EQUIPMENT

This well illustrated and practical manual will be an asset to any radio man's service library. It shows how to build, how to properly calibrate, how to use dozens of different types of radio and electronic testing devices. It covers briefly the theoretical explanation of radio, but only to make sure the reader first understands electrical and radio theory. The major portion of the book is devoted to technical data, which is presented in clear, understandable language. An ideal text for the practical radio man and a *must* for the radio serviceman.

Graphically Illustrated

Included are 182 informative illustrations—diagrams, charts, tables, and photographs—carefully chosen by the author to illustrate his sixteen chapters. RADIO TEST INSTRUMENTS is a unique presentation of a culmination of the author's own practices and applications. He has constructed and calibrated, tested and built, each piece of equipment described. And he shows how you can build and use these test instruments.

Covers Fully All These Test Instruments

- Multipliers
- Resistors
- Multi-Range Voltmeters
- Multi-Range Ammeters
- Ohmmeters
- Ultra-High-Resistance Megohmmeters
- Volt-Ohm-Milliammeters
- Wattmeters
- Vacuum-Tube Voltmeters
- Decibel Meters
- Bridge-Type Impedance Meters
- Direct-Reading Impedence Meters
- Simple Capacitor Checkers
- Compact Capacitor Checkers
- Simple Coil Checkers
- Substitution-Type Capacitance Checkers
- Resonant Inductometers
- Precision Resistance Bridge
- High-Gain Null Detectors
- Oscilloscopes
- R.F. Test Oscillators
- and many others

ACCURATE . . . AUTHORITATIVE
PROFUSELY ILLUSTRATED
221 PAGES; 182 ILLUSTRATIONS
AN EXCEPTIONAL VALUE
FOR ONLY
$4.50

Price $4.50. Use convenient coupon with full return privilege

ZIFF-DAVIS PUBLISHING COMPANY
185 North Wabash Avenue, Chicago 1, Ill.

MAIL THIS COUPON TODAY

Ziff-Davis Publishing Company, Dept. REE
185 North Wabash Ave., Chicago 1, Ill.

I am enclosing $4.50 (check or money order) for which please send me one copy of RADIO TEST INSTRUMENTS. I understand that I may return book within five days for full refund if I am not entirely pleased.

Name .....

Address .....

City ..... State .....

Now! BIG RECEIVER QUALITY IN THE LOW-PRICED FIELD!!

THE NEW NATIONAL NC-33

$65.95

AMATEUR NET

Here's the receiver you've been waiting for! A real communication receiver covering all frequencies from 500 kcs to 35 mcs, the brand new NC-33 offers the same fine workmanship that distinguishes National's more expensive receivers. Dollar for dollar, feature for feature, it's better built, better looking, better performing! See it — compare it — today at your dealer's. You'll decide it's the perfect choice for your shack, living room, playroom or den!

- Operates from 110-120 volts AC or DC. Ideal for shipboard and other uses where DC only is available.
- Electrical bandspread on all bands! Broadcast, amateur, police and foreign bands plainly marked.
- Automatic noise limiter assures optimum reception under all operating conditions.
- CW oscillator with pitch control provides superb CW reception.
- Lightweight — easy to carry.

TO FIND YOUR NEAREST NATIONAL DEALER SEE THE CLASSIFIED SECTION OF YOUR 'PHONE BOOK

FREE! Big New 1948 National Catalog!

National
©
EST. 1914

NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

NATIONAL COMPANY, Inc.
61 Sherman St., Malden 48, Mass.

Gentlemen: Please send me your new 1948 catalog of National receivers, components and parts.

NAME .....

STREET .....

CITY ..... ZONE .... STATE .....

Speakers that mean business... FOR YOU!

TELEPHONE CHERRY 8873

The Drive-In Theatre Equipment Company, Inc.

Manufacturers of NATIONAL AUTO VOICE In-car Speaker Units

2110-2130 SUPERIOR AVENUE
CLEVELAND 14, OHIO

January 20, 1948

Mr. R. S. Fenton, Sales Manager
Parts Section, Receiver Division
Electronics Department
General Electric Company
1001 Wolf Street
Syracuse, New York

Dear Mr. Fenton:

We would like at this time to express our appreciation for your expeditious handling of our recent rush order for 5¼" PM Speakers.

The speakers used in the Drive-In Theatre in-car units must meet more rigid standards than those ordinarily required commercially. The Drive-In Speaker is subjected to the most adverse weather conditions, and must be able to stand up over a period of years without appreciable impairment of its electrical characteristics. The voice coil form, and the cone proper, must be impervious to moisture or direct rainfall.

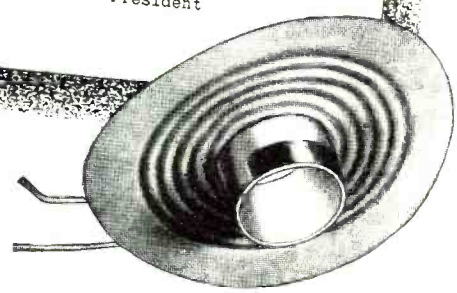
It may be of interest to you to know that after a survey of the speaker field, we chose the GE Speaker as the one best able to meet our exacting requirements. The aluminum voice coil form is ideal for our work, since there is no danger of expansion due to moisture absorption. The speakers met Navy type tests such as shock, vibration, temperature, salt spray, and frequency response requirements.

Since standardizing on GE speakers, our customer reaction has been entirely satisfactory.

Very truly yours,
DRIVE-IN THEATRE EQUIMPENT CO., INC.

E. B. Brady

President



ALUMINUM FOIL BASE VOICE COIL

THE LETTER reproduced here speaks for itself and —G-E Speakers. The superb engineering which makes this speaker ideal for outdoor use, also makes it ideal for replacement in home receivers, where widely varying conditions of dryness and humidity affect speaker performance.

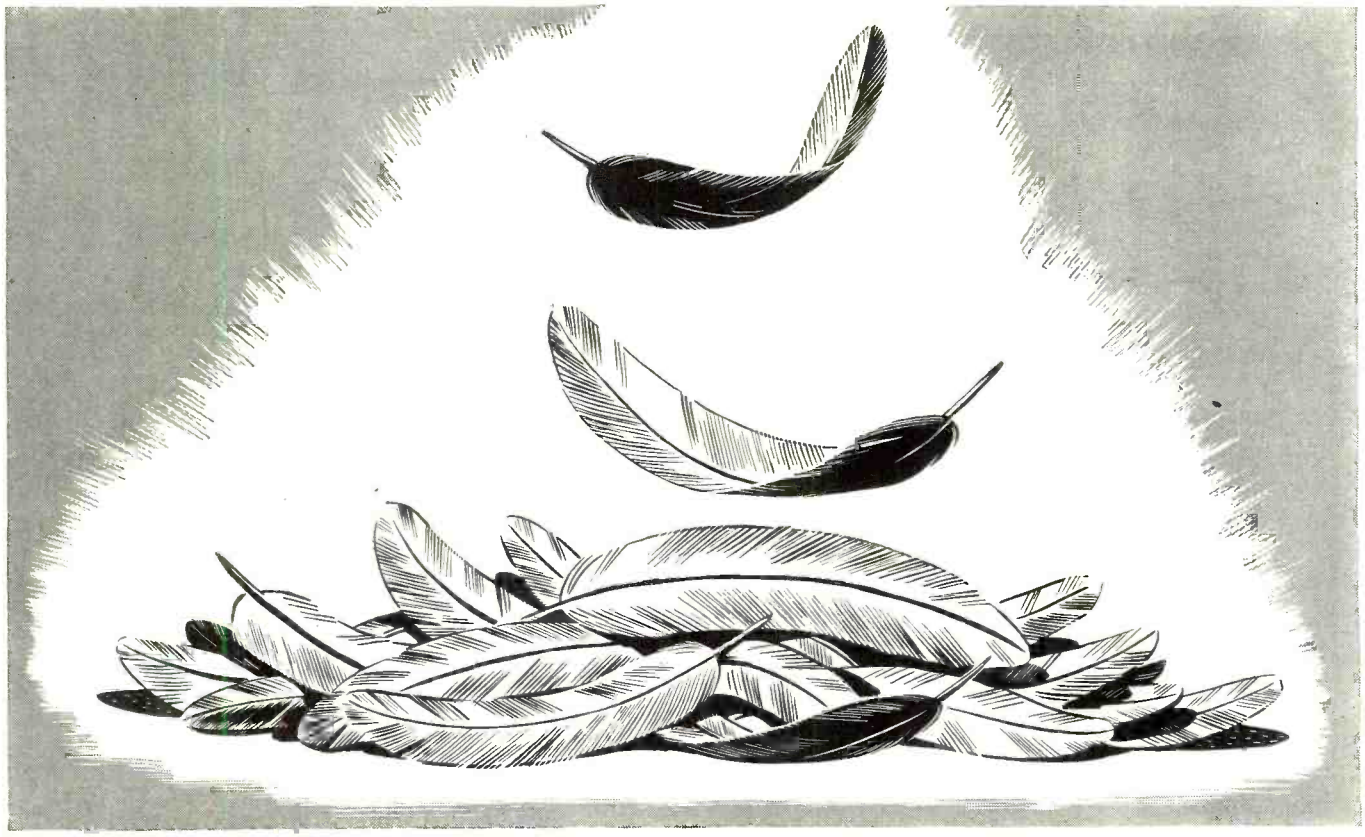
Here is an opportunity to develop the speaker replacement market to its fullest extent and push the outdoor theatre market.

G-E Speakers are competitively priced—and in quality they are outstanding. Build speaker business now. Send us your order.

For complete information write:
General Electric Company, Electronics Department, Electronics Park, Syracuse, New York.

GENERAL ELECTRIC

169-G2



Quiet . . . . . .

Reputation is built alone through continued supremacy. Of the many points that help to make Radiart VIBRATORS the leader in the field, the factor of quiet, noiseless operation has reached a new point of perfection because of recent engineering developments. Here is vibrator operation at its best! Servicemen everywhere depend on the engineering skill of Radiart to serve their customers interests best. They know Radiart is always correct, electrically and mechanically for each recommended application.

It Costs No More To Get A Red Seal VIBRATOR, Radiart Includes This Important Feature . . . At Regular Low Prices

STANDARD OF COMPARISON

RADIART

The Radiart Corp.

CLEVELAND 2, OHIO

RADIO CONTROLLED MODEL SAILBOAT

Fig. 1. Fastening antenna in position. The control unit transmitter is shown in the foreground.

By R. C. SCHMIDT, W1VDY, and L. A. WILLIAMS
Raytheon Manufacturing Company

Two channel operation, 51 and 53 megacycles, provides complete 180 degree rudder control.

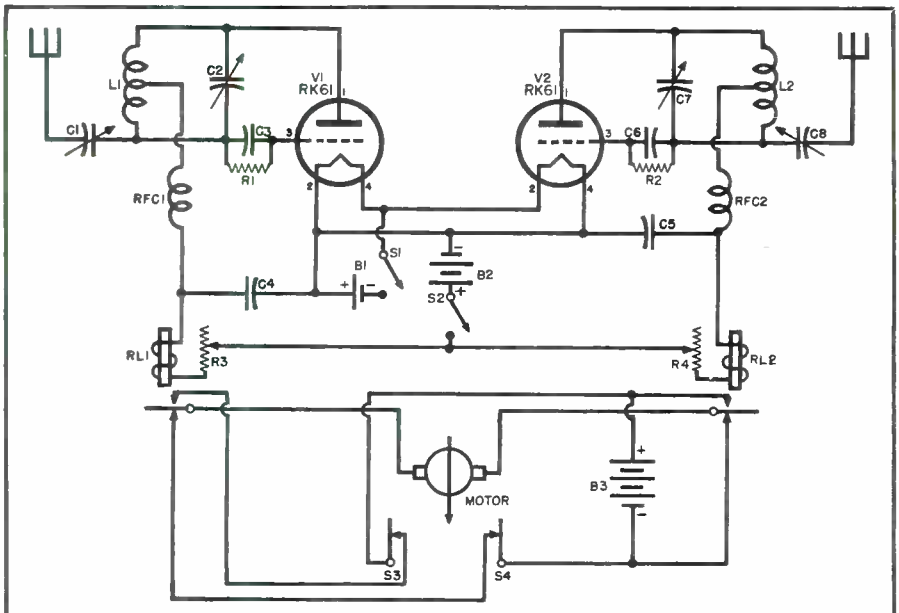
SIMPLICITY is the keynote in the design of any piece of radio remote control equipment for model boats or aircraft, because light weight, low battery consumption, troublefree operation, and low cost, all hinge upon this factor.

In the radio control of the model sailboat described here, the necessary control operations are solely those of turning the rudder either to left or right at will, this operation being performed by a small permanent magnet reversible electric motor and suitable gear train. The remote radio link must, therefore, either carry two intelligence channels or alternatively, a single channel could be used to alternately select one and then the other control operation. This "selector" system or single channel control can be made to accommodate a larger number of control operations. However, since the operations occur in a fixed sequence, it is at times a very slow and unwieldy method of control. Also, it is quite common for the receiving equipment to get out of sequence with the remote transmitter; thus some form of repositioning of the selector is necessary in the selector system, which usually boils down to another intelligence channel. For this reason a system was chosen using two separate radio channels.

The boat used for this experiment is a "Class A" type. The hull is of mahogany planked construction with a length of 6 ft. and a beam of 14 inches. The single mast is about 8 ft. in length.

Receiver

The receiving equipment consists of two single tube receivers using *Raytheon* type RK61 tubes operating in the 50-54 mc. amateur band. The RK61 is a subminiature version of the prewar RK62. This tube operates in a simple superregenerative circuit, and has a small relay in its plate cir-



R_1, R_2—3 megohm, ½ w. res.
R_3, R_4—10,000 ohm, wirewound rheostat
C_1, C_8—3-30 μμfd. trimmer cond.
C_2, C_7—35 μμfd. air trimmer
C_3, C_6—100 μμfd. mica cond.
C_4, C_5—.05 μfd., 200 v. cond.
L_1, L_2—6 t. #14 copper wire, c.t., 7/16" i.d., spaced wire diam.
RFC_1, RFC_2—46" length, #36 d.s.c. wire wound on 1 megohm, ½ w. res.
B_1—1½ volt flashlight cell
B_2—45 volt "B" battery
B_3—12 volt standard flashlight cell
V_1, V_2—RK61 tube
Motor—Pittman 12 volt model railroad motor (See text)
RL_1, RL_2—8000 ohm, s.p.d.t. sensitive relay (Sigma #4F)
S_1—S.p.s.t. toggle sw.
S_2—Midget knife sw.
S_3, S_4—Microswitch (See text)

Fig. 2. Schematic diagram of receiver. Two superregenerative receivers are used as a means of reversing motor. These receivers operate on different channels.

cuit. Plate current under "the no received signal" condition is 1.5 ma., and triggers to 0.5 ma. or less depending upon signal strength. The plate circuit relay must therefore operate within this range of plate current change. The *Sigma* model 4F relay usually serves adequately here. This relay has an 8000 ohm coil, and can be adjusted to operate on as little as 0.2 ma. current change. With some tubes the optimum relay resistance may be as low as 5000 ohms.

As regards power supply, the RK61 receiver is very economical, requiring only 1.5 volts at 50 ma. each for filament supply, and 45 volts at 1.5 ma. for the plate.

Rudder Control Mechanism

The motor used is a *Pittman* 12 volt d.c., 6000 r.p.m. model railroad type, which can be obtained at any hobby craft store. It draws about .3 to .4 amp. under full load. In order to assure easy operation, a 3000 to 1 gear reduction was used. In length of time with the motor operating under load, the rudder may be shifted from full left to full right in about 15 seconds.

There are many ways of applying this control. The main purpose was to find a simple, positive, and variable mechanism which would be practically foolproof. The complete mechanism may be placed under the deck or above deck. The reason for placing the mechanism above deck in this case was to save hull damage in case of bad operation. The unit is enclosed in a watertight metal box with all operating parts inside (see Fig. 3). It was only necessary to drill one hole in the deck to allow for wiring. Using this method, the rudder can be moved to any position up to 90° left or right from the neutral or center point.

By the use of 2 microswitches (S_3, S_4 Fig. 2) for limit switches the rudder cannot move beyond the 90° position.

Circuit and Construction Details

Fig. 2 includes the circuit of the receiver and associated motor drive for the rudder. The receivers are mounted on a piece of lucite which fits flush with the hatch. The tuning condensers, C_2, C_7, and plate current adjustment resistors, R_3, R_4 are brought out through the top, along with midget knife switch S_2. This switch affords a convenient means of inserting a 5 or 10 ma. current meter in the plate circuit for tuning purposes. The photograph of Fig. 4 shows the arrangement of component parts below decks. The sensitive relays were bolted to the metal back

Fig. 3. Aligning receiver. A 0-5 or a 0-10 milliammeter is clipped across the open knife switch (S_2) for tuning the unit.

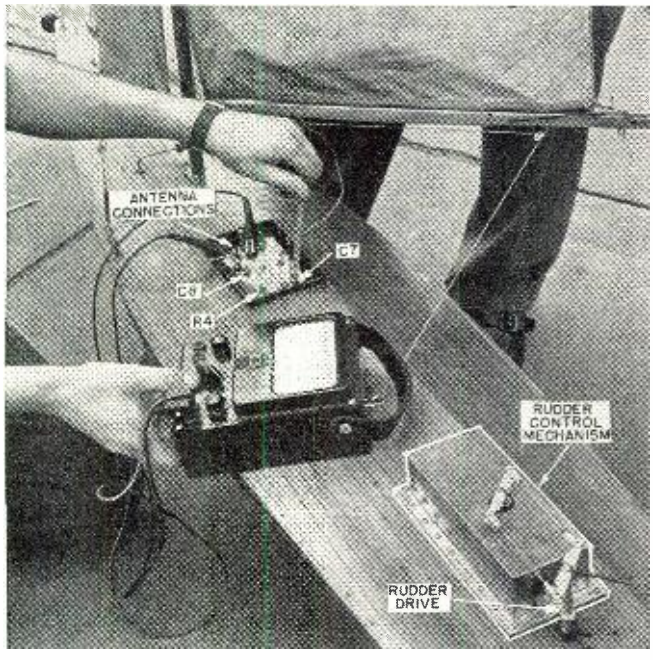
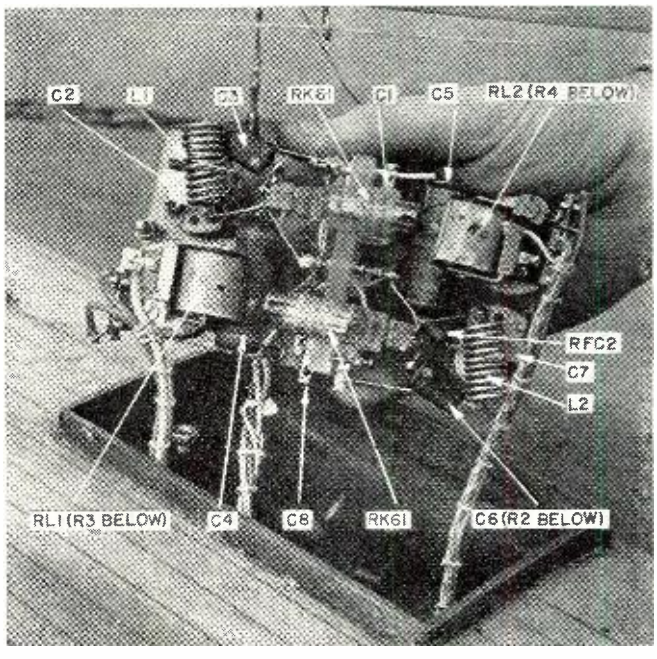


Fig 4. Under chassis view of receiver. The two sensitive relays are mounted atop the metal covers of rheostats R₃, R₄.



covers of the control rheostats to conserve space. The RK61's are mounted horizontally in a cradle also made of lucite, and are held in place with rubber bands. The tubes have 2 inch tinned leads which may be used to wire them directly into the circuit if space is at a premium or the leads may be trimmed to 3/16" and plugged into subminiature tube sockets which are available. From the tube replacement angle, the use of sockets is better.

Connections from the receiver are cabled and brought to a common terminal board mounted in the bottom of the hull, as are all the leads from batteries, motor, and the limit switches on the motor. The limit switches, S_2, S_3 serve to open the motor circuit when the rudder has reached the limit of its travel in either direction.

The transmitter consists of a very simple push-pull oscillator using two 957 acorn tubes with 1.5 volts on the filaments from two paralleled intermediate size flashlight cells. The plate supply is a pair of 67½ volt "B" batteries of the type used in portable broadcast radios. The complete transmitter unit is housed in an aluminum box 4½" x 4½" x 10". The control switch S_1 is a single-gang, 2-circuit, 3-position rotary switch. This switch, when turned to the left of center, connects the filaments only. When turned to the right of center, it powers the filaments, and also cuts in the padding condenser, C_1, thus obtaining the second control channel frequency. In the interests of simplicity, it was decided to switch the filament circuit only for turning the transmitter off and on to either channel. The short time delay while the tubes are warming is unnoticeable for practical operation in this type of application. However, a separate filament switch with S_1 in the plate lead would be satisfactory also.

The photo, Fig. 6, is an internal view of the transmitter. A small subchassis partitions the batteries, and mounts the transmitter circuit components. The 957 sockets are mounted back-to-back and in a vertical position. The condensers, C_1 and C_2, are mounted on a pillar-supported piece of lucite, so that they can be tuned from the top of the transmitter box through two appropriate holes. The quarter-wave whip antenna plugs into a feedthrough insulator also located in the top of the box.

In tuning the transmitter, S_1 is turned so that C_1 is *not* connected. Then C_2 is tuned to the *high* frequency control channel, i.e., approximately 53 mc. Then, switching over to the position which includes C_1 in the circuit, C_1 is tuned for the *low* frequency channel at 51 mc. It has been found more convenient to set the transmitter just once, and make subsequent tuning adjustments on the two receivers. Thus, having once set the transmitter well within the band, there will be no

(*Continued on page* 176)

Fig. 5. "Coming about"— Boston's Back Bay section is the backdrop for this demonstration. The rudder position indicator should be visible to the operator at all times.

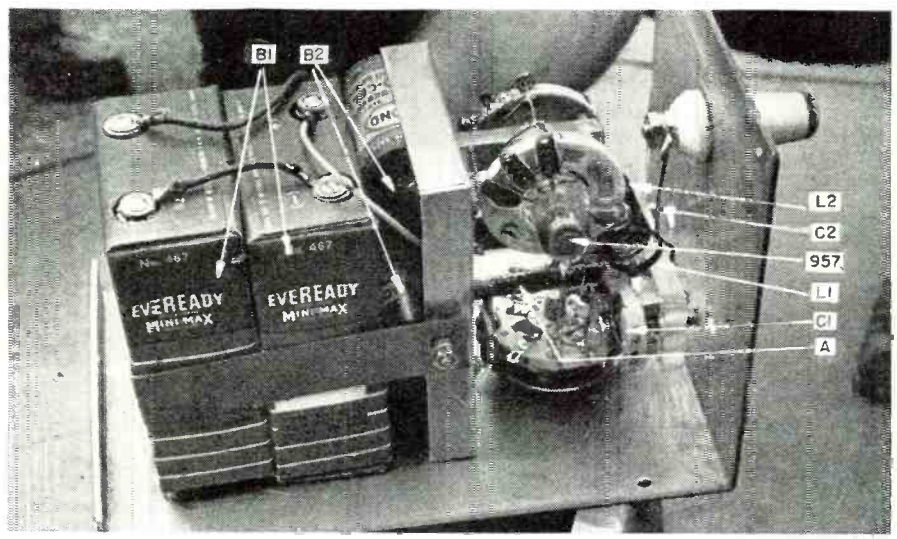
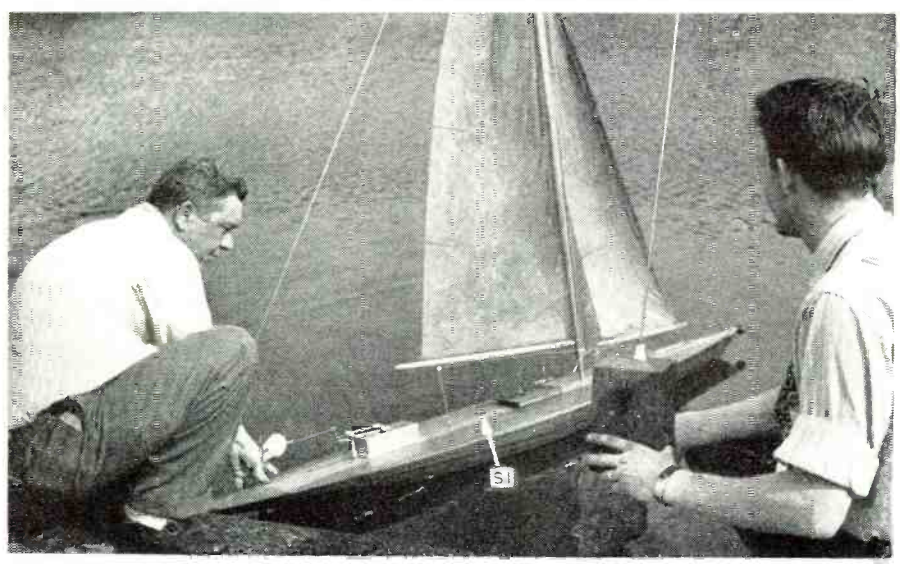


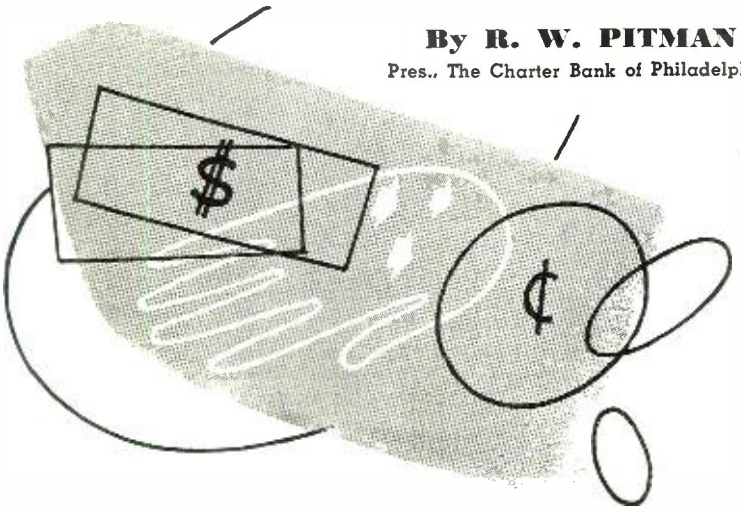
Fig. 6. Internal view of transmitter control unit. Condensers C_1 and C_2 are mounted on a polystyrene bracket supported from the subchassis by a metal rod, A.

Fig. 7. Boat carries 500 sq. in. of sail to conform with "Class A" racing standards.



MONEY—What You Need And How To Get It*

By R. W. PITMAN
Pres., The Charter Bank of Philadelphia



Bank credit plays an important role in your business success. Investigate the possibilities of using this service.

NOT being possessed of Aladdin's lamp, I want to confess immediately that I don't know how much money you need, and I certainly can't tell you how to get it, even if I did know how much you need. If I were possessed of such knowledge, I would apply it to my own personal use and probably would be in Florida now, instead of in Philadelphia talking to you.

In fact, I have always been impatient of these experts who visit me and explain how "intelligent" management will improve my financial condition. That "intelligence" usually means that I should buy something they have for sale. I become impatient because investigation usually indicates that they, themselves, are frequently financially worse off than I am, if that is possible.

Without previous approval from your Committee, therefore, I will take the liberty of changing the title of my remarks to *"BANK CREDIT—HOW TO BUILD IT—HOW TO USE IT—AND HOW TO TREAT IT."* Now like a good Methodist preacher, having stated my text, I will proceed to pay little attention to it.

During my nearly 30 years in the banking business, I have seen a number of our large industries grow from infancy to maturity, and I have seen the pioneers in those businesses who had imagination and courage grow with the industry. I have seen too many of those pioneers, however, without imagination and without courage fall far behind the industry and finally lose out entirely.

Take the automobile industry. Many successful dealers, distributors, and factory executives today were the fellows who, 30 years ago, opened up a shop to tinker with these new contraptions in the hopes that when the toy of luxury became the necessity of today, they would be an integral part of that growth, with profit to themselves. More frequently they did not succeed because, along with their inventive genius and curiosity which attracted them to this horseless carriage, they did not have the business ability necessary to finance their growth. Nor did they have the imagination which would cause them to employ in their business the knowledge and use of financing which is a condition precedent to the growth of any business.

I have seen the same things happen, and so have you, in the early development of radio stations, the electric appliance business (such as refrigerators, washing machines, etc.), the farm implement business and, going way back, the sewing machine business—all durable goods which can only be manufactured in quantity and sold in quantity (which means service in volume) through the use of sound banking as a fixed and important part of the business.

You and I also have seen "grease monkeys" with one truck develop an interstate trucking business as large as a small railroad. Too many of their companies, however, have fallen by the wayside because of their inability to envisage the essentiality of sound bookkeeping and bank credit in the growth of their business.

It seems to me that you people here today are on the ground floor of an industry which has a future potential as great or greater than most of those I have enumerated. How to keep apace with that development from a banker's viewpoint is something that we might consider for a few minutes.

In the first place, don't ever forget that the banker is as anxious to do business with you as you are to do business with him. He has money to sell just as you have service to sell. If he doesn't lend money, he can't stay in business any more than you can stay in business if you don't have customers.

Don't let the marble fronts and barred windows of banks frighten you. The banker does that to emphasize security and safety in order to attract depositors who furnish him with his raw material which is money. When you talk to your banker, get on a personal basis with him just as fast as you can. Don't withhold any of your money problems any more than you would withhold pertinent matters from your doctor, lawyer, or priest. Frequently you will find that he can advise you from his varied experience in watching other people make mistakes as well as successes, and give you information sometimes more valuable than any loan he might make to you.

Keep in mind that he is the trustee for the funds of other people—many times the lifelong savings of other people. When he tells you he can't serve you, keep in mind that he is turning away a customer who might make him money, but he is doing so because it is, in his opinion, (1) not good for you, or (2) not good for the investment of the funds which have been entrusted to him.

A banker wants to know three things before he lends you money. They are; (1) can you pay?, (2) will you pay?, and (3) can he make you pay? Let's take them up in order:

Can you pay?—In seeking an answer to this question, he wants to know just what your experience and technical ability are in your particular kind of business. He wants to know what volume of business you do and what profit you make in this business. He wants to know what sort of an employee organization you have and whether or not your customers are satisfied people. In other words, do you deliver a service which will react to your profit? If you are in the merchandising business, merchandising a concrete commodity rather than a type of service, he wants to know the source of supply, whether it is steady or not, and whether your suppliers are satisfied to do business with you.

(*Continued on page* 161)

* Our thanks to Howard Browning for permission to reproduce this speech which was originally presented at the "Town Meeting of Radio Technicians" held at the Bellevue-Stratford Hotel in Philadelphia.

HIGH FIDELITY-

Too Much Confusion Too Little Clarification

By HARRY W. BECKER
Chief Eng., Electronic Sound Eng. Co.

How would you define "high fidelity," "wide frequency range," and "tone quality"— are they synonymous or does each have its own connotation?

WITH so much debate and controversy raging around "high fidelity," "wide frequency range" and "tone quality," it is high time that the radio industry and the audio engineering profession carefully orient their thinking and talking about these terms. Clear definitions of meaning and function are a crying need today, because "high fidelity," "wide frequency range," and "tone quality" have now become part of our language; their misuse and misinterpretation reflect adversely on the radio industry and on audio engineers.

Popular opinion tends to interrelate the three attributes, assuming a double dose of, say, high fidelity will improve the most ordinary receiver or record player and a triple dose of the three will produce results paralleling nothing less than Gabriel's horn. Manufacturers and dealers have done little to correct such a belief, assuming that it is incorrect.

Much of the widespread confusion has arisen from irresponsible bandying of these terms by manufacturers and dealers in their consumer advertising. The listening and buying public is not only confused but also disillusioned as to the possibilities of ever owning a set that lives up to the Shangri-la of sound promised in advertising specifications.

The confusion has led to controversy. Popular writers are accusing the industry of failing to give the public what it wants and deserves in the way of fidelity and quality. Other writers are taking it out on the public, saying the listener doesn't know what he wants to hear and isn't interested at all in wide range listening. All this leaves those in the industry with an important obligation to clarify, define, and explain.

Is there a common denominator in high fidelity, tone quality, and wide frequency range? Let us ask, "What is high fidelity?" Is it quality? Is it wide-range reproduction of the original? Or is it merely faithful reproduction of a good or bad original? Most audio engineers would answer "yes" to the last question, "no" to the two preceding. If the proper definition hinges, as it must, on "faithfulness of reproduction of the original," and this implies no distortion, let us now ask whether "fidelity" and "quality" are synonymous, related, or exist independent of one another.

A moment's thought is sufficient to make it obvious that no matter how faithfully a program is reproduced, a discordant original performance remains much the same way. So-called "tone quality" depends on the harmonics or overtones issuing forth from the resonant cavity of the originating musical instrument. Under strict laws of nature, for a musical tone to sound pleasing to the ear, the harmonic or overtone must lose strength as it goes up in pitch; or, in other words, the energy per cycle of vibration must decrease as the frequency of vibration increases. In actual practice, musical instruments do not strictly obey this rule. If they did, an oboe would sound like a violin. The characteristic sounds of the various instruments are due to a variance in the strength of these overtone vibrations and are judged either good or bad by the effect of the beats thus produced on the ear. A Stradivarius violin reproduces overtones that give it a distinguished, pleasing tone quality. Unpalatable tone quality in an inferior violin, or in one poorly played, will be unpalatable tone quality when reproduced with high fidelity. This is obvious to any student of the audio processes, but it is so often overlooked by the public. Overlooking this one point has caused as much confusion over high fidelity as anything. Wherever misconceptions on this point occur, whether in the industry or the public, every effort should be made to straighten out the misunderstanding.

What about public disappointment in wide frequency range and more specifically in FM sets? The public was told it would get "quality" in FM. Yet, there are numerous examples of obtaining much better tone quality on AM on a narrower frequency band than on FM with the highly-touted wide frequency range.

The truth of the matter is that wide range reproduction in many cases has not been pleasant from the listener's point of view. The reason for this is simple. A wide range will reproduce the overtones of a musical instrument and make possible easier recognition of the instrument, assuming the reproducing system has virtually no distortion. However, radio manufacturers have not as yet made available to the public sets capable of reproducing a wide frequency range and maintaining tone quality at the same time. In the future when sets of this type are available, we will have true high fidelity.

In many cases, the original *is* quality. The tonal balance is perfect, the distribution of energy is proper, the effect is pleasing, and yet the reproduction is a distinct disappointment.

(*Continued on page* 164)

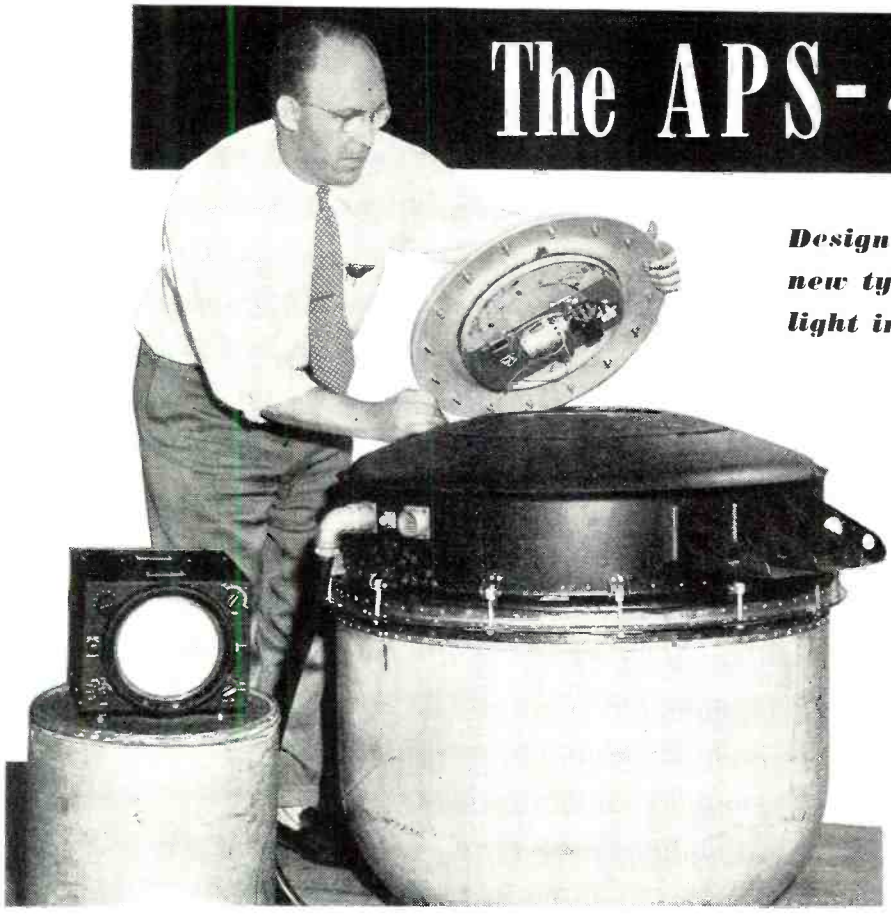
The APS-42 RADAR

Design and operational features of a new type radar unit. It is compact, light in weight, and excels all other airborne equipment.

By

L. W. MALLACH

Project Eng., The Houston Corp.



Transmitter-receiver and antenna are carried in this pressurized container made of spun magnesium and laminated fiber glass. Single cable connects unit to scope shown at left.

THIS outfit doubles the range of the well-known wartime APS-10. It weighs only 115 pounds, involves only two units, and for flexibility of operation surpasses any radar yet airborne. It is an X-band navigational radar equipment complete within itself, and provides radar mapping, responder beacon operations, obstacle detection, and weather mapping. The Army Air Forces call it the AN/APS-42 (XA-2). It is intended for service in both military and commercial aircraft, preferably in a chin or belly location. In both positions it will furnish a nominal 360° scan.

For mapping, the equipment supplies an approximate cosecant-squared pattern from the antenna, for use in mapping areas adjacent to the path of flight, to show contours and type of terrain traversed.

In responder beacon operation, it transmits a 2.2 microsecond pulse and receives on a frequency of 9310 megacycles, with automatic frequency control for picking up signals from transponder type beacons operating in this band. The antenna utilizes a cosecant-squared pattern for beacon operation to minimize any differences in altitude of the aircraft or angle of flight while triggering and receiving a beacon.

For obstacle detection, this radar transmits a pencil beam approximately six degrees vertically and horizontally in the approximate plane of the aircraft. This is useful for detecting the position of any reflected object within the swept pattern, particularly mountains and other aircraft.

Of considerable importance, too, is the fact that the equipment also may be used for detecting areas of heavy moisture content and the accompanying turbulent areas with which they may be associated. For this service, a 2.2 microsecond pulse with a pencil beam is transmitted.

Of the two experimental units completed, one has gone to the All Weather Flying Squadron, the other to the Aircraft Radio Laboratory—both at Wright Field—for in-service testing. A total of 107 production units now are being manufactured for the Navy, for assignment to planes flown by NATS.

Tests so far indicate substantial fulfillment of the design objectives for transport-type radar navigation equipment. Problems involved consisted basically of evaluating the functions of wartime airborne radar which would seem more useful for air transport uses.

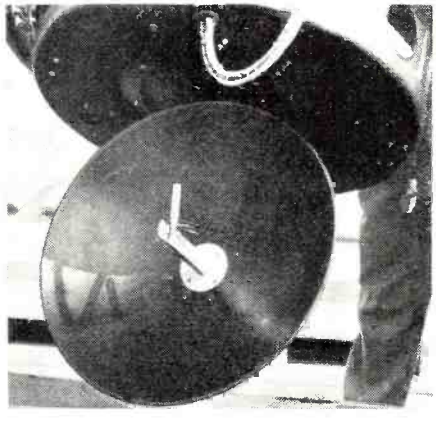
Among the functions studied were the bombing type radar's ability to map large land areas, the fighter radar's ability to detect other aircraft in the vicinity, and the paratrooper's radar equipment used for beacon navigation and more-or-less precise navigation of uncharted areas.

In looking over the field of wartime equipment, it became evident that the radar best suited for commercial use was the APS-10. But serious disadvantages were inherent. Accordingly, it was decided to utilize basic design, and add other desirable radar features, together with operational simplification and antenna stabilization.

Final design, as evolved by *The*

Top view of transmitter-receiver. Gyroscope and motors keep unit approximately level during flight.

Signals and echoes flow out and in through this short radar antenna and parabolic reflector.

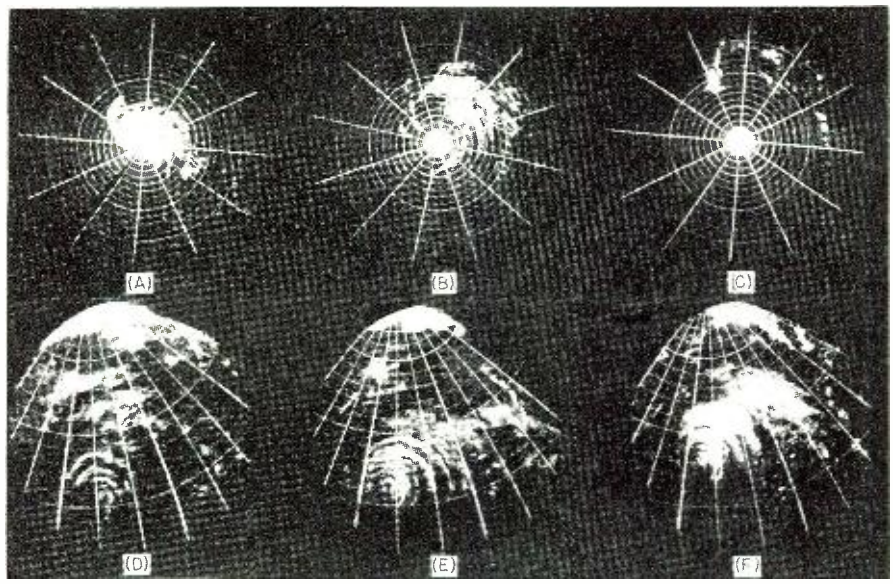


Houston Corporation on AAF contract, includes these principal features; low over-all weight; compactness; flexibility of operation, as noted in the first paragraph; higher power, in order to achieve the results mentioned more easily; stabilization of the antenna to present a better picture regardless of aircraft attitude; simplicity of operation requiring a minimum of pilot-operated controls, and reliability of operation over long periods of time by simplification of adjustments and components.

To accomplish these features, the equipment was designed so that the radar transmitter-receiver and antenna were mounted in one spherical package measuring 33 inches in diameter and 36 inches over-all height. Such a package or unit is suitable for either belly or chin mounting with approximately 21 inches of the cylinder protruding below the aircraft skin with antenna enclosed. This unit is stabilized by an internal arrangement so that the antenna is mounted on gimbal rings with servos providing automatic stabilization for 25 degrees either direction in roll and 20 degrees in pitch.

Inasmuch as the transmitter-receiver is mounted directly over the antenna, the maximum electrical efficiency is achieved through the shortening of the connecting cables. All components required for the operation of the transmitter-receiver-antenna are stabilized and mounted within this package, which is also pressurized by an integral air pressure pump actuated by an automatic pressure switch. By this means, the entire assembly is maintained at sea level pressure up to 30,000 feet, thus providing a minimum of disturbances from high voltage discharges or other high altitude phenomena.

The indicator employed is a standard 7-inch type cathode-ray tube using a PPI type display. This display is, in effect, a polar coordinate map of the surrounding area, with the plane's position being in the center of the tube and the relative angle to other objects being indicated by the angle in degrees from the top of the tube, the top being the straight-ahead direction.



Pictures (A, B, and C) of a hurricane on a radar unit which scans complete circle around the station instead of merely an area in any one direction, as shown in D, E, and F. The storm (A) appears as a great white blob on the radar scope as the hurricane passes almost directly overhead. As the clouds travel northeast (B), the image moves from the center of the scope. In picture C only wisps of clouds remain as the hurricane moves away. Pictures D, E, and F, taken on another type of radar, were made from Army station near Orlando, Florida. In picture D, the center of the storm, at lower left, is bordered by hazy concentric arcs. These are line squalls. Above them other hazy spots are masses of rain clouds. In pictures E and F the hurricane comes closer. Position of radar unit is in the bright area at the top of the photograph.

In order to simplify the operation and make it suitable for the pilot to handle his own radar equipment with a minimum of effort, several controls are mounted on the indicator:

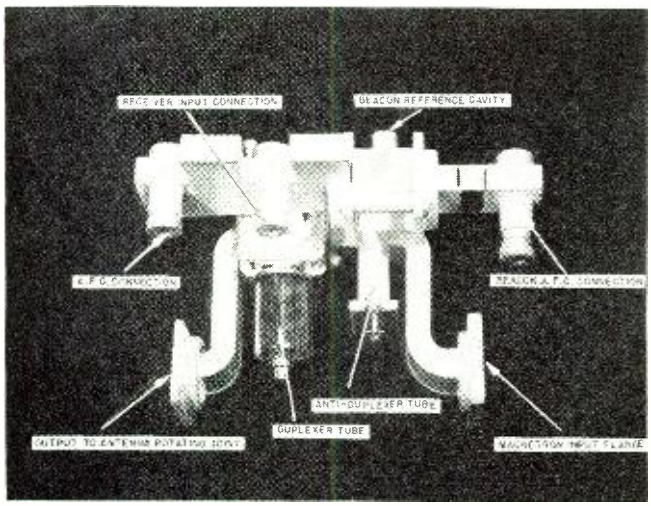
1. *A combination "on-off" and "range" switch.* In the maximum counter-clockwise position the equipment is "off," while moving the switch to any range position turns the equipment "on." Subsequent operation is automatic after an initial three-minute warm-up time-delay period. The ranges provided are 5, 15, 50, and 150 nautical miles, with five evenly spaced range marks on each range, together with "range-in-use" lights above the indicator tube.

2. *A "function switch."* This provides for the versatility of operation of the equipment. The first position is "mapping," which provides for a radiated beam known as cosecant-squared or equal energy; and, as its name implies, it distributes an equal amount of transmitted power to the ground in the immediate vicinity of the ship as well as at the horizon. Therefore, all of the ground contour from immediately ahead of the plane to the horizon is reproduced on the indicator, as a contour map of the surrounding area.

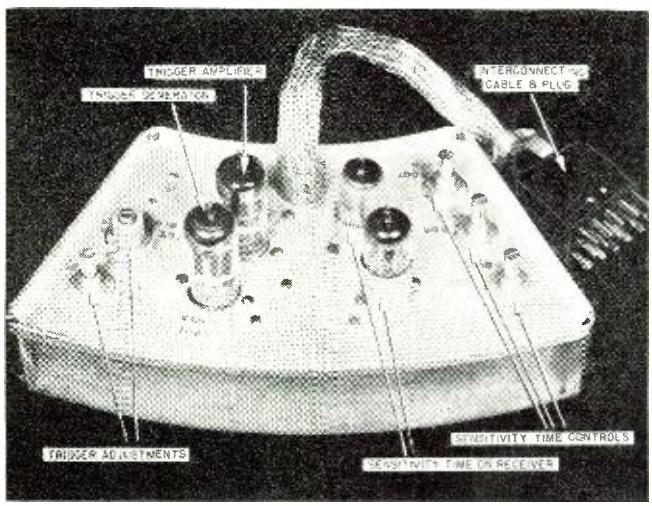
In the next position, "obstacle detection," the antenna pattern is a very narrow or pencil shape beam which is

(*Continued on page* 178)

Electroform wave guide mixer (duplexer assembly).



Trigger generator and sensitivity time control.



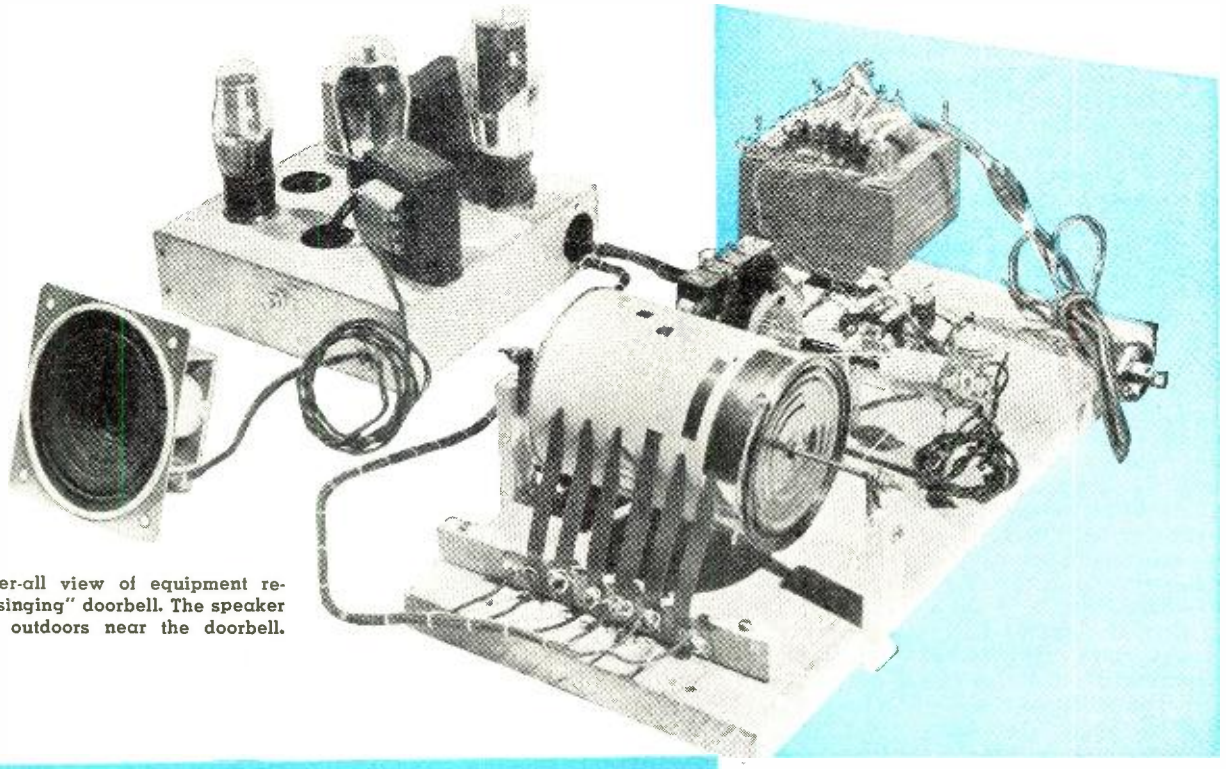


Fig. 1. Over-all view of equipment required for "singing" doorbell. The speaker is mounted outdoors near the doorbell.

A Doorbell that is Different

By RICHARD H. HOUSTON

Neon tube relaxation oscillators provide any desired series of musical notes in novelty unit.

A SHORT time ago the author was preparing for a novelty party and was stuck for a good gag to start the evening off right. This was during the short-lived reign of the erstwhile popular song "Open the Door, Richard," and that phrase was very common around the writer's house. An idea!—of course—a doorbell that would play "Open the Door, Richard"!

The device was constructed and proved to be very successful at the party (even got a plug in a local paper!). Since that time the gadget has been retuned occasionally and has provided a lot of fun by playing snatches of tunes appropriate to the season or occasion. The small amount of effort spent in building such a device will be well worthwhile for any reader who goes in for novel gadgets.

The doorbell (as we shall call it for the sake of simplicity) was built in the best haywire tradition due to the short time available, but there is no reason why the mechanism shown in Fig. 1 could not be built more substantially and put into an attractive cabinet, rather than into a cardboard box, as was the author's unit.

The doorbell consists of an oscillator, an amplifier and speaker, a motor-driven keying mechanism, and simple control circuits. The push-button at the door operates a relay which causes the keying mechanism to play, in succession, the notes of the desired tune.

The notes are produced by a neon-bulb relaxation oscillator, consisting of N_1 and the RC combinations R_1C_1, R_2C_2 . . . etc. The frequency of the oscillator, and therefore the pitch of the note produced, depends upon the values of R and C. As anyone familiar with such circuits knows, the exact values of R and C for any given frequency will vary quite a lot from one circuit to another. For that reason, no values are given for the RC combinations, however the following approximate values may be used as a start. R is composed of a fixed resistor and a potentiometer for tuning to different notes.

Since it is difficult to make a neon-bulb oscillator operate over a very great frequency range, the five RC combinations were chosen so that each potentiometer would cover a different range of tones. Thus the lowest frequency RC combination will handle the first three or four notes of the scale; the next highest frequency combination will handle the next three or four notes, and so on. The values of the resistors and potentiometers and those of the condensers used to produce the lowest and highest notes are as follows:

Note	Res.	Pot.	Cond
Lowest	500,000	1 meg.	.01
Highest	100,000	500,000	.005

While experimenting to find correct RC combinations, remember that increasing either the resistance or the capacitance *lowers* the tone.

The neon bulb in the original model was a type NE-16, a two-contact bulb with no series resistor in the base. A different type of neon bulb will operate just as satisfactorily if an NE-16 is not available, but the RC value approximations may not be too close. Actual tuning of the oscillator will be described later.

The output of the oscillator is coupled by C_6 to the grid of V_1, a 6F6. No volume control was incorporated, however one could be put in the 6F6 grid circuit if desired. A

500,000 ohm control should be used with a 100,000 ohm resistor between C_6 and the top of the control to isolate the oscillator from load changes produced by varying the setting of the volume control. The arm of the control should connect to the grid of V_1. The amplifier is strictly conventional and drives a 6-inch speaker. A .01 μfd. condenser, C_7, is connected from the plate of V_1 to ground to eliminate some of the oscillator harmonics.

The heart of the gadget is the motor-driven switching drum. As can be seen in Figs. 1 and 5, the drum is made from a tin can with a "push-in" lid (like a paint can). The drum serves to switch the different *RC* combinations into the neon bulb circuit. Six strips of phosphor-bronze (or spring metal of any kind will work) are mounted so as to wipe on the can as it revolves. Five of these "brushes" (tone brushes) are connected to the *RC* circuits, the other one (collector brush) to the neon bulb. These six brushes enable the device to play a wide variety of tunes, however, additional tone brushes and *RC* combinations would make the tune selection more flexible. A sheet of paper with holes properly spaced to produce the desired notes is wrapped around the drum underneath the five tone brushes, and is held in place with a strip of *Scotch* tape. The collector brush rides on the can at all times. Then as the drum turns, the tone brushes make contact through the holes in the paper, keying the oscillator in correct sequence to produce the desired notes. Care must be taken to see that no two tone brushes ever touch the drum at the same time, since even an instant's double contact may cause the next note to be erratic.

The axle of the drum consists of two long 6-32 machine screws in centered holes in the ends of the drum. The screws are secured with nuts on the outside of the drum. No elaborate bearings are necessary. The end of the axle screw merely passes through a hole in a strip of metal, and the screw is prevented from sliding out by two nuts tightened together as can be seen in Fig. 5.

The lid of the can used as the drum contains another long 6-32 screw mounted like the axle, but off-center. This screw actuates a normally-closed microswitch which stops the drum after one complete revolution. The lid may be pried out and rotated to adjust the stopping point if necessary.

The drum is driven by a small 117 volt a.c. motor through a string-and-rubber-band belt. The motor circuits which were used are included in Fig. 2. The pulley sizes will depend on the speed of the motor, but should be chosen so as to make the drum revolve once in about five seconds.

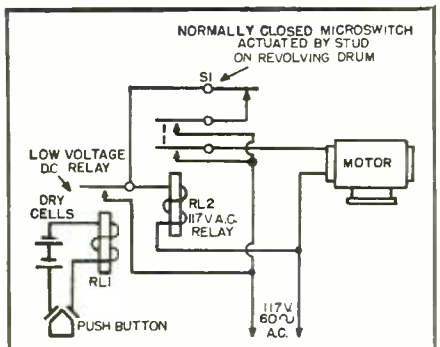
The power supply is conventional and delivers about 350 volts. The power transformer mounting shown in Fig. 1 is not recommended, but is simply part of the previously-mentioned haywire! Don't forget the fuse, because safety demands that a piece of equipment to be operated unattended for long periods be well-fused. The reader will note that voltage for the neon bulb is supplied from a VR-105. This was done, as a deluxe gesture, to prevent sudden frequency shifts due to line surges which are numerous in an apartment, such as the one the writer is forced to occupy. Long-time drift due to changes in the oscillator components can be compensated by means of the potentiometers.

The control circuits are very simple. The push-button operates RL_1 causing 117 volts to be applied to the coil of RL_2. RL_1 is used merely to isolate the 117-volt line from the push-button. When RL_2 closes, 117 volts is applied to the motor. Two contacts on RL_2 act as locking contacts to hold the relay closed. When the switching drum has made one full rotation, S_1 (Fig. 2) is actuated, opening the locking circuit, releasing RL_2, and stopping the motor.

There is practically no limit to the choice of appropriate tunes to be set up on the switching drum. One of the best and most time-resistant selections is the part of the ditty about Barnacle Bill that says, "I'll come down and let you in." This phrase will be used in the example of tuning to follow. Novelty songs like the one for which the gadget was originally built come out frequently and are good sources. On the serious side, there are songs appropriate to various seasons and holidays, such as Christmas and Easter, and for Halloween, we all know the spooky little phrase used on the radio as the ghost goes a-haunting. And how about leaving a musical message when you find you'll be gone overnight: "We won't be home until morning!" These are only suggestions—let your imagination take it from there.

Tuning the notes is no great trick and requires only an average musical ear. No attempt was made to tune the notes to any standard pitch since few of the writer's friends are gifted

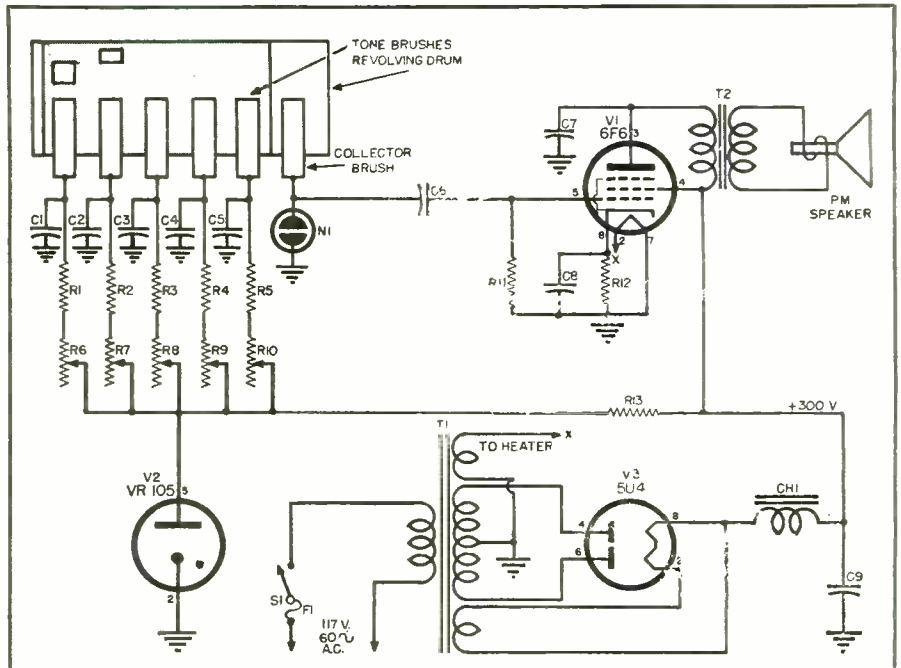
(*Continued on page* 122)



RL_1—6 volt d.c. relay, s.p.s.t. sw., normally open (Potter & Brumfield PR3D or Guardian type 200-1)
RL_2—117 volt a.c. relay, d.p.s.t. sw., normally open (Potter & Brumfield PR7A or Guardian type 200-2)
S_1—S.p.s.t. microswitch on drum (See text)
Motor—117 volt motor (See text)
Dry Cells—6 volt battery
Push-button—Push-to-close sw.

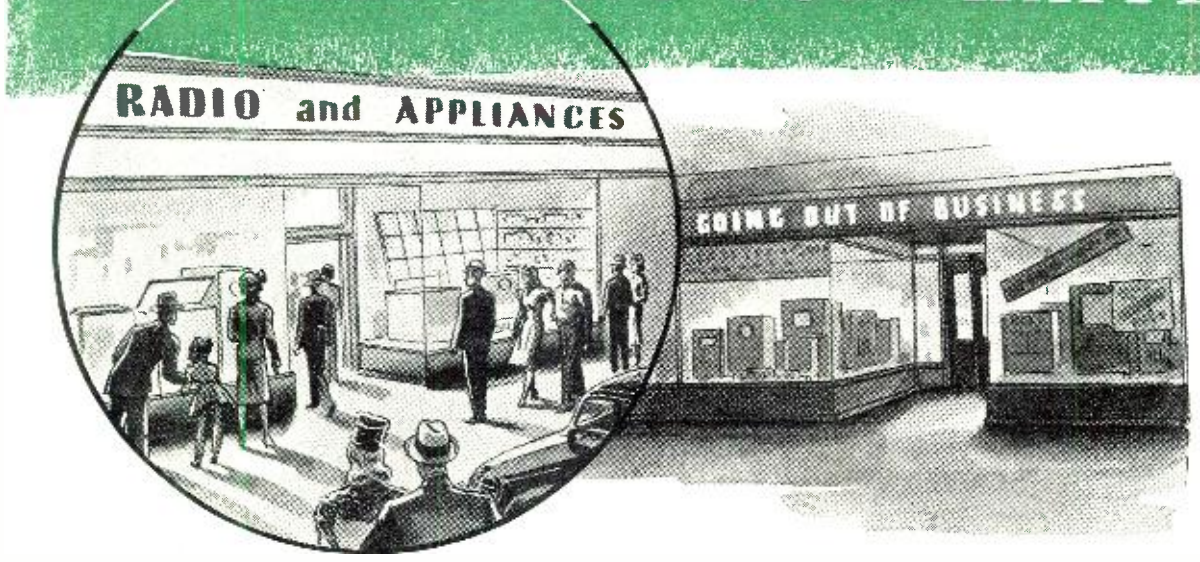
Fig. 2. Diagram for motor drive assembly.

Fig. 3. Schematic diagram of relaxation oscillators, amplifier, and power supply.



R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}—See text
R_{11}—500,000 ohm, ½ w. res.
R_{12}—470 ohm, 1 w. res.
R_{13}—7500 ohm, 10 w. res.
C_1, C_2, C_3, C_4, C_5—See text
C_6—.001 μfd., 400 v. cond.
C_7—.01 μfd., 600 v. cond.
C_8—25 μfd., 50 v. elec. cond.
C_9—30 μfd., 400 v. elec. cond.
N_1—Neon lamp (GE NE-16)
S_1—S.p.s.t. toggle sw.
F_1—117 volt line fuse
T_1—Power trans. 350-0-350 v. @ 60 ma.; 5 v. @ 3 amps.; 6.3 v. @ 2 amps.
T_2—Output trans. (Single 6F6 to v.c.)
CH_1—20 hy., 60 ma. filter choke
Spkr.—6" PM speaker
1—6F6 tube
1—5U4 tube
1—VR-105 tube

FAILURES DON'T JUST HAPPEN!



By
DR. LOUIS BADER
Assoc. Prof. of Marketing, School of Commerce, N.Y.U.

With unprecedented opportunities existing in the retail field no radio dealer needs to fail. Using tested business techniques can avert disaster.

PRIOR to World War II the death rate among retail stores was high. It was not unusual for 20 per-cent to 25 per-cent of new retail stores to close up in their first year for a variety of reasons. Within three years 50 per-cent of them closed. In some years, in the 1930's, 200 to 300 thousand small businesses closed their doors. Where small businesses closed because of failures that took the owners through bankruptcy proceedings the reasons for the failures were stated by impartial students as due to the incompetence and inexperience of the owner and lack of capital, which together accounted for roughly over 75 per-cent of the failures. Competition, fraud, failure of others, depression, and other reasons accounted for the rest. Incompetence could consist, among other things, of having too many radios in stock at the wrong time.

Since 1940 failures have been small in number and many newcomers among small business men probably do not realize that failures occur or why. Quite possibly we shall be out from under the abnormal conditions of the war and its aftermath within another year or two and many businessmen will have to look the *devil of failure* in the eye. If you are one of these men, are you going to be able to say "Get thee behind me, Satan?" Believe it or not, you can say it.

We could develop this lugubrious thesis that many small business enterprises cannot be successful because of the owners' incompetence, inexperience and insufficiency of capital; that these owners should not have started their businesses because they were not necessary; that the location selected was not the right one; or that the necessary investigation as to the possibility of success was not made, and so on.

Such an article would be negative and no great good would be served. We want to be constructive, and we contend that small business enterprises do not need to fail or close up shop,—especially in the radio and appliance service-dealer field except under the special circumstances that it should not have been started at all. We base our assumption on:

1. *The big market* that should exist over the next 10 or 15 years for radios, appliances, and their servicing.

2. The small businessman need not be incompetent and inexperienced and he can make his capital be sufficient to establish a business and grow into success.

Take the first of these—*the big market*. There are more than 143,000,000 people in the United States and by 1960 there will probably be about 160,000.000. This number breaks down into nearly 40,000,000 families. About 30,000,000 of these are now being served with electricity. The electric power companies will catch up to another 5,000,000 families over the next ten years. Nearly 3,000,000 of these 40,000,000 families are doubling up with other families. During the next ten years many of these and 5,000.000 more other new families will move into homes of their own. Several million of the older families will move into new homes. On top of this we now know we can reach an annual national income of more than two hundred billion dollars by 1960 if we wish. A huge sum will be spent each year for homes not now equipped, for new homes needing full equipment, and for replacement of worn and obsolete appliances, radios, and television sets. There is good reason to believe that the sum so spent will, over a period of years, average out at more than three billion dollars annually and may possibly reach five billion dollars. Look at the appliances (Table 2) that can be offered through your store to prospective customers, and think of the new devices which might come on to the market during the next 15 years. Except for radios, in the field of large appliances, we are far from the point of saturation. In fact, the market for television sets is only beginning. In addition many of the appliances in use are obsolete and should be replaced. All the while that the dealer works in this market to secure business there is a steady run of business coming along in the servicing end of this industry. All the large appliances sooner or later need servicing. An aggressive and progressive service department

will dig out and receive a substantial amount of business in this field and encourage the purchase of new products. Do you wonder, Mr. Dealer, why some people grow almost lyrical over the business possibilities in this industry? You must, too, if you want to have the right attitude toward the possibilities of growth for your business.

There is one short-run hitch to this exposition of the size of the market. Most economic analysts and a good many businessmen expect a recession in business beginning sometime in 1948. A survey among the members of the New York Credit Men's Association shows 80 per-cent of them expect this recession. They think so because prices are high, it is getting harder to sell, and inventories are piling up. Because of what followed World War I, a recession can be expected. But, even among those who expect one, many believe it will not be severe nor of long duration and that after it a prolonged period of prosperity will follow. We are inclined to be optimistic and, therefore, we do not expect much of a depression, but look for a long period of prosperity. However, we must not forget that recession or depression results largely from what men do. Quite possibly men might this time do the things that effectively put the brakes on a depression and set the wheels of prosperity whirling. Anyway, that is what I hope will happen.

Now for the second proposition, which in effect is to be a statement on how to build a successful business. Such a statement should be worth a million dollars. It is believed that ordinarily for every successful concern 20 to 25 others in the same industry are only just getting by and still others by the hundreds fail, and by the thousands just close up.

A good many small businessmen start their business adventures on an emotional basis, "they want to be their own bosses." Apparently they do not ask the questions, "Is there a real need for my business; have I something to offer customers that is distinctly to their advantage and, therefore, worth their while to give me their trade?" Many small businessmen start out hopelessly handicapped by this highly selfishly emotional basis which constitutes, in all too many cases, the main reason for opening a new business.

There is nothing dishonorable about wanting to be one's own boss, but a business to be successful in *getting and keeping customers* must be based on service—service to those whose patronage is necessary to the success of the enterprise. If you don't know what service you should give, or if you are not prepared to give it, then you should not start a business or you

(*Continued on page* 198)

CUSTOMER RELATIONS

1. We greet as many customers as possible by name.
2. We have a personal word or two with customers, when possible.
3. We greet customers immediately when they enter the store even if we must keep them waiting before serving.
4. We take the greatest of care to assure the utmost courtesy in handling customers, even the difficult ones. Staff avoids giving a flat "no" to a request for merchandise not in stock.
5. We try to have patience in explaining official regulations to customers in a conciliatory fashion.
6. We give special consideration to the tired shopper.
7. We distribute available goods equitably among regular community customers, and also among acceptable new people in the community.
8. We avoid the patronizing phrase "we can let you have" and use instead "we will see that you get."
9. We express genuine regret when unable to supply customers' requirements.
10. We consult customers regarding ways of improving service.
11. We refer customers to a competitor when we are out of an item and are not afraid to express praise of a competitor.
12. We will do favors for customers gladly, not grudgingly.
13. We pay attention to newly married couples.

STAFF ENCOURAGEMENT

14. We are obliging over minor requests from customers.
15. We encourage clerks to take added care in personal appearance, and to smile.
16. We endeavor to work out a bonus plan for clerks which will give them an interest in the store as a whole.
17. We study the methods used by chain stores and other stores in nearby towns and cities to see what methods can be adapted to our own store.
18. We develop a complete store re-arrangement plan and then undertake one section at a time as money and material become available.
19. We modernize store front if materials are available.
20. We carry on painting of outside and inside of store more or less continuously.
21. We cut down old-fashioned, high type of shelving to present a modern streamlined appearance.
22. We clean window background, paint or renew to create best effects.
23. We remove window backgrounds wholly or partially so as to allow a view from the street right into the store—the whole store becomes a show window.
24. We departmentalize our store for easier unit stock control, and put plans into effect in at least one department by way of getting the system started well in advance.
25. We maintain spacious aisles, not crowded.
26. We arrange merchandise to encourage self-selection.
27. We move counters back to within about 2½ feet from shelving to provide maximum aisle space for customers and eliminate as many counters as possible, replacing them with modern bunks.
28. We set up a self-serve section where it is feasible.

MERCHANDISE

29. We give customers suggestions about related merchandise in other departments.
30. We keep both reserve stocks and counter stocks orderly and clean.
31. We carefully study substitute merchandise to avoid undue inventories and to make sure of timely liquidation.
32. We instruct all clerks to keep a "Want Book."
33. We review stock regularly to find out why certain lines are not selling.
34. We continue special seasonal promotions of appropriate goods.
35. We display odd and broken lines for quick sale and eliminate all old goods.
36. We add a certain amount of novelty merchandise to brighten up current offerings.
37. We maintain prominent display of free supply goods.
38. We maintain a small stock of scarce goods for emergency purposes, regardless of other demands.
39. We make a special effort to procure short-supply goods in genuine cases of emergency need.
40. We set up a desirable objective for stock turnover in each section of store.
41. We concentrate on quality merchandise and avoid buying inferior goods merely because they are available.

PRICING

42. We bring prices into line with current cash competition.
43. We maintain established special discounts for churches, etc.

DISPLAYS

44. We change window displays at regular intervals even more carefully than in normal times, in order to avoid a "tired" appearance.
45. We keep making attractive innovations in the store, featuring one section after another to give old customers something new to look at.
46. We make use of empty shelving for display purposes by use of display alcoves.
47. We create a patriotic or seasonable atmosphere in store displays.

ADVERTISING

48. We maintain local advertising.
49. We maintain direct mail promotions.
50. We donate advertising space in local papers to patriotic or charity campaigns.

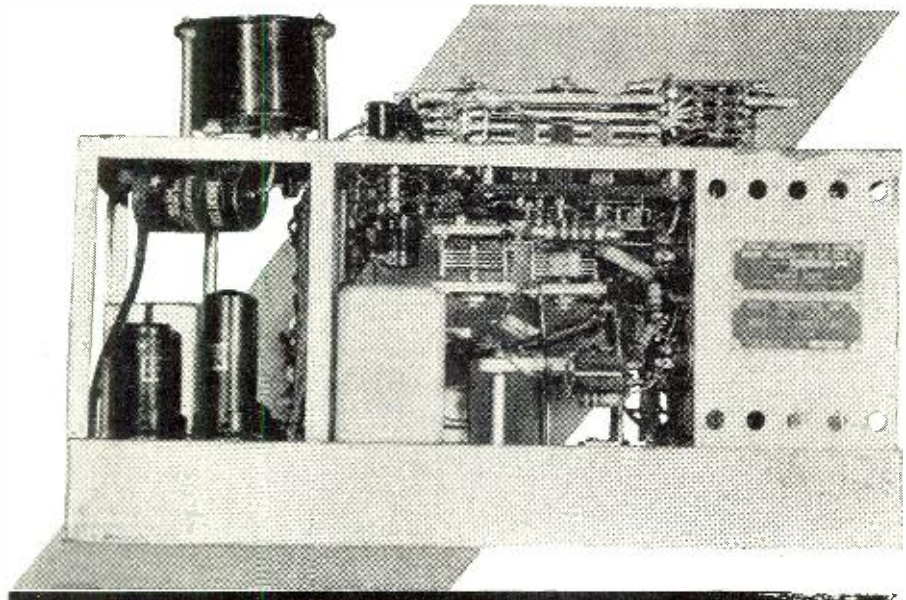
COMMUNITY AFFAIRS

51. We join the organization of merchants for improvement of local merchandising, and to assist in local patriotic work.
52. We participate in local charity organizations such as Red Cross,—but avoid "trying to run things."
53. We attend meetings of farm forum radio programs to keep informed on farmers' problems.
54. We influence town officials to provide parking space for farmers and others.
55. We avoid extremes in shortening store hours, having due consideration for farmers' and workers' shopping time.

SUPPLIER RELATIONS

56. We concentrate buying with few suppliers and work faithfully with the salesmen concerned.
57. We take full advantage of ways in which reliable wholesalers can be of assistance.
58. We ask salesmen and other friends to suggest improvements which may have been overlooked.
59. We visit suppliers as regularly as possible and ask for their advice.

Table 1. Fifty-nine ways to gain customers' good will as suggested by R. F. Chisholm in his book, "Your Own Store and How to Run It."



Bottom view of converted SCR-522 war surplus unit. All changes, as explained in the text, can be made without difficulty.

Putting the 522 TRANSMITTER on 6 and 10 METERS

By H. S. BRIER, W9EGQ

Only minor changes are required to convert this popular war surplus item into a workable ham rig.

THE "522" (625A) transmitter works as well on six and ten meters as on two meters. Its reputation on two meters makes it unnecessary to say more. The conversion is simple, and should take less than an hour to complete.

Locate the 20 μμfd. ceramic coupling condensers between the 12A6 frequency multiplier tank condenser and the 832A tripler grids. Unsolder them from the condenser and bend out of the way. Next unsolder the 20 μμfd. coupling condensers between the tripler plate circuit and the final amplifier grids from the hairpin tank.

Connect the free ends of the amplifier grid coupling condensers to the stators of the 12A6 tank condenser with two lengths of #12 wire. These leads should be exactly the same length, and are run through ventilating holes in the chassis on each side of the tripler tube socket. This removes the 832A tripler from the circuit, and the tube should be removed from the socket.

For ten meters approximately ten μμfd. of capacity must be added to the 12A6 tank circuit. Either a 3-30 μμfd. ceramic trimmer condenser, or a ceramic fixed condenser may be used. The easiest place to install it is where the #12 wires join the amplifier grid coupling condensers.

Remove the final amplifier and antenna coils. Replace them with ten-meter coils, specifications for which are given in Table 1. If a balanced feeder system is to be used, remove the jumper grounding one antenna output terminal at this time. This completes the changes required for ten-meter operation. Tuning instructions and power requirements will be given later.

For six-meter operation the 832A tripler is removed from the circuit as outlined above, and three turns are removed from the 12A6 tank coil. This coil is supported by its leads beside the tuning condenser. At first glance it appears almost impossible to remove this coil without dismantling the transmitter. Actually it comes out with little difficulty. The coil contains 15 turns, tapped at the eighth turn. Remove two turns from the eight-turn end, and one turn from the other end, and re-install the coil.

The oscillator will cover almost the entire six-meter band without change; however to reach 54 megacycles, one turn must be removed from the oscillator coil. Replace the final amplifier and antenna coils (see Table 1), and unground the output link, and the 50-54 megacycle conversion is completed.

Original power requirements were 300 volts at 250 milliamperes, "B," 150 volts at ten milliamperes bias, and 13 volts at 2.35 amperes for filaments. Eliminating the 832A tripler reduces the "B" drain to 150 milliamperes, and the filament drain to 1.55 amperes. A few additional changes permit further simplification of the power requirements by eliminating the bias supply.

To do so three steps are necessary: Unground the 12A6 modulator cathodes, and return to ground through a 225-250 ohm, five watt resistor. Next remove the load from terminal four of the modulator driver transformer (part number 159) and ground the terminal to the chassis. Finally, replace the 6000 ohm grid resistor of the 832A amplifier with one of 15,000 ohms. This resistor is mounted on the partition separating the audio and r.f. sections of the transmitter, and alongside of plug 123-2.

Power connections to plug 123-2 are as follows: 300 volts to pin three or four (they are connected together); bias, if used, to pin one; hot filament to pin two; and pin eight is the common ground. A single-button carbon microphone with a three-volt battery in series connects between pin one of plug 123-1 and ground.

The transmitter is designed to use four pretuned frequencies, and while the sliders, etc., may be removed without difficulty, this feature is even more easily retained. Push the first slider home, and measure the distance from it to the protruding end of the next slider. Allow the slider to spring back to its original position. Then drill a one-eighth inch diameter hole through all four sliders. The center of this hole should be exactly one-sixteenth of an inch less than the previously measured distance from the end of the sliders. To choose a channel, the correct slider is pushed home, and a one-eighth inch metal shaft inserted in the hole through the remaining sliders; thereby holding them in position.

Tuning is simple. Connect a one milliampere meter, with an internal resistance of 100 ohms, to the meter terminals. Loosen the wing nuts on

(*Continued on page* 112)

New Band FM Receiver

By

J. C. Michalowicz

Dept. of Elec. Eng.
Catholic University of America

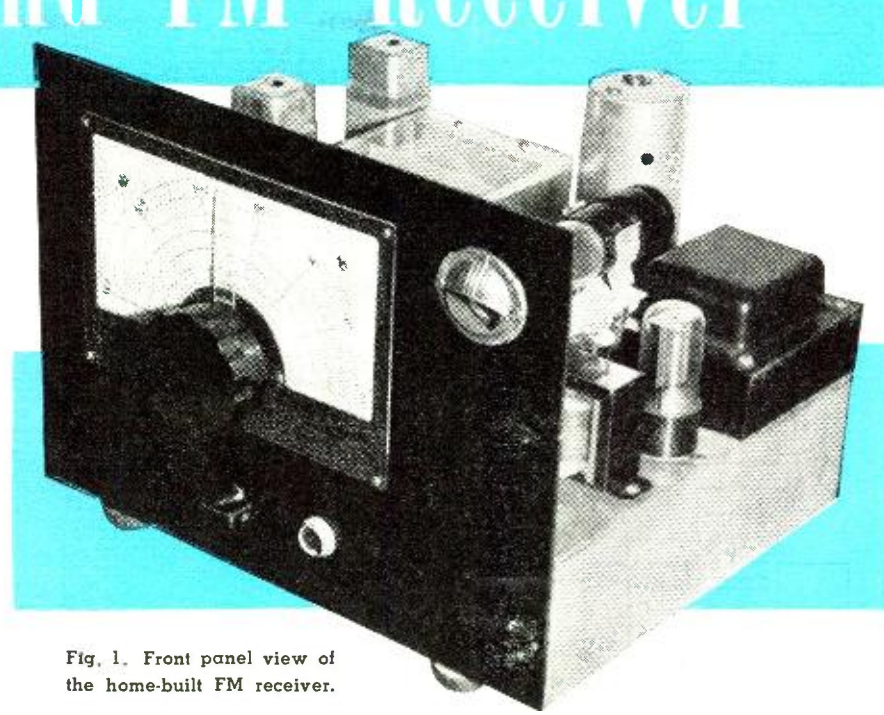


Fig. 1. Front panel view of the home-built FM receiver.

Complete construction details for building your own new band, 88-108 megacycle, home receiver.

THE constant effort to obtain interference-less, high-fidelity radio reception, has resulted in the birth of the frequency modulation receiver. The rapid progression from the use of the 50 mc. band to the new FCC-allotted 100 mc. band, has shown a need for an easily constructed receiver, using readily obtainable tubes and components. Conventional circuits and practice are followed in the design of this receiver in order to keep to a minimum the need for fussy and tedious adjustments and alignment. The heterodyne high frequency section consists of a trio of the popular acorn-type tubes; a 956 for the input high-frequency amplifier, a 955 as the high frequency local oscillator, and a 954 as the frequency converter. The two stages of intermediate frequency amplification use 6AC7's followed by two limiter stages using 6SH7's. A double-diode 6H6, used for the discriminator, rounds out the frequency modulated section. The rectified plate voltage is obtained through use of a 5Y3 full-wave rectifier and a VR150/30 is used to stabilize the high-frequency plate voltages. A 6U5 tuning eye is incorporated to facilitate ease in accurate tuning. The tube complement was especially chosen to include such tubes as have been made readily available through the surplus market.

Since not only simplicity in design but also neatness in appearance is the aim in the layout of this receiver, the elimination of all but the "essentials" is effected on the front panel, as shown in Fig. 1. The main tuning condenser dial, a *National* type ACN, has the place of prominence, directly below which is the volume control knob coupled to the "on-off" switch. The tuning eye is placed as high as possible for ease of visibility, and with the audio output jack placed in line with the volume control. completes the layout of the front panel controls. The rear chassis attachments consist of (reading from left to right as shown in Fig. 4) 117 volt a.c. input receptacle, 117 volt a.c. output receptacle for auxiliary apparatus such as an audio amplifier, an optional speaker jack if the audio amplifier is mounted on the same chassis and, finally, the limiter microammeter receptacle.

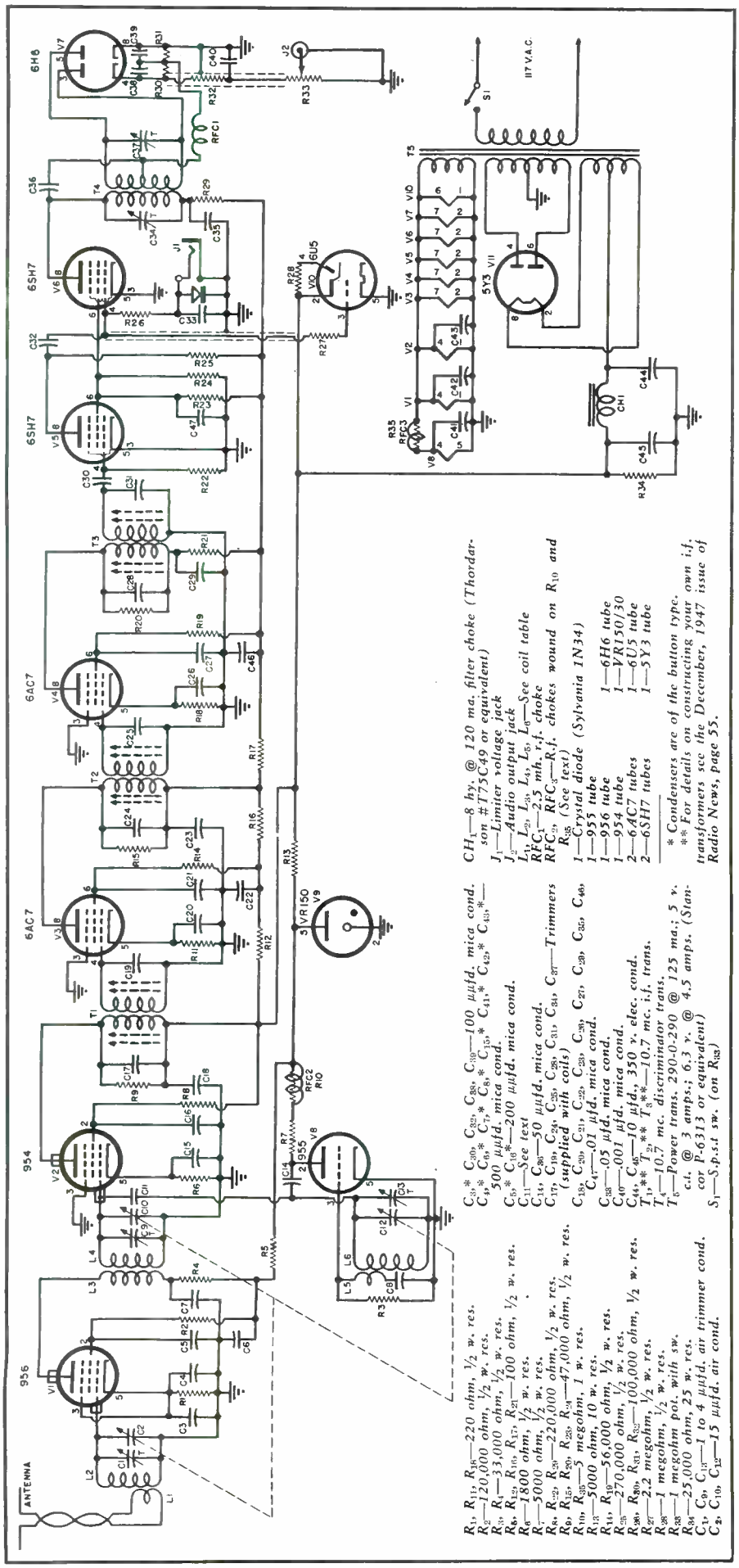
All components, with the exception of the high frequency amplifier-oscillator-mixer stage, are mounted on a metal 12" x 10" x 3" chassis, as shown in Fig. 5. Reading clockwise around the high-frequency subchassis are the two stages of intermediate frequency amplification consisting of T_1, V_3, T_2, V_4, and T_3; the two limiter stages, V_5 and V_6; and the discriminator stage, T_4 and V_7. The rectified power supply with its transformer, T_5, the full-wave rectifier tube, V_{11}, the voltage regulator, V_9, and the filter units, CH_1, C_{14}, and C_{15} are placed as a group at the lower right.

The high frequency stage is constructed as an integral unit, primarily to provide the ultimate in interstage shielding and secondly, to allow for convenience in aligning the unit alone. This unit is shown with its top and two side plates removed in Fig. 3. It consists of an aluminum box 7" x 3¾" x 3" in size. A piece of lucite is used as the top for this unit, with holes drilled directly above the air trimmers, C_1, C_8, and C_{13}, to facilitate ease in alignment. Three 15 $\mu\mu$fd. variable condensers, C_2, C_{10}, and C_{12}, are used as the main tuning device, being ganged together by means of fiber-disc flexible couplers.

The forward compartment of the unit includes the input grid coil, L_2 and the condenser, C_2 (not visible in Fig. 3). This tuned circuit is connected to the grid pin of the 956 amplifier tube which protrudes through the interstage shield. Antenna input is provided through a double-holed receptacle to which is connected the input inductor, L_1. This receptacle is mounted on the top cover of the high frequency unit and is shown lying beside the subchassis in Fig. 3. The middle compartment houses the 956 amplifier tube, the 954 mixer and the mixer tuned circuit, L_4 and C_{10}. The plate pin of the 954 mixer passes through the bottom of the sub-chassis, thus being completely shielded from the high frequency network. The aft compartment contains the local oscillator circuit, consisting of the 955 oscillator-triode and its tuned-grid circuit, L_6, C_{12}. Oscillator-mixer coupling is obtained by merely inserting an insulated conductor through the interstage shield from the oscillator compartment into the mixer compartment and terminating it in the near vicinity of the mixer grid. This is indicated on the wiring diagram as C_{11}. With the exception of the high frequency amplifier grid inductor, L_2, and the antenna coupler, L_1, all the coils are mounted on ½ inch polystyrene forms cemented in place.

Electrical Circuit

The schematic diagram of the receiver is shown in Fig. 2. The 950-series tubes adapt themselves very



R_1, R_{11}, R_{36}—220 ohm, ½ w. res.
R_2—120,000 ohm, ½ w. res.
R_3, R_4—33,000 ohm, ½ w. res.
R_5, R_{12}, R_{16}, R_{17}, R_{21}—100 ohm, ½ w. res.
R_6—1800 ohm, ½ w. res.
R_7—5000 ohm, ½ w. res.
R_8, R_{22}, R_{26}—220,000 ohm, ½ w. res.
R_9, R_{15}, R_{20}, R_{29}—47,000 ohm, ½ w. res.
R_{10}, R_{35}—5 megohm, 1 w. res.
R_{13}—5000 ohm, 10 w. res.
R_{14}, R_{19}—56,000 ohm, ½ w. res.
R_{25}—270,000 ohm, ½ w. res.
R_{30}, R_{31}, R_{32}—100,000 ohm, ½ w. res.
R_{27}—2.2 megohm, ½ w. res.
R_{28}—1 megohm, ½ w. res.
R_{33}—1 megohm pot. with sw.
R_{34}—25,000 ohm, 25 w. res.
C_1, C_9, C_{13}—1 to 4 $\mu\mu$fd. air trimmer cond.
C_2, C_{10}, C_{12}—15 $\mu\mu$fd. air cond.
C_3*, C_{30}, C_{32}, C_{39}, C_{40}—100 $\mu\mu$fd. mica cond.
C_4, C_6*, C_7*, C_8*, C_{15}*, C_{41}*, C_{42}*, C_{43}*—500 $\mu\mu$fd. mica cond.
C_5*, C_{18}*—200 $\mu\mu$fd. mica cond.
C_{11}—See text
C_{14}, C_{38}—50 $\mu\mu$fd. mica cond.
C_{17}, C_{19}, C_{24}, C_{25}, C_{28}, C_{31}, C_{34}, C_{37}—Trimmers (supplied with coils)
C_{16}, C_{20}, C_{21}, C_{22}, C_{23}, C_{26}, C_{27}, C_{29}, C_{35}, C_{36}, C_{47}—.01 μfd. mica cond.
C_{33}—.05 μfd. mica cond.
C_{40}—.001 μfd. mica cond.
C_{44}, C_{46}—10 μfd., 350 v. elec. cond.
T_1,** T_2,** T_3**—10.7 mc. i.f. trans.
T_4—10.7 mc. discriminator trans.
T_5—Power trans. 290-0-290 @ 125 ma.; 5 v. c.t. @ 3 amps.; 6.3 v. @ 4.5 amps. (Stancor P-6313 or equivalent)
S_1—S.p.s.t. sw. (on R_{33})
CH_1—8 hy. @ 120 ma. filter choke (Thordarson #T75C49 or equivalent)
J_1—Limiter voltage jack
J_2—Audio output jack
L_1, L_2, L_3, L_4, L_5, L_6—See coil table
RFC_1—2.5 mh. r.f. choke
RFC_2, RFC_3—R.f. chokes wound on R_{10} and R_{38} (See text)
1—Crystal diode (Sylvania 1N34)
1—955 tube
1—956 tube
1—954 tube
2—6AC7 tubes
2—6SH7 tubes
1—6H6 tube
1—VR150/30
1—6U5 tube
1—5Y3 tube

* Condensers are of the button type.
** For details on constructing your own i.f. transformers see the December, 1947 issue of Radio News, page 55.

well to this 100 megacycle application when utilizing conventional circuits. At these frequencies, however, great care must be taken to minimize lead length and reduce parasitic oscillations. The use of the new "button" type, low capacitance condenser will be found to have an advantage in such circuits, since its construction permits direct connection to other components and tube socket terminals without the use of any hook-up wire whatsoever. The use of mica condensers throughout the other circuits will be found more desirable than the use of paper condensers.

Each one of the tuning condensers has its own trimmer, a 1 to 4 $\mu\mu$fd. air condenser. Mica trimmers are not desirable at these frequencies, as they are not as stable as air condensers and are more susceptible to "drift" due to the change in atmospheric conditions. The oscillator signal is still further stabilized by the use of a voltage regulator tube in the plate voltage circuit. The oscillator heater and plate chokes, RFC_3 and RFC_2, consist of about 60 turns of #28 enamelled copper wire wound on a conventional one watt, 5 megohm carbon resistor. The design data for the various high-frequency inductors may be found in Table 1. These coils have been designed to be used with an i.f. frequency of 10.7 mc.

Closer adjustment for the desired bandwidth and resonant points can be obtained by increasing or decreasing the spacing between turns, if the variation of the number of turns affords too coarse an adjustment. The inductance of the coil L_1 depends, of course, upon the impedance of the input transmission line and should be constructed to comply with its characteristics. Specifications as shown for L_1 are for use with a 300 ohm antenna feed-in line.

The intermediate frequency circuit consists of two stages using 6AC7 pentodes. Although the i.f. transformers used in the receiver built by the author were home constructed, commercial products having a 10.7 mc. mid-frequency will operate as well. Such transformers are readily available, the *National Company's* IFM and IFN transformers being of a suitable type. Parasitic oscillations in these stages are kept to a minimum by careful interstage shielding, generous use of mica condensers, and the occasional insertion of 100 ohm resistors in the screen-grid and plate circuits. The use of these low-value resistors offers enough impedance at these high frequencies to be very effective and yet have negligible resistance to the flow of direct current.

Two limiter stages are employed since the use of only one limiter stage allows considerable interference, especially ignition noise, to come through, whereas the additional stage cuts this interference to zero. How-

Fig. 2. Complete schematic diagram of the FM tuner. A good, high-fidelity audio amplifier should be used in conjunction with the unit.

ever, if the interference resulting from the use of a single limiter stage is not objectionable, more over-all gain can be obtained by replacing a limiter stage with an additional i.f. stage, since the gain per limiter stage is usually no more than unity. But good engineering practice demands the use of two limiter stages for high quality reception, and the sacrificing of this single stage for more gain is poor economy. The time constants in limiter circuits should be relatively fast. The time constant of the grid circuit of the first limiter stage, consisting of R_{22} and C_{30}, is almost twice that of the second limiter stage consisting of R_{26} and C_{32}. Thus, whatever interference is allowed to pass the first limiter stage is made negligible by the time the signal reaches the discriminator stage. A meter jack for a microammeter is inserted in the grid circuit of the second limiter to aid in i.f. transformer and high frequency stage alignment.

The discriminator stage employs the conventional 6H6 double-diode for frequency demodulation. Here, again, the discriminator transformer was constructed by the author, but a *National Company* IFL transformer will serve as well. The output of the discriminator is terminated in an audio frequency de-emphasizer network consisting of R_{32} and C_{40}. The purpose of this network is to de-accentuate the frequency emphasis toward the upper audio frequency that is introduced in an FM transmitter. The de-emphasizer is connected to a one-megohm potentiometer and then to the audio output jack. No audio circuit is provided, although the power circuit has ample capacity to energize a single audio stage, employing, say, a 6V6 beam-power amplifier.

It must be kept in mind that since high fidelity is the aim of frequency modulation reception, good engineering should not end with the completion of the discriminator stage. The output should be terminated in an amplifier, flat within 2 db. of 1000 cycles-per-second over the audio range from 50 to 15,000 cycles-per-second. An amplifier, employing two stages of "Class A" amplification, transformer-coupled to a push-pull 6V6 stage will serve the purpose very well. Also, no compromise should be made in the physical size of the speaker. It should be at least a 12-inch model mounted within an efficient baffle.

The rectified plate voltage supply needs no explanation, emphasis being placed on good filtering, consisting here of a *C-L-C* network. A VR150 tube, a gaseous regulator, is incorporated to prevent any drift in the oscillator and mixer stages.

Alignment

The alignment of an FM receiver consists of practically the same tests that are performed upon an AM receiver, although certain precautions must be heeded in order to obtain the best of results. If a FM signal generator is available, its use is most desirable but not absolutely essential. If the conventional amplitude modulated signal generator is to be used, it must, of course, cover the 100 megacycle band. It must also generate a signal in the 10 megacycle neighborhood with good frequency spread, since the FM circuits have a bandwidth of as much as 200 kilocycles.

The best portion of the receiver in which to start alignment, is the intermediate frequency amplifier circuit. Since the limiter input voltage and the applied antenna signal strength have to bear a definite relation to each other, it is the limiter voltage that should be inspected in making the alignment tests. An appropriate microammeter inserted in the jack, J_1, will measure this voltage. Many persons have the habit, in aligning FM as well as AM receivers, of obtaining an over-all characteristic of the entire i.f. amplifier, rather than stage by stage. Such a procedure consists of varying, at random, all the different adjustments of the i.f. transformers until the over-all characteristic appears to be satisfactory. In narrow-band AM, this procedure may be permissible, but in broad-band FM, this technique is not conducive to the production of the best quality. Such practice generally results, when applied to FM receivers,

(*Continued on page* 190)

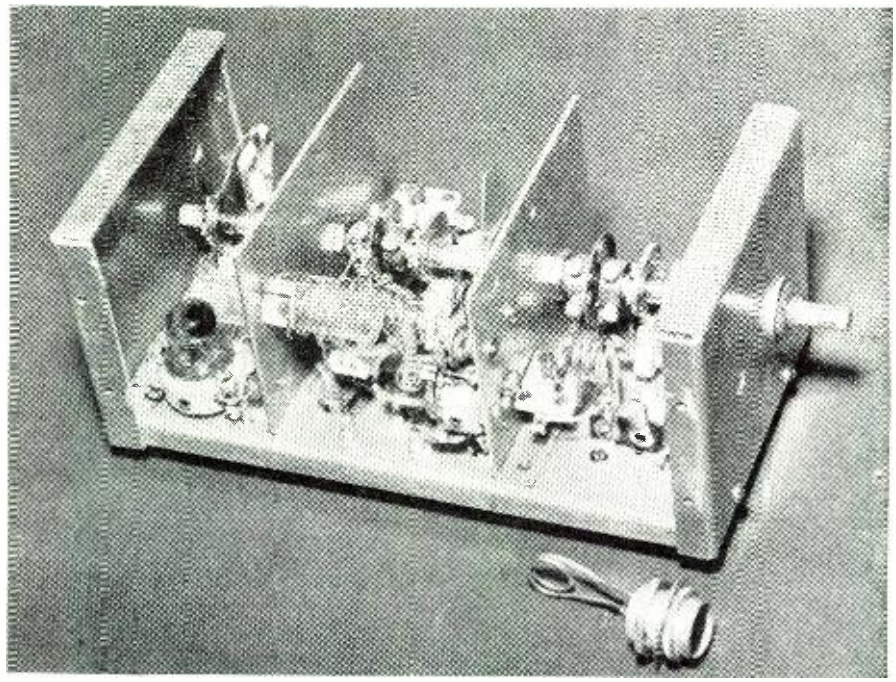
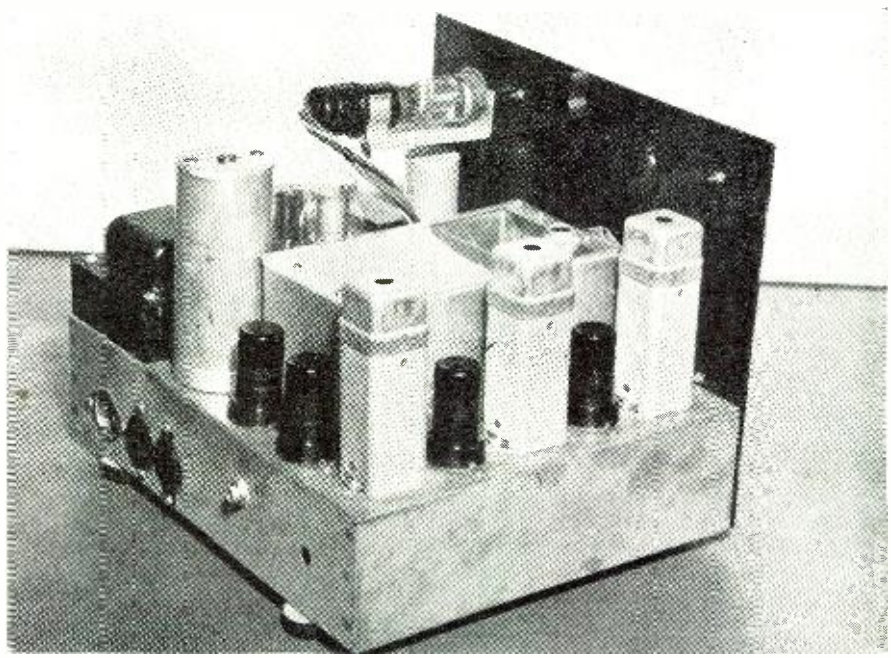


Fig. 3. Inside view of the high frequency sub-chassis assembly.

Fig. 4. Rear view of receiver. See Fig. 5 for identification of components.



A Versatile SERVICE TEST INSTRUMENT

By
C. T. HAIST, JR.

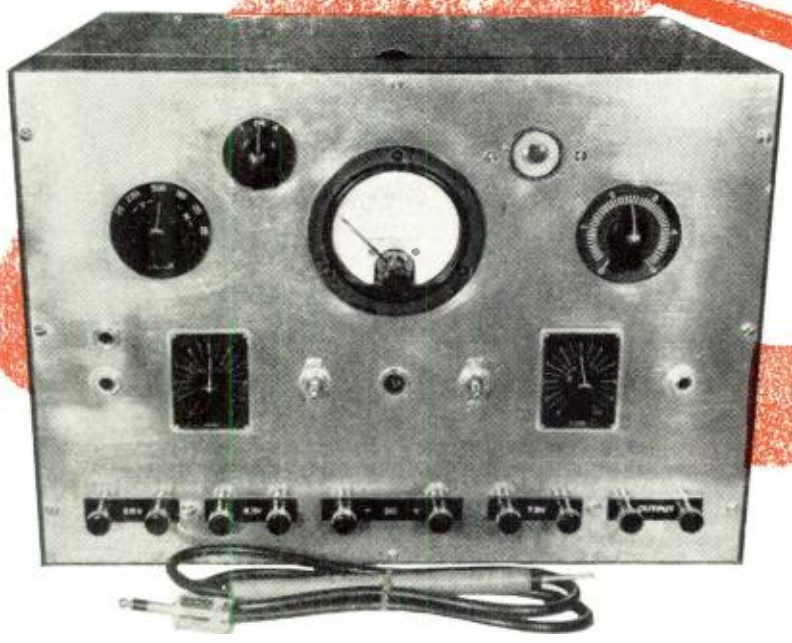


Fig. 1. Panel view of completed test instrument. For identification of various controls refer to the text.

All in one—this instrument provides a signal tracer, hi-fi audio amplifier, a variable d.c. output as well as various heater voltages.

HOW many times have you the experimenter, serviceman, or amateur wished you had a power supply at hand that would give you 2.5, 6.3, or 7.5 volts for a filament supply or a variable plate voltage supply for testing a new tube circuit; or how many times could you have used a good power supply for testing the low power stages of a new rig you just finished building? I bet you have also wished at sometime or another you had a built-up audio amplifier for testing detector and r.f. circuits, microphones, pickup units, and loudspeakers. A good public address system is also handy to have around, as well as an audio amplifier for troubleshooting a radio receiver by the audible signal method.

A piece of equipment that would do these things and then some was built for my workshop several months ago. It has really proved its worth in saving time and making tests and experiments less tiring. This unit is so simple in design and easy, as well as inexpensive, to construct, that its value was not fully appreciated. Friends that have seen this unit have commented on its value and expressed the desire to build a similar one. Because of the good results obtained and the enthusiasm of friends this article was written so other interested parties could build up a similar unit. All parts used in this construction were found in the junk box or purchased on surplus sales. The basic unit of this device is the power supply that will deliver about 350 volts at 200 mils. The output from the 5U4G rectifier is connected to a double section filter for obtaining a low percentage of hum ripple voltage. The supply output voltage is also continuously variable from 0-325 volts and delivers up to 75 mils. (More current may be had by paralleling the regulator tube). This is accomplished by a circuit consisting of a 6H6 which is connected in such a manner as to obtain a bias voltage for the grid of a current regulator tube such as a 2A3, 6A3, 6B4G or 6A5G. By varying R_{21} or the knob on the upper right hand side of the instruments panel the voltage is made variable from zero to the maximum voltage. In Fig. 1 the terminal strip along the bottom of the panel gives 2.5v., 6.3v., and 7.5v. a.c. which are supplied from a separate universal filament transformer. Terminals on the panel marked "—" and "+" are the variable "B" voltage while the terminals marked *"Output"* are for the fixed "B" voltage. The output voltage and current are indicated by a milliammeter on the front panel. A selector switch to the left of the meter selects the meter ranges of 25, 50, 250, and 500 volts and 2.5, 50, and 250 mils. These scales were chosen since the meter movement was 1 mil and the meter had a 0-25 volt scale, which saved drawing a new scale. A "50" was drawn with a numeral guide under the "25" at full scale, making interpretation of the different ranges selected easy. The metering circuit is connected to the power supply so it reads the voltage and current of the variable output terminals only. With the variable voltage control knob turned all the way up the meter reads the full output voltage of the supply.

The different range scales are achieved by adding series resistors for the voltage ranges and placing different shunts across the meter for the current ranges. The easiest and least expensive method of setting up the different ranges is to series or parallel resistors you may have on hand until the correct readings are obtained. With the power supply turned on and the voltage control set at maximum, set the meter selector switch to the 500 volt position. By means of an external voltmeter or multirange tester, measure the voltage at the "minus" and "plus" terminals. Insert the proper resistors in the meter circuit until the panel meter reads the same. This voltage will be around 375 to 400 volts, no load. With the range switch set for 250 volts, turn down the voltage control until the external meter reads

250 volts. Place the necessary resistor or resistors in the metering circuit until the panel meter reads 250 volts. The same procedure is followed for the other voltage scales.

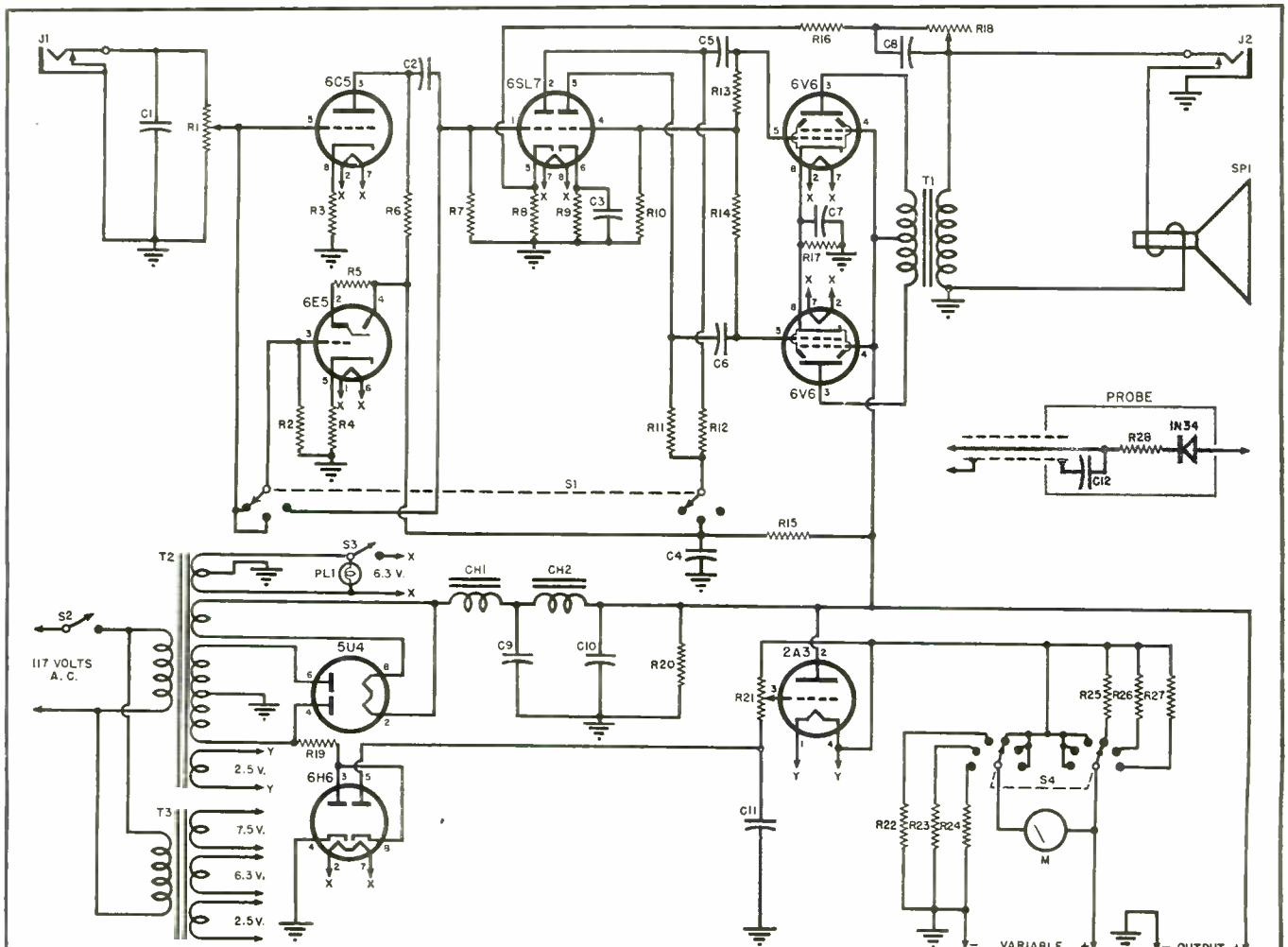
The current shunts are low resistance. They may be wound with #28 copper magnet wire if *Nichrome* is not available. The shunts are also selected by cut and try. The external meter is again used in series with a dummy load such as a 50 watt adjustable 4000 ohm resistor. The resistance is adjusted until the current is proper for full scale readings. The shunts are then connected so the panel meter reads the same as the external meter. If you know the resistance of your 0-1 mil. meter and want to spend the money for multipliers and shunts, it is an easy matter to calculate the proper values. Any radio handbook gives the formula for this procedure.

The power supply switch is located just to the right of the pilot lamp in the center of the instrument. A switch to the left of the pilot lamp controls the hi-fidelity audio amplifier operation by opening or closing the filament circuit to the audio tubes. This allows the use of the power supply without the load of the amplifier when it is not needed. In order to take full advantage of the versatile performance of this unit, an exceptionally good audio system is incorporated. A type 6SL7 dual triode functions as an audio inverter and drives two 6V6's in push-pull as a final amplifier. For high fidelity operation, control R_{18} is rotated to its minimum resistance position which shorts out condenser C_5. With this setting a small amount of the audio output is fed back to the cathode of the inverter tube thus producing inverse feedback at all frequencies. For bass boost, resistance R_{18} is increased thus placing condenser C_5 in series with the inverse feedback lead. This allows the higher frequencies to pass as before but effectively blocks the lower frequencies, thus preventing degeneration of the bass. In the high fidelity position, the audio response curve of the amplifier is essentially flat from 60 to 15,000 cycles and an output of 5 watts with less than 5% harmonic distortion is easily attainable.

A 6C5 triode amplifier is used ahead of the 6SL7 inverter to provide sufficient voltage gain for phono pickups and crystal microphones. Two input jacks, connected in parallel, are located to the extreme left of the panel. The double jack is not necessary but was installed in case, at a later date,

(*Continued on page* 166)

Fig. 2. Complete schematic diagram for service test instrument. The secondary winding of T_1 must be properly polarized with relation to the feedback circuit. Should oscillation occur, it would indicate that leads should be reversed.



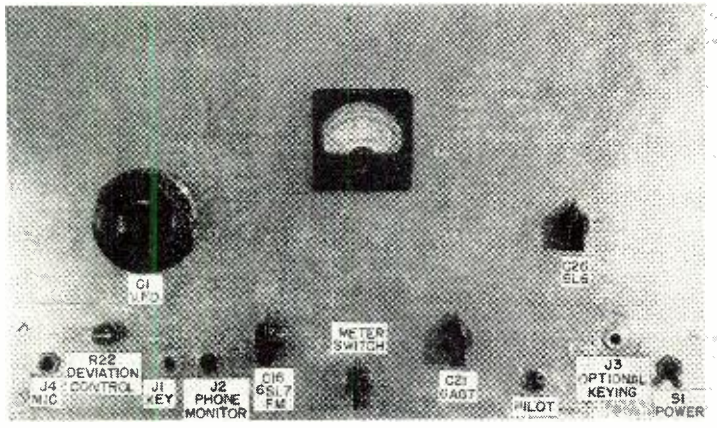
R_1—500,000 ohm linear taper pot.
R_2—1 megohm, ½ w. res.
R_3—2500 ohm, ½ w. res.
R_4—1000 ohm, ½ w. res.
R_5—2 megohm, ½ w. res.
R_6—50,000 ohm. ½ w. res.
R_7, R_{20}—500,000 ohm, ½ w. res.
R_8, R_9—3000 ohm, ½ w. res.
R_{10}, R_{11}, R_{12}, R_{13}, R_{14}—25,000 ohm, ½ w. res.
R_{15}—10,000 ohm, 10 w. res.
R_{16}—10,000 ohm, ½ w. res.
R_{17}—200 ohm, 10 w. res.
R_{18}—50,000 ohm rheostat
R_{19}—125,000 ohm, 1 w. res.
R_{20}—20,000 ohm, 25 w. res.
R_{21}—100,000 ohm pot.

R_{22}, R_{23}, R_{24}, R_{25}, R_{26}, R_{27}—See text
C_1, C_{12}—100 μμfd. mica cond.
C_2—.01 μfd., 450 v. cond.
C_3—10 μfd., 25 v. elec. cond.
C_4, C_9, C_{10}—8 μfd., 450 v. elec. cond.
C_5, C_8—.1 μfd., 450 v. cond.
C_7—25 μfd., 50 v. elec. cond.
C_8—.05 μfd., 450 v. cond.
C_{11}—1 μfd., 450 v. paper cond.
J_1, J_2—Closed circuit jack
T_1—Output trans. 8000 ohm p-to-p to 4 ohm v.c.
T_2—Power trans. 375-0-375 @ 200 ma.; 6.3 v. c.t. @ 3 amps.; 5 v. @ 2 amps.; 2.5 v. @ 2 amps.

T_3—Fil. trans. 2.5 v. @ 2 amps.; 6.3 v. @ 5 amps.; 7.5 v. @ 3 amps.
S_1—D.p., 3-pos. rotary sw.
S_2, S_3—S.p.s.t. toggle sw.
S_4—2-pole, 6-pos. rotary sw.
PL_1—6.3 v. pilot light
SP_1—6½" PM speaker
CH_1—5 hy., 200 ma. filter choke
CH_2—12 hy., 200 ma. filter choke
M—0-1 ma. d.c. meter (See text)
1—1N34 selenium rectifier
1—6SL7 tube
1—6E5 tube
1—5U4 tube
1—6H6 tube
1—6C5 tube
1—2A3 tube
2—6V6 tubes

A Simple NBFM TRANSMITTER

By
J. P. SIMMONS, W6EBT



Front panel view of completed narrow-band FM transmitter.

With but two frequency multiplier stages, this unit supplies 10 watts on 10 meters and a conservative 15 watts on 20, 40, and 80 meters.

THE much discussed and often praised BCI-less NBFM has been placed on an experimental basis on 3850-3900, 14,200-14,250, 28,500-29,000 and 51,000-52,500 kcs. Therefore, some simple, v.f.o.-controlled NBFM exciter-transmitter unit is in order. The exciter-transmitter to be described was designed with the intention of seeing just what could be done with a v.f.o. combining NBFM, voltage regulated power supply on the oscillator, break-in keying, and all-band operation. In this layout, each stage, beginning with the oscillator, was completed before proceeding to the next, thereby reducing the possibility of unexpected "bugs" and eliminating any as they showed up. This plan paid dividends, as the final product required only slight changes in the number of coil turns.

The author took advantage of surplus parts to keep down the total cost. For high quality NBFM operation, an inexpensive crystal mike may be used. Ads in current issues of RADIO NEWS were utilized to full advantage in purchasing parts for this rig.

As an exciter, this unit has sufficient output to drive a high-power beam amplifier like push-pull 813's. Experience has shown that *equal* results can usually be obtained from a simple variable-frequency oscillator followed by an efficient quadrupler than can be realized through the use of a crystal oscillator which doubles in its plate circuit followed by a doubler.

A glance at the schematic shows the 6SJ7 (V_1) v.f.o. operating on 80 meters. The 6AG7 (V_2) Class A r.f. amplifier serves as an untuned isolating r.f. stage. The 6SL7 (V_3) frequency modulator tunes as any r.f. amplifier, C_{16} also serving to vary the magnitude and phase angle of the R_p. Increased deviation is obtained in this FM circuit by use of a powdered iron-slug coil form. The author uses one obtained from a surplus SCR-522A crystal tuning circuit. It is ½ inch in diameter by 2 inches long. Any powdered coil form may be used, however.

The second 6SL7 (V_6) is used as a two-stage speech amplifier. An ordinary, inexpensive crystal mike works smoothly with this duo-triode speech amplifier.

The Frequency Modulator

The only noteworthy feature of this circuit is the FM adjustment shown in the schematic diagram. The condenser (C_{13}) is nothing more than two short lengths of insulated wire twisted together for three turns. The circuit arrangement is similar to the familiar plate neutralization. Here, however, the connection is for the purpose of increasing the frequency modulation. Once installed, no further adjustment is necessary.

In tuning the condenser C_{16}, it will be found that the plates will normally be set near ½ meshed and need hardly be touched during frequency changes of several hundred kilocycles in the v.f.o.

The phone-monitor circuit is handy for checking the quality of speech.

The Quadrupler

A 6AG7 (V_4), with the control and screen grids operating as in pentode amplification, serves as an efficient doubler, tripler, or quadrupler. The 6AG7 is capacity-coupled to the plate of the frequency modulator through C_{18}, a 100 $\mu\mu$fd. mica condenser. This stage is biased by a 1 megohm (R_{13}) resistor in the grid return. It also has an optional keying circuit. This is sometimes desirable as it permits the v.f.o. to be shifted and monitored (in the receiver) while the key is up. The combination of the 150 ohm resistor (R_{14}) and .01 μfd. bypass condenser (C_{19}) in the cathode circuit permits the stage to double, triple, or quadruple with sufficient excitation to the next doubler and allows the oscillator to be keyed on c.w. with a resulting clean cut note.

All of the ground return connections are brought to a single ground point on a tie-post mounted alongside the isolantite socket. With the cathode bias resistor indicated, the plate current is held to a safe value when the oscillator key is up.

The 6L6 Power Doubler

The output from the 6AG7 buffer, doubler, tripler, or quadrupler is fed directly from the 6AG7 plate to the 6L6 grid through a 50 $\mu\mu$fd. midget variable coupling condenser (C_{23}). Several values of coupling condenser were tried, however, and while the capacity was not found to be especially critical, a 50 $\mu\mu$fd. *APC* type gave optimum results. Bias on this stage

is obtained from two sources. Grid leak bias is provided by a 100,000 ohm resistor R_{17} in the grid return circuit. The tube is also biased by the use of a 400 ohm cathode resistor, R_{19}. The cathode is bypassed to ground by a .01 μfd. paper condenser (C_{21}). A 50 ohm, 1 watt resistor in series with the grid leak and another in the plate circuit are provided for reading 6L6 grid and plate currents. The meter switch is connected directly across same. A series resistor (R_{20}) supplies the screen voltage and the screen is bypassed with C_{25}, a .02 μfd. paper condenser. Series feed is used but the ground potential end of L_5 is bypassed to allow the plate condenser to be directly mounted on the metal panel.

Inspection of the photograph shows a large space where the 6L6 coil is located. The author has planned a bandswitching coil assembly with "end links" to be placed here.

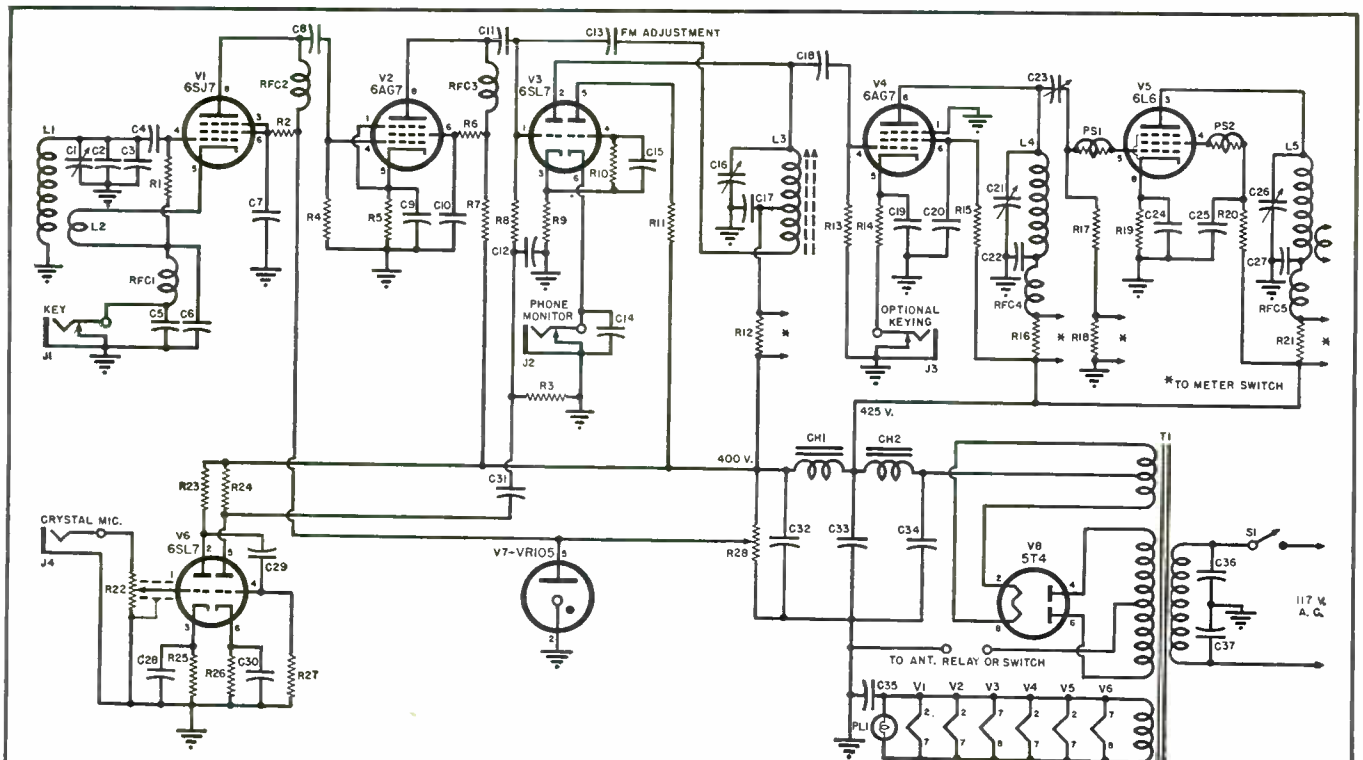
Mechanical Details

The author's v.f.o. covers 3488-4050 kc. The photographs show the method of attaching the v.f.o. tuning condenser. Duraluminum (galvanized iron can be used, too) brackets were bent to proper size in an ordinary bench vise. Two brackets are used, one underneath and the other in front of the v.f.o. main tuning condenser. The vernier dial (from a surplus Army coil unit) is secured to the front panel and coupled to the v.f.o. condenser via an insulated coupling. However, a metal one may be used. The v.f.o. coil form was also individually shielded to further isolate and eliminate temperature changes. (An empty rectangular spice can may be used for the v.f.o. coil shield). The v.f.o. coil was secured to the chassis with four machine screws, the coil connections being run directly through large holes in the chassis, connections being made to the screws projecting underneath.

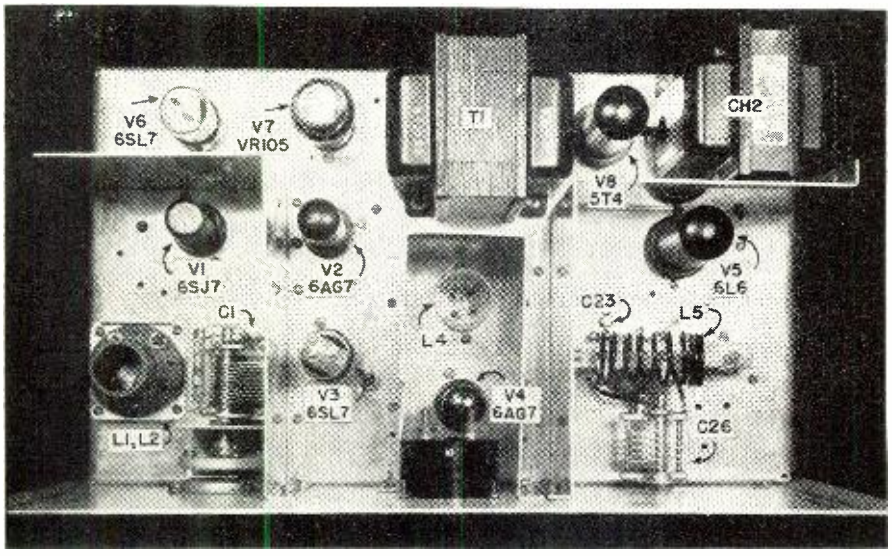
The shield around the v.f.o. deflects heat from other tubes thereby providing additional freedom from drift caused by condenser temperature change. The author also uses shields around the doubler stages, but the one around the v.f.o. is the most important. The other two could be eliminated to simplify the construction, especially for those not having metal bending facilities available. The chassis, and shields were made of surplus .060" thick 24SO, the panel of .091" thick 24ST. The chassis is 10"x17"x3", the panel is 19"x12". A standard manufactured chassis may be used, however. An aluminum chassis is highly recommended due to the high conductivity of this metal for grounding purposes. Shielding the v.f.o. and anchoring the oscillator coil and tuning condenser are necessary to stability.

The parts list gives the components used. The author placed tie posts near each tube socket under the chassis to provide convenient grounding points for bypasses, etc., and then interconnected all the individual grounded tie points. This provides definite grounding and eliminates uncertain grounds when using the chassis as common ground. The latter is necessary with a steel chassis. Each frequency multiplier coil is mounted adjacent to its respective tube. The 6AG7 doubler "tank" condenser is mounted approximately un-

Complete schematic diagram of the NBFM transmitter. A v.f.o. is incorporated.



R_1, R_2, R_9—26,000 ohm, 1 w. res.
R_3, R_{10}, R_{27}—500,000 ohm, ½ w. res.
R_4—6000 ohm, 1 w. res.
R_5, R_{14}—150 ohm, 5 w. wirewound res.
R_6—30,000 ohm, 2 w. res.
R_7—1000 ohm, 2 w. wirewound res.
R_8—50,000 ohm, ½ w. res.
R_{11}—1 megohm, ½ w. res.
R_{12}, R_{16}, R_{18}, R_{21}—50 ohm, 1 w. res.
R_{13}—1 megohm, 1 w. res.
R_{15}—22,000 ohm, 2 w. res.
R_{17}—100,000 ohm, 1 w. res.
R_{19}—400 ohm, 10 w. wirewound res.
R_{20}—40,000 ohm, 10 w. wirewound res.
R_{22}—500,000 ohm pot.
R_{23}, R_{24}—250,000 ohm, ½ w. res.
R_{25}, R_{26}—1000 ohm, 1 w. res.
R_{28}—30,000 ohm, 50 w. wirewound res. (with slider)
C_1—140 μμfd. straight line var. cond.
C_2—350 μμfd. ceramicon cond.
C_3—20 μμfd. ceramicon cond.
C_4—300 μμfd. ceramicon cond.
C_5, C_6, C_7, C_{11}—.002 μfd., 400 v. cond.
C_8, C_{12}, C_{18}, C_{28}, C_{30}—100 μμfd. mica cond.
C_9—.003 μfd., 100 v. cond.
C_{10}, C_{36}, C_{37}—.05 μfd., 400 v. cond.
C_{13}—50 μμfd. mica cond.
C_{15}—See text
C_{15}, C_{19}, C_{20}, C_{24}, C_{29}, C_{31}—.01 μfd., 600 v. cond.
C_{16}, C_{21}—75 μμfd. var. cond.
C_{17}, C_{22}, C_{27}—.005 μfd., 600 v. cond.
C_{23}—50 μμfd. midget var. cond. (APC type)
C_{25}—.02 μfd., 600 v. cond.
C_{26}—35 μμfd. midget var. cond.
C_{32}, C_{33}—40 μfd., 450 v. elec. cond.
C_{34}—2 μfd., 600 v. bathtub cond.
C_{35}—.1 μfd., 600 v. cond.
J_1, J_2, J_3—Closed circuit jack
J_4—Open circuit jack
T_1—Power trans., 425-0-425 @ 200 ma.; 6.3 v. @ 4 amps.; 5 v. @ 3 amps.
PS_1, PS_2—Parasitic suppressor, 50 ohm, ½ w. res. with 10 t. #20 en. wire
CH_1—6 hy., 75 ma. filter choke
CH_2—10 hy.,200 ma. filter choke
S_1—S.p.s.t. toggle sw.
Meter-sw.—2-pole, 4-pos. sw.
Meter—0-50 ma. d.c. meter (See text)
L_1, L_2, L_3, L_4, L_5—See coil table
RFC_1, RFC_2, RFC_3—R.f. choke (National R-100U or equivalent)
RFC_4, RFC_5—R.f. choke, #20 en. closewound, 1" coil length on ¼"form
PL_1—6.3 v. pilot lamp
1—6L6 tube
2—6SL7 tubes
1—VR-105 tube
1—5T4 tube
1—6SJ7 tube
2—6AG7 tubes



Top view shows placement of the required shield partitions.

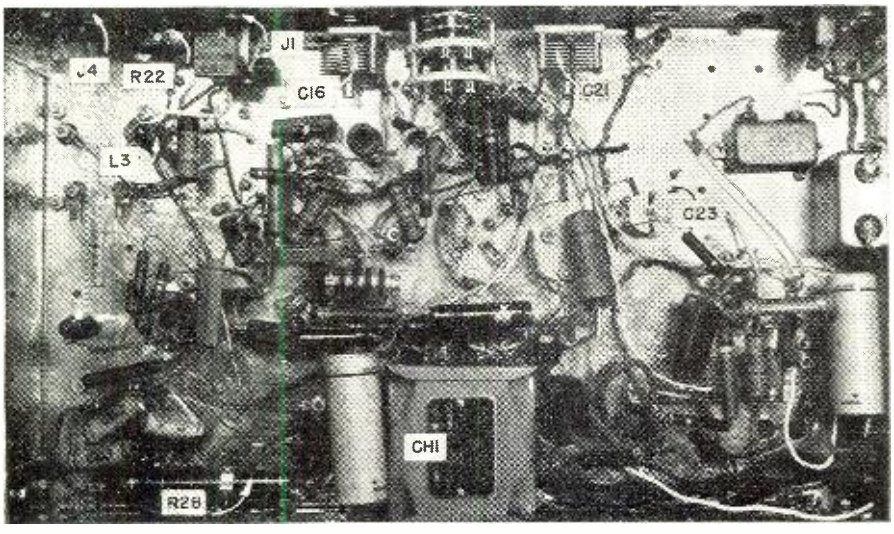
der its inductance. The coil forms used are 4-prong polystyrene of standard make, 1¼" in diameter. Small surplus standoff insulators are used to support the 6L6 "tank" coil. The 6L6 was wound around a 6AG7 tube as a coil form for 20 and 10 meters, spaced the diameter of the #12 wire. A jack-bar and coil strips were made from polystyrene strips, banana plugs, and jacks. For 40 and 80 meters, #20 wire is used. (Slip a thin sheet of plexiglass or strips around the 6AG7 before winding the coil). After winding the coils apply *Duco* household cement; after 5 or 6 minutes, the 6AG7 tube is withdrawn leaving neat coils. (Leave the plexiglass sheet or strips in the forms, but trim to make neat). More cement may be applied to insure rigidity for rough handling. Underneath the chassis, parts are grouped around respective tube sockets and as convenience dictates. Two terminals are provided at the left rear of the chassis for completing the "B minus" connection to ground through the separate contacts on the antenna relay. A switch may serve the same purpose. The blank hole on the front panel is for the phone monitor jack.

Osc.	L_1—10½ t. #20 en., 1¼" diam., spaced diam. of wire
Osc.	L_2—3 t. #20 en., interwound at "ground" end of L_1
6AG7 FM	L_3—50 t. #31 en., ½" diam. closewound, tapped at 15 t. from "ground" end (Iron core slug —see text)
6AG7	L_4—80 m.—36 t. #20 en., 1¼" diam. closewound 40 m.—18 t. #20 en., 1¼" diam. spaced 1/16" 20m.—8 t. #20 en., 1¼" diam. 1" long
6L6	L_5—80 m.—41 t. #20 en., 1" diam. closewound 40 m.—20 t. #20 en., 1" diam. spaced 1/16" 20 m.—12 t. #12 en., 1" diam. spaced diam. of wire 10 m.—7 t. #12 en., 1" diam. spaced ⅛"

Coil winding data.

A power supply delivering 400 volts at 200 ma. is used. However, the total plate current is only around 125 ma. under load. This insures good regulation under keying. The plate transformer also supplies the filament voltages.

Under chassis view identifies placement of major components.



Antenna Coupling

The antenna coupling circuit consists of 3 turns fed to the #12 copper two-inch spaced transmission line feeding the 3-element rotary through the 5' 10" long RG-8-U matching transformer. Any of the capacitive, inductive, or link coupling circuits will be suitable however with other types of antennas.

Tuning Up

There is only one point that need be brought up in connection with tuning the unit. It is possible to tune the quadrupler stage to the 3rd instead of the 4th harmonic of the v.f.o. unit. This will come in handy during the Autumn of 1949 when the 21 megacycle band opens up. After coupling an antenna or final amplifier to the exciter, it will be necessary to check the amount of deviation by monitoring the 20 or 10 meter carrier, adjusting the gain or deviation control to about half open while talking into the microphone and setting C_{16} slightly off resonance. A drop in the 6AG7 grid current of about .1 or .3 ma. will be noted. On 75 meters, the maximum deviation will run around 1500 cycles or a trifle better, with the gain control well open.

The author incorporated meter switching to check the current in the various circuits. A 0-50 milliammeter, with the internal shunt removed, is used. Convenient shunts were made from what looked like #31 wire, which was wound around 1" lengths of ¼" polystyrene rod and held in place with *Duco* household cement. The individual shunts were secured directly to the meter switch and the twisted wires run from there to the individual circuits being metered. Any meter with a convenient scale may be used, however.

Final Notes

The currents drawn by the 6AG7 and 6L6 doubler stages run approximately 25 ma. and 46 ma. respectively. Under keying, they are practically unchanged, varying only a few milliamperes. This is an advantage as it does not place a large varying load on the power supply and helps keep the voltage steady for driftless v.f.o. operation on c.w. For optimum performance, the 6L6 should be loaded to 50 milliamperes. On 10 meters, the unloaded 6L6 plate current will dip to about 22 milliamperes, on 20, 40, and 80 meters proportionately lower (with excitation). The output on ten will run about 10 watts and the efficiency approximately 45 per-cent.

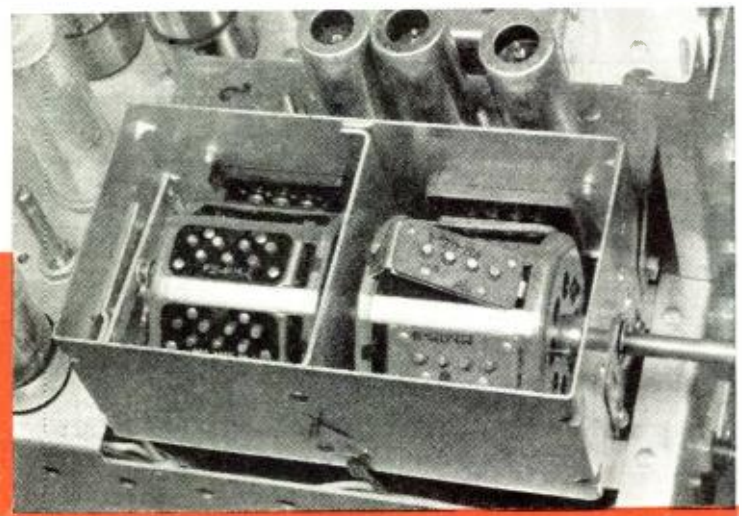
This exciter is the result of two other NBFM, v.f.o.-controlled units which were built up and completely dismantled before a satisfactory unit was completed. The parts totaled approximately $37.50 less the crystal microphone, at current new and surplus prices.

If desired, an 829B with the control grids in push-pull and the plates in parallel (this allows the 829B to dou-

(*Continued on page* 192)

MODERN TELEVISION RECEIVERS

Close-up of Philco Precision Channel Selector, showing how easy it is to insert coils for various channels. This switch provides for any 8 channels of the 13 assigned by the FCC; and since a maximum of 7 stations is possible in any one metropolitan area, this Channel Selector can be used in any location in the United States.



By
MILTON S. KIVER*

Part I. An analysis of the r.f. stages incorporated in present-day, commercially-built television receivers. In future articles of this series, the author will present a stage-by-stage comparison of all TV sets. Alignment and service techniques will also be covered.

IN the last year, the status of television throughout the country has changed from "Is television commercially available?" to "How long will it take to reach my community?" The progressive serviceman, recognizing this onsweeping trend, will now concentrate doubly hard on familiarizing himself with the operation of each television receiver as it appears on the market. As an aid toward this end, this article and those that follow will analyze various television receiver circuits, tracing the signal paths from input terminals to image tube and loudspeaker, and compare the methods employed by different manufacturers to achieve similar results.

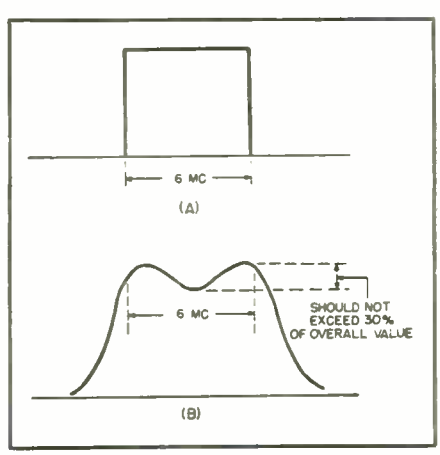
R. F. Systems

The logical starting point in any system is where the incoming signal is received. In this respect, a television receiver is similar to the standard broadcast set. Television receivers currently being marketed are designed with an input impedance of 300 ohms. This exactly matches the characteristic impedance of the recently developed parallel-wire polyethylene transmission line and permits direct connection between the two. In addition, many of the newer wide-band antennas have impedances of 300 ohms and the erection of a completely matched antenna system is thus quite readily effected. The foregoing consideration is an important one because mismatching at any point in the antenna lead-in system results in a loss of signal power.

The television signal occupies a 6 mc. bandwidth and input circuits must be capable of adequately receiving a signal this wide. Toward this end, closely coupled and heavily loaded coils are a necessity. The ideal input response curve is shown in Fig. 1A. However, the practical modification more closely approaches the curve shown in Fig. 1B. The dip or valley in the center is a result of the close coupling; it should, however, never exceed 30 per-cent of the peak or total amplitude of the curve. The sound and video carriers, separated by 4.5 mc., are located at either end of the curve, within the 90 per-cent response region.

So much for the general requirements of the input stages of a television receiver. Now let us investigate the actual form of the circuits themselves.

Fig. 1. (A) The ideal r.f. response curve, and (B) the practical modification.



RCA Receivers

The r.f. section of the *RCA* receivers (all models containing 7" and 10" direct-viewing screens) is designed around a circuit which departs sharply from so-called conventional design. In the first place, the r.f. amplifier, converter, and oscillator contain 6J6 double triode tubes and ordinarily triodes are not suitable for high-frequency use. However, the 6J6, the 6C4, and others have been specially designed for high-frequency operation. They are small in size, with interelectrode capacitances reduced to a minimum and connecting leads made as short as possible. When used in push-pull arrangement or as grounded-grid amplifiers, they function with good results. Any slight tendency toward oscillation can usually be overcome by inserting small neutralizing condensers. This is the purpose of C_1 and C_2 in Fig. 2. The input circuit is untuned. T_1 serving to short-circuit all low-frequency signals picked up by the antenna. R_1 and R_2 are the terminating resistors for the 300-ohm antenna transmission line, providing also a d.c. path for the biasing voltage from the contrast control to the grids of the r.f. amplifier.

The 13-channel tuning arrangement in the plate circuit of the r.f. amplifier is an artificial quarter-wave transmission line. The line is balanced, containing series inductances in each section of the line. Coils L_{2B} and L_{2A} provide the proper inductance to tune the

* Mr. Kiver is the author of "U.H.F. Simplified," "F.M. Simplified" and "Television Simplified"—all published by D. Van Nostrand Company, Inc., New York.

Manufacturer	Model No.	Picture Type		Tube Size (diam.)	Screen Size	Model Type		Tuning Method		R.F. Amplifier
		Direct	Proj.			Table	Console	Continuous	Selector Switch	
Andrea	T-VJ12	X		12	7½x10	X			X[1]	6J6
	C-VJ12	X		12	7½x10		X		X[1]	Same as Model T-VJ12
	CO-VJ12	X		12	7½x10		X		X[1]	Same as Model T-VJ12
Belmont	21A21	X		7	5½x 4¼	X		X		6AK5
General Electric	801	X		10	6 x 8		X		X	6AU6
	802	X		10	6 x 8		X		X	Same as Model 801
Motorola	VT71	X		7	4½x 6	X			X	½ of 7F8
	VT101	X		10	6⅜x 8½		X		X	6AG5
Philco	48-1000	X		10	6 x 8	X			X	6AG5
	48-1050	X		10	6 x 8		X		X	Same as Model 48-1000
	48-2500		X	5	15 x20		X		X	6AG5
RCA	621TS	X		7	4½x 5⅝	X			X	6J6
	630TS	X		10	6⅜x 8½	X			X	6J6
	721TS	X		10	6⅜x 8½	X			X	6J6
	630TCS	X		10	6⅜x 8½		X		X	Same as Model 630TS
	721TCS	X		10	6⅜x 8½		X		X	Same as Model 721TS
	730TV1	X		10	6⅜x 8½		X		X	Same as Model 721TS
	730TV2	X		10	6⅜x 8½		X		X	Same as Model 721TS
	641TV	X		10	6⅜x 8½		X		X	6J6
	8TS30	X		10	6⅜x 8½	X			X	Same as Model 630TS
	648PTK		X	5	15 x20		X		X	6J6
United States Television	T-502	X		10	6 x 8		X		X	6AG5
	T-507		X	5	21 x16		X		X[2]	6AG5
	T-525		X	5	25 x19		X		X[2]	Same as Model T-507
	T-530		X	5	30 x22½		X		X[2]	Same as Model T-507
	T-621		X	5	22½x16¼		X		X[2]	Same as Model T-507

[1] The Andrea receivers employ a tuner "turret" which is somewhat similar to the Philco tuner except that all 13 channels are wired into position. The r.f., modulator, and oscillator tubes, with their circuit components, are also contained within the copper-plated steel case. This reduces reradiation and protects the circuits from external fields.
[2] The r.f. tuning circuits of U.S.T. receivers closely resemble those employed in G.E. receivers. See explanation in article.

Table 1. A comparison of present-day television receivers. The above chart includes only those models which are on the market and which have been discussed in the article thus far. As new models become available, they will be added to chart and adequate explanation of their operation given.

circuit to channel 13, 210-216 mc. Iron-core slugs in L_{25} and L_{26} permit adjustment of each coil's inductance. L_{13} to L_{23} on one side of the line, and L_{14} to L_{24} on the other side of the line, are fixed sections which are added in series to L_{25} and L_{26} as the shorting bar is moved progressively down the line. Note that the highest frequency is obtained when the shorting bar is closest to the plates of the tubes. With each movement of the bar to the left, more inductance is inserted into the circuit.

The physical construction of each of the inductances L_{13} to L_{24} is a small non-adjustable silver strap between the switch contacts. Each strap is cut to provide a 6-mc. change in frequency. Coils L_{11} and L_{12} bridge the gap between 174 mc., channel 7, and 88 mc., channel 6. For the lower television channels, L_1 to L_9 and L_2 to L_{10} are used. These coils are constructed in the form of a "figure eight." Signal coupling between the r.f. amplifier and the mixer is achieved by C_3, C_4, C_5, and a single turn of link coupling.

For servicing purposes, an open coil in either section of the tuning line will disrupt operation for that channel and all lower ones. It will not, however, interfere with the operation of higher frequency channels. If this seems puzzling, remember that the "B+" of the other section can travel through the shorting bar to the plate connected to the affected line. However, an open circuit in both sections of the line, on any channel, will disrupt all operation. Voltage or resistance checks will then reveal the open coil.

G. E. Sets

In the *General Electric* television receiver, Model 801, the r.f. amplifier employs a 6AU6 high-frequency pentode connected as a grounded-grid triode amplifier. See Fig. 3. Triodes are superior to pentodes because of their lower noise factor and in this portion of the receiver tube noise is an important consideration. In addition, the use of a triode does not noticeably reduce the gain of the set because of the low plate load impedance employed in television receivers. To permit a 6 mc. signal to pass with uniform amplification, loading resistors reduce the impedance of the tuning circuit to a value somewhere between 2000 and 10,000 ohms.

Fig. 4 illustrates why pentode and triode tubes give comparable gains in television receiver circuits. The amplified signal divides between the plate resistance of the tube and the tuned output circuit. Since a pentode's internal resistance is considerably higher than the impedance of the tuned circuit, most of the amplified signal is lost in the tube. Consequently, the over-all gain is low and it is possible to achieve practically as much gain with a well-designed triode.

In grounded-grid amplifiers, the grid is grounded and the input signal is fed into the cathode. The grid r.f. potential is zero and the cathode potential fluctuates in accordance with the input signal. The effect on the plate current is the same as if the cathode had been kept fixed in potential and the grid voltage was varied. The chief advantage is the fact that a grounded grid acts as a shield between the input and output circuits and prevents the tube from oscillating. See page 178 for more detailed explanation.

In the *G.E.* receiver, the antenna is connected into the cathode circuit of the r.f. amplifier. The input impedance is 300 ohms, again matching the polyethylene twin-conductor transmission line. L_1 is a simple high-pass filter rejecting all low-frequency signals. The cathode chokes, L_2 to L_6, are placed in series with the cathode resistor to prevent the input impedance from being lowered by the shunting effect of the total stray capacity to ground of the cathode of the tube. The choke value is changed with frequency. R_1 and C_1 provide cathode bias.

The r.f. amplifier is coupled to the mixer tube through a wide-band transformer. One such unit is provided for each channel. The windings are self-tuned by the distributed and tube capacities to provide maximum gain through a high L/C ratio. On channels 1 and 2, the transformer is triple-tuned to prevent the image frequencies of the 88-108 mc. FM band from causing interference. The r.f. coils for each channel are placed physically near the oscillator coils (of the same channel) in order that both voltages combine at the mixer grid.

Belmont Radio

In each of the previous circuits, the various channels were brought into position by means of a selector switch. The *Belmont* television receiver, Model 21A21, employs continuous tuning over the thirteen channels. The tuning assembly, shown in Fig. 5, is a permeability tuner in which the movable slugs of each coil are mechanically ganged together and moved in or out of the coils when the front dial is rotated.

When a station selector switch is

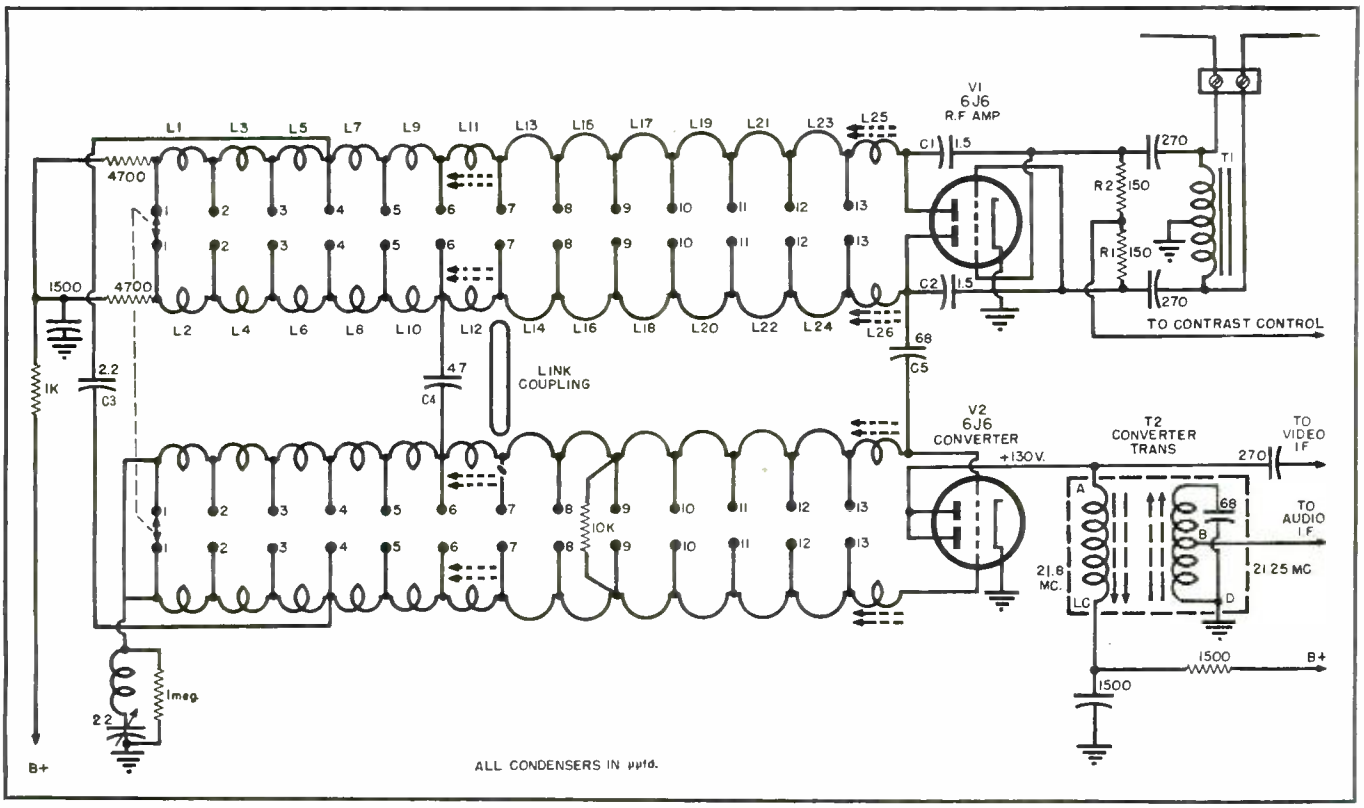


Fig. 2. The simulated transmission line tuning arrangement used in RCA television receivers.

used, the switch is turned to the desired channel and a fine-tuning control is adjusted for best sound quality from the loudspeaker. In the *Belmont* receiver, the tuning knob is rotated for best sound output from the loudspeaker. Tuning is a bit more complicated with continuous tuning because, for any particular channel, the sound can be heard at three separate but closely adjacent positions of the dial. However, the center position is the correct one. Note that with continuous tuning, the fine-tuning control is eliminated. (For those who are not familiar with television receivers, the fine-tuning control is a vernier adjustment on the local oscillator frequency. It is designed to permit the set user to counteract the effect of oscillator drift.)

There are two sets of coils in each of the front-end stages, of which only one set is used at any one time. See Fig. 6. T_1, T_4, and T_6 operate only on the six lower television channels. When the set is tuned to channel 7 and above, a low-high band switch on the front panel (see Fig. 7) is placed in the high position. The active coils in the set now become T_2, T_4, and T_5.

The r.f. amplifier uses a 6AK5 high-frequency pentode whose gain is controlled by the automatic gain control (a.g.c.) voltage developed in the video 2nd detector. (A.g.c. in a television receiver is equivalent to a.v.c. in a sound receiver). Bandswitch S_{1-A} and S_{1-B} connects the antenna to coupling coil T_{1-B} on the low band and to coil T_2 on the high band. The output of the r.f. amplifier is impedance-coupled to the converter.

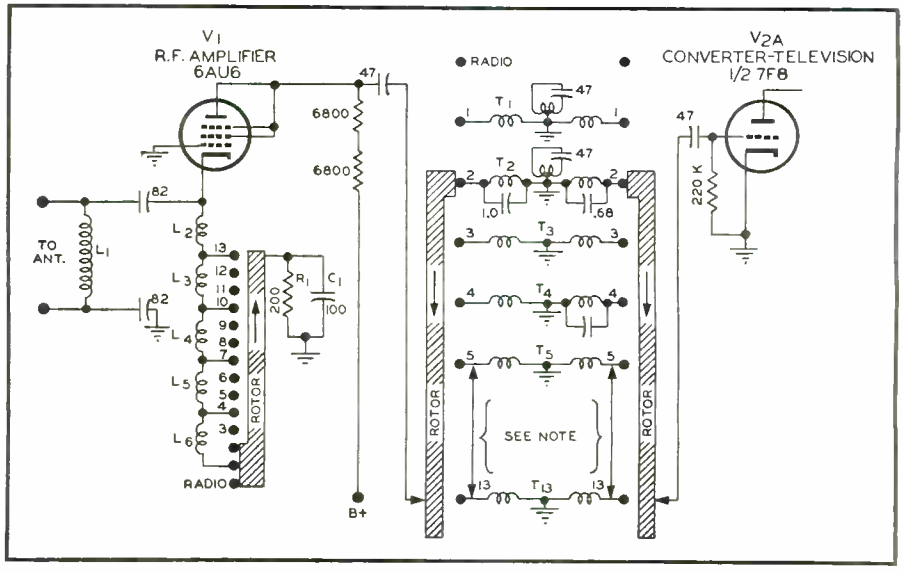
Philco Receivers

The front-end of *Philco* television receivers employ a tuner turret in which coils for each channel may be separately inserted. Provision is made on the rotating turret to mount eight of the thirteen sets of coils, thereby enabling any set to receive eight stations. Since any one community is assigned a maximum of seven stations, the set will thus permit complete coverage.

The antenna coil and r.f. amplifier input coil are mounted on one assembly; the mixer and local-oscillator coil are mounted on a second assembly. These two assemblies then constitute the complete set for one channel.

Examination of the schematic diagram, Fig. 8, reveals that separate transmission lines are used for the high and low-frequency television channels. This permits the use of two antenna arrays, each specifically designed for one band of frequencies. The six lower channels connect to the low frequency antenna; the seven upper channels to the high-frequency antenna. This arrangement is particularly effective when television signals come

Fig. 3. The r.f. amplifier stage of the G.E. Model 801 and 802 television receivers. Note: r.f. coils and switch points for channels 6 through 12 not shown. Coils T_6 through T_{12} correspond to channels 6 through 12 and are connected the same as T_5.



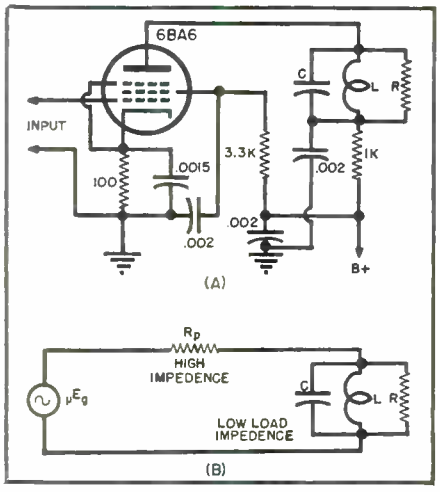


Fig. 4. A pentode r.f. amplifier (A) and its equivalent circuit (B).

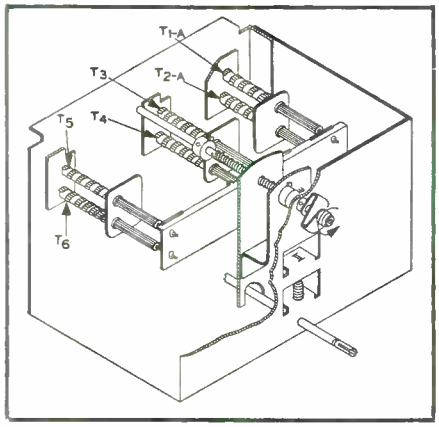


Fig. 5. Tuning assembly used in the Belmont Model 21A21 television receiver.

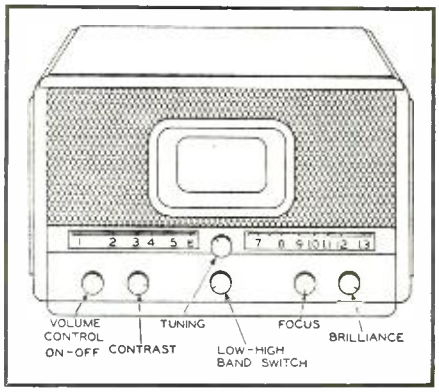


Fig. 7. Front panel layout of the Belmont Model 21A21 television receiver.

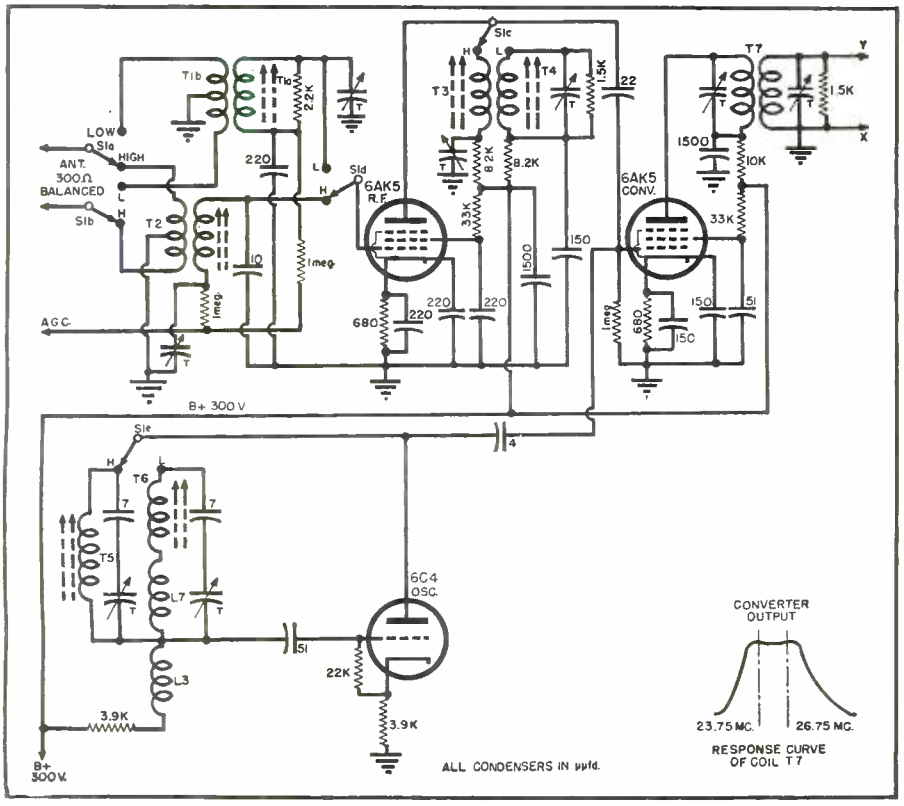
from widely separated points of the compass.

The antenna coil is coupled to the r.f. amplifier input coil through a tertiary winding. This latter resonant circuit increases the coupling between the other two circuits and produces a wide spread, double-peaked response curve. See Fig. 9B.

The r.f. amplifier itself employs a 6AG5 pentode, with a.g.c., normal cathode bias, and a small amount of degenerative feedback voltage. The latter is useful for stabilizing the circuit and reducing the effect of tube and circuit changes on signal gain. The output of the r.f. amplifier is impedance-coupled to the following 6AG5 mixer.

The tuned circuit in the r.f. amplifier output (actually the mixer grid input) is, as far as the incoming signals are concerned, a series resonant circuit. The response of this coupling network is peaked, producing a curve such as indicated in Fig. 9A. If we combine this response curve with the broad, double-peaked input response curve, we obtain an over-all response which is fairly linear for the required 6 mc. This is shown in Fig. 9C. The oscillator coil is coupled to the r.f. amplifier output coil, thereby permitting these two voltages to combine at the mixer.

Fig. 6. The r.f. section of the Belmont television receiver.



Motorola Receivers

Most television receivers currently manufactured have a 300-ohm input impedance; *Motorola* sets, however, have provision for either 75 or 300-ohm lines. This is accomplished simply by using the full primary winding of the input transformer for the 300-ohm line and half of the winding for the 75-ohm coaxial line. See Figs. 10 and 11. Inductance of a coil is proportional to the square of the number of turns. Doubling the number of turns produces four times the inductance and, at the same frequency, four times the impedance. 300 ohms is four times 75 ohms.

The secondary of the input transformer, T_1, consists of a high and low frequency winding in series. The low frequency coil is tuned for each of the six lower channels by changing the tuning condenser across the coil. The high-frequency coils in series with the low-frequency coils do not present enough inductance to interfere with the operation of the low-frequency coils. For channels 7 through 13, condensers C_1, C_2, and C_3, short out the low frequency resonant circuit. A simple short across the low-frequency coil is not the most effective method of eliminating the effect of this coil because of the switch and lead inductance present. A more effective short is obtained by developing a series resonant circuit composed of the switch and lead inductance and the condensers placed across the low-frequency winding.

To insure the proper 6 mc. bandwidth, loading resistors R_1 and R_2 are used.

The r.f. amplifier is very similar to those previously described, but the coupling circuit between the r.f. amplifier and the mixer is new. The coupling network is a critically double-tuned circuit with mutual coupling provided by C_4 and C_5. In the simplified diagram, Fig. 11, the two variable inductances, L_A and L_B, represent each of the pairs of coils shown as L_1 through L_{26} in Fig. 10. Each pair of coils is pretuned to the same frequency by means of a brass slug. C_A represents the output capacity of the 6AG5 plus distributed capacitances; C_B is the input capacitance of the 6J6 plus distributed wiring capacitance.

In this type of tuned circuit, the bandwidth is determined by the degree of coupling and the Q of each coil. The degree of coupling is controlled by the size of C_4 and C_5. The smaller these capacitances, the greater the mutual impedance and the greater the bandwidth. The values C_4 and C_5 chosen

(*Continued on page* 142)

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

MAC HIRES A HELPER

MAC was pleased to find his brand-new assistant waiting at the door of the shop when he came down to open up. The kid greeted him with a shy smile, his curly red hair looking like a torch in the bright rays of the Spring sun.

"Right on time, eh Barney?" Mac said as he unlocked the door of the radio shop and motioned the youth inside.

"Yes, sir. Mom was so afraid that I might be late for work the very first day that she had me eating breakfast at five-thirty."

Mac's leathery face wrinkled in a sympathetic grin as he shrugged his broad shoulders into his shop coat and fastened the belt. He waved the boy into a chair and leaned back against the desk in front of him. "Barney," he asked, "just how much *do* you know about radio service?"

"Not much that I'm really sure of, Mr. McGregor," Barney confessed. "I had a little radio theory in physics in high school, and I picked up some more while I was studying to get my amateur license. My transmitter and some of the other gear around the ham shack are home-built, but that was mostly a case of copying them out of books and magazines. I think you had better just figure that I am plenty dumb about radio but that I don't want to stay that way."

"Good! The less a fellow thinks he knows about anything the easier he learns. You will pick up a lot just watching and listening, but that is not enough. If we are going to make a real serviceman out of you, you must know the 'why' as well as the 'how' of fixing radios. I'll give you some books to read, and I want to hear you coming up with lots of questions. If I can, I'll answer them; and if I can't we'll dig out the answers together."

Barney nodded his head vigorously in approval of this program.

"Well," Mac said, picking up some cardboard tags from the desk, "we may as well start right now. Miss Perkins usually takes care of things up front here, but she doesn't come to work until nine o'clock. Incidentally, do not let her fool you. She likes to think that she is a sharp-tongued old sour-puss, while she really has a heart as big and as soft as they come—but don't ever let her know you know it."

Barney's blue eyes twinkled. "I think I understand, sir. Mom is a little like that."

"As I was saying," Mac went on, "there will be times, say during her lunch hour, when you will have to take sets in. When you do, *always* fill out one of these cards and fasten it to the set."

He handed one of the numbered tags to Barney and continued. "Be sure to get down correctly the name, address, and phone number of the customer. On that space on the back, write out the complaint with the set. Is it dead? noisy? distorting? cutting out? How long has it been that way? If if cuts out, how long does it take for it to do so after it has been turned on? Does it cut out entirely or just drop in volume? Does the dial lamp go out? Does anything such as jarring the set or snapping on a light seem to bring it back? Does the trouble occur at any particular time of day or on any particular station?"

Barney's eyes were beginning to look a little glazed, but Mac went on relentlessly. "Don't forget to ask the customer if he can think of any little things he noticed wrong with the receiver before this last trouble showed up, little things that did not warrant taking it to a repairman but which he would like to have corrected while it is in the shop?"

"Are we just giving him a sales line, sir?" Barney asked.

The corners of Mac's mouth twitched at that "we," but he explained gravely, "Not at all! It is true that the customer likes to have his troubles taken seriously, but those questions are to help us. Quite often a minute spent in getting information on a set's behavior will save you an hour hunting trouble. Miss Perkins is a jim-dandy at collecting this information, and often the trouble with a set can be figured out just from reading what she has down on the card. She is *good.*"

"I suppose the fellow who reads the card has to know a little something, too," Barney ventured without a trace of a smile.

"It helps," Mac agreed, looking at him sharply.

"What do I do with the set after I get its case history?"

"That depends on whether or not it is an 'intermittent'. An intermittent is any set that has some trouble that shows up only part of the time. The trouble may be cutting out, changes in volume, distortion, and so on; but if the condition comes and goes, the set is an intermittent."

"What do I do with one of those?"

"Mostly nothing, except to carry it gently back into the shop. I want these sets disturbed just as little as possible until I get a chance to hear them misbehave. They can tell you a lot about what ails them if you can just hear them go through their routine once."

"What if the sets are not intermittent?"

"First, check to see if there is a way of knowing where the tubes belong, either in the form of a chart pasted to the cabinet or chassis or by numbers stamped on or near the sockets. If not, draw up a little tube-position chart before taking out the tubes."

"Do I check the tubes?"

"Not until I have shown you how I want it done. You just wipe them clean, using carbon-tetrachloride to remove any gum, and place them in a cardboard box together with the tube-diagram and the tag number of the set to which they belong. Come on back in the shop and I'll show you what you do then."

Barney followed Mac through the swinging-door back into the service shop. Mac went across the room and opened the door of a small closet-like compartment. Inside was a short

(*Continued on page* 114)

Front panel layout of completed television oscilloscope shows position and identity of all operating controls.

A TELEVISION OSCILLOSCOPE

By
L. H. VanARSDALE, JR.

Part 1. Covering the design problems encountered in constructing a television oscilloscope. Complete construction details will be presented next month.

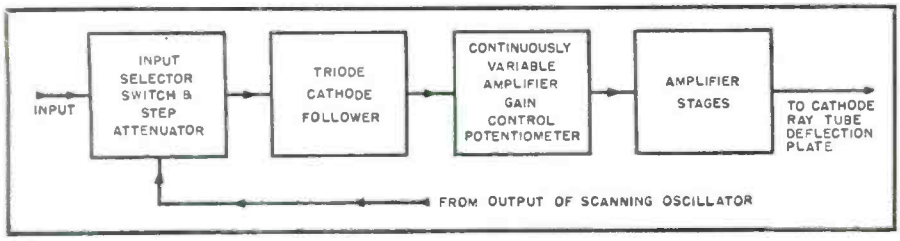
A NUMBER of very excellent articles have appeared in the literature describing various types of oscilloscopes suitable for use in connection with audio frequency work. As is well known, such work entails the use of frequencies from approximately 20 to 15,000 cycles-per-second, and the usual "garden variety" of scope does a fine job within these frequency limits. Contrasted to these relatively simple requirements, however, an oscilloscope suited for television work must permit observation of a variety of relatively complicated waveforms over a much wider frequency range. The usual oscilloscope is, unfortunately, not often capable of satisfying these more complex requirements.

This series of two articles is intended for those who may be interested in knowing the design requirements for an oscilloscope suitable for general television use and also for those who may desire to construct a versatile instrument suited for both audio and television applications. The first article will discuss the requirements which such an instrument must meet to be suitable for television use, and, in addition, will describe some circuits capable of satisfying these requirements. The second article will describe a practical instrument, utilizing these circuits, which will not only permit observation of the waveforms in another television receiver, but may also be used as the picture and scanning portions of a television receiver itself.

In the television oscilloscope, the following parts of the instrument must come in for special attention:

(1) Horizontal and vertical deflection amplifiers,
(2) Horizontal and vertical scanning (sweep) circuits,
(3) Video voltage connection to the cathode-ray tube,
(4) Power supplies.

Fig. 1. Simplified block diagram of a typical deflection amplifier.



Succeeding paragraphs discuss these features in the order listed.

Deflection Amplifiers

To simplify the design of an oscilloscope, the design of both the horizontal and vertical deflection amplifiers is often made identical. This is particularly desirable in the case of a scope for television use, since the usage requirements for both are nearly identical. The comments which follow will, therefore, apply equally to both.

The deflection amplifiers should meet the following specifications:

(a) Frequency response—flat from 20 cycles to 200 kc..
(b) Available amplification—at least 150.
(c) Input voltage range—0.1 volt to 200 volts peak-to-peak.
(d) Output voltage—essentially distortionless with sufficient output to deflect the cathode-ray tube beam at least 1½ times the screen diameter,
(e) Gain Control—of a type which will not alter frequency response.

The reasons behind these requirements may be of interest. The lower limit of the *frequency response* has been chosen at 20 cycles-per-second simply to assure the proper performance of the instrument at low audio frequencies, in the event it is desired to use it for that purpose. The high frequency limit is determined principally by the frequency of the saw-tooth scanning voltage which the amplifier must handle without distortion. It can be shown mathematically that an amplifier must have a substantially flat frequency response to at least the 10th harmonic frequency of a saw-tooth-shaped oscillation in order to amplify this voltage without appreciable distortion. Since the frequency of the horizontal scanning voltage in a standard 525 line television picture is 15,750 cycles-per-second, the amplifier must be flat up to 157.5 kc. (10 × 15,750 cycles = 157.5 kc.). The upper limit of 200 kc. was, therefore, chosen, since this gave a comfortable margin above the required limit of 157.5 kc. and permits saw-tooth scanning rates up to 20,000 cycles-per-second to be used or observed, if desired.

The *available amplification* was chosen at 150 as a minimum since it was felt that an oscilloscope should permit observation of voltages in the order of 0.1 volt. With a deflection sensitivity of 100 volts/inch, which is a not uncommon value, this would mean that a 0.1 volt peak-to-peak a.c. signal would be about 3/16" high if the gain were exactly 150.

The *input voltage range* limits were chosen as 0.1 and 200 volts peak-to-peak, since practically all voltages normally observed on an oscilloscope fall within these limits. In the instrument to be described in the next article, provision has been made for observing higher voltages by bringing out a direct connection to the deflection plates on the rear of the chassis.

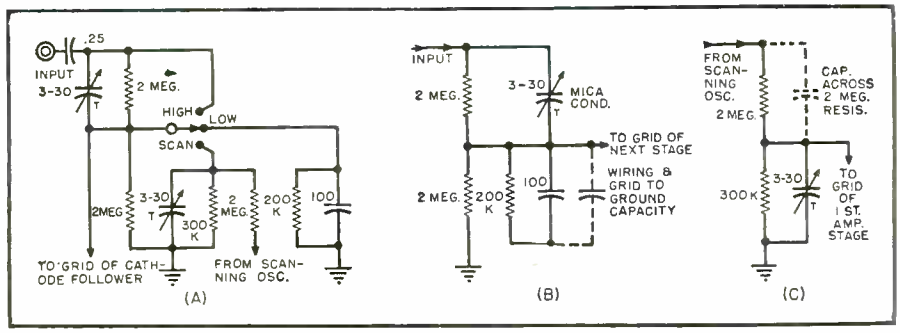


Fig. 2. (A) Wiring diagram of one form of input selector and step attenuator. (B) Diagram of "LOW" position attenuator. (C) Diagram of "SCAN" position attenuator.

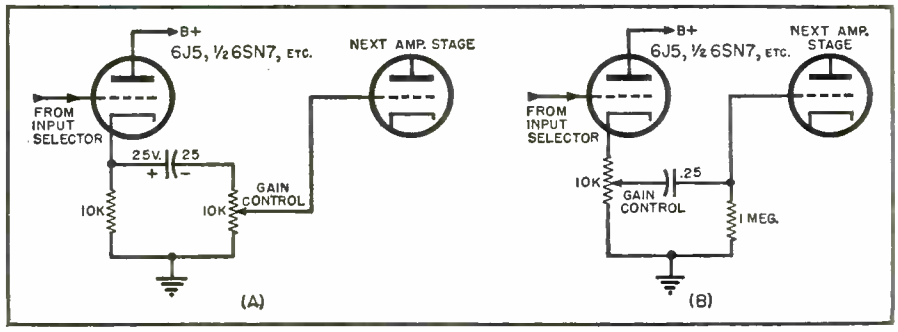


Fig. 3. (A) Diagram of a typical cathode follower stage preceding the actual amplifier stages of a deflection amplifier. (B) Alternate cathode follower circuit. This method is not preferred as momentary pattern shift occurs when gain is changed.

The reason for the *essentially distortionless* characteristic of the amplifier is obvious. In addition, it is deemed essential that sufficient output voltage be available from the amplifiers to deflect the beam at least 1½ times the cathode-ray tube screen width while maintaining the desired distortionless performance. The amplifier to be described in the second article of this series is of particular interest on this point, since it is capable of an undistorted output in excess of 400 volts peak-to-peak.

The *gain control* of a wide-band amplifier cannot be the more familiar high-resistance grid input potentiometer as used in audio work, since such a gain control discriminates very badly against the higher frequencies, principally because of the bypassing effect of the grid-to-cathode capacity at these higher frequencies. This difficulty can be readily overcome by inserting the gain control in a cathode follower circuit output. This point will be discussed in greater detail

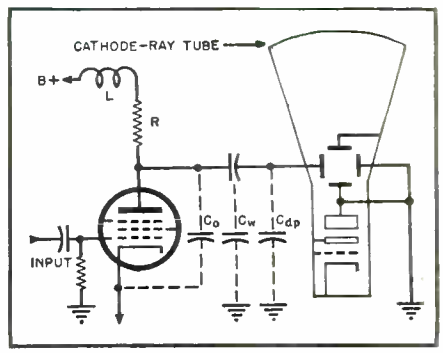
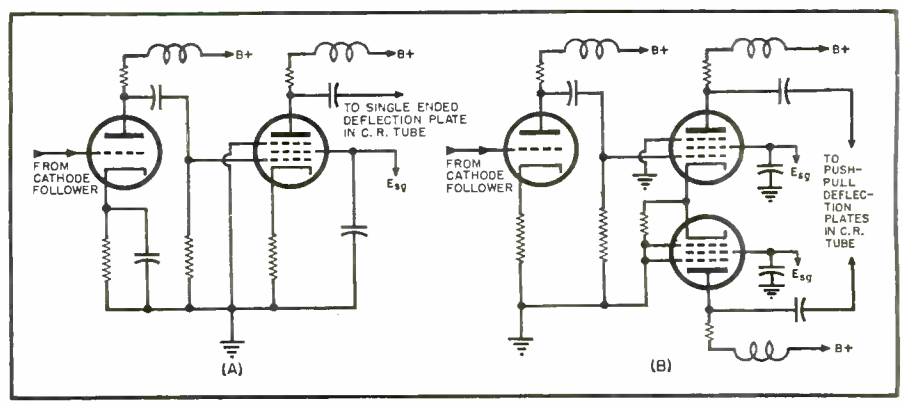


Fig. 4. Basic circuit for video-type amplifier stage. The various stray capacities affecting high-frequency response are dotted.

Fig. 5. (A) Deflection amplifier circuit suitable for single-ended deflection. (B) Deflection amplifier circuit suitable for push-pull deflection.



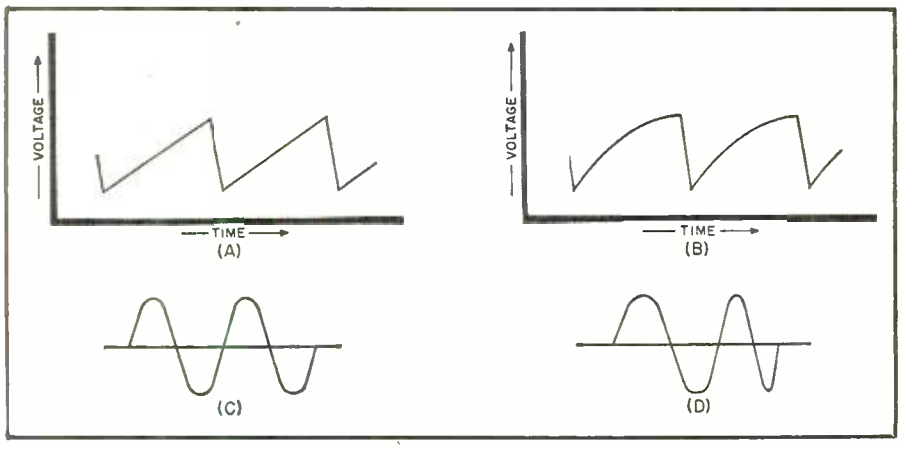


Fig. 6. (A) Linear saw-tooth scanning voltage waveform. (B) Non-linear saw-tooth scanning voltage waveform. (C) Appearance of two sine waves as seen with linear saw-tooth scanning voltage. (D) Appearance of two sine waves as seen with non-linear saw-tooth scanning voltage shown (B) above.

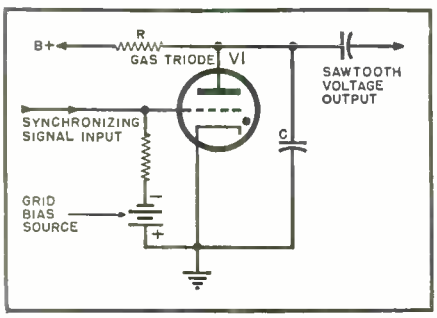


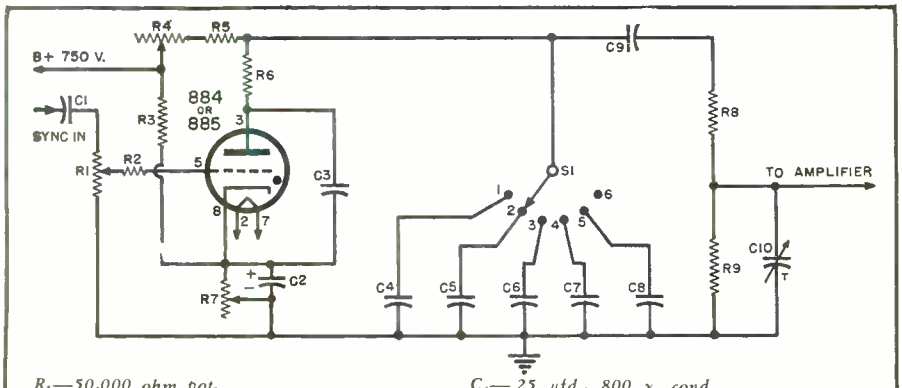
Fig. 7. Basic circuit for the gas-triode type of saw-tooth scanning oscillator.

when describing the cathode follower.

Fig. 1 is a block diagram of one complete deflection amplifier such as might be found in an oscilloscope having the previously described characteristics. Fig. 2A gives the schematic diagram of one form of input selector and attenuator which meets the bandwidth and input voltage requirements. While this assortment of condensers and resistors may seem a bit complex, they actually contribute considerably to the proper performance of the whole circuit. Mentally rotating the selector switch to the *"HIGH"* position, it will be noted that the input jack is thus directly connected to the grid of the cathode follower tube through the .25 μfd. coupling condenser. As the grid return of the cathode follower to ground is 2 megohms when the switch is in this position, the input circuit offers a very small loading effect to the circuits under test.

The switch is used in this *"HIGH"* gain position when small voltages are being observed. However, when it becomes necessary to view larger voltages, an attenuator must be inserted between the input terminal and the cathode follower grid to prevent the larger voltages from overloading this tube. This is accomplished by rotating the switch to the *"LOW"* gain position. In this position, only one-tenth (1/10) of the input voltage appears at the grid of the cathode-follower tube, thus permitting input voltages ten times greater to be observed on the oscilloscope.

Fig. 8. Complete circuit for gas-triode type saw-tooth scanning oscillator.



R_1—50,000 ohm pot.
R_2—25,000 ohm, 1/2 w. res.
R_3—200,000 ohm, 4 w. res.
R_4—5 megohm pot.
R_5—800,000 ohm, 2 w. res.
R_6—500 ohm, 1/2 w. res.
R_7—3000 ohm rheostat
R_8—2 megohm, 1/2 w. res.
R_9—300,000 ohm, 1/2 w. res.
C_1—.1 μfd., 600 v. cond.
C_2—25 μfd., 50 v. elec. cond.
C_3—400 μμfd. mica cond.
C_4—.25 μfd., 800 v. cond.
C_5—.07 μfd., 800 v. cond.
C_6—.025 μfd., 800 v. cond.
C_7—.005 μfd., 800 v. cond.
C_8—.002 μfd., 800 v. cond.
C_9—.5 μfd., 800 v. cond.
C_{10}—3-30 μμfd. trimmer

Note: Frequency coverage: Switch pos. #1, 15 to 60; Pos. #2, 50 to 200; Pos. #3, 180 to 600; Pos. #4, 500 to 2000; Pos. #5, 1400 to 5400; and Pos. #6, 5000 to 20,000 cycles.

The attenuator itself is shown, without the other components, in Fig. 2B. The wiring capacity and the grid-to-ground capacity are both shown as a dotted condenser to assist the explanation. At low frequencies, the resistance portion of the attenuator would be sufficient, because the small capacity of the grid circuit, which may run around 10 μμfd. will have no appreciable effect. However, as the frequency goes higher, the reactance of this capacity gets smaller and thus has the same effect as though another resistor were added across the 200,000 ohms already there. This effect is sufficient to change the attenuation from 10:1, for which the resistors are calculated, to 20:1 at 20 kc. and 37:1 at 200 kc., using the 10 μμfd. grid-to-ground capacity figure.

To overcome this effect, an additional capacity attenuator is added in parallel with the resistance attenuator. These capacities are proportioned to assure the same degree of attenuation at the higher frequencies as the resistors alone afford at the lower frequencies, thus eliminating the frequency discriminating effects of the resistance attenuator by itself to the higher frequencies. The adjustment of the small 3-30 μμfd. trimmer to make the relationship between the resistors and condensers exactly correct is described in the second installment.

The *"SCAN"* position of the input selector connects the output of the saw-tooth oscillator to the input of the cathode follower through its own attenuator. The need for this additional attenuator is best explained by considering the design of a saw-tooth oscillator itself. Generally speaking, it is desirable to get the largest possible output from any saw-tooth oscillator while still maintaining the desired scanning linearity, since the waveform is more nearly a perfect saw-tooth shape at higher output voltages, and the return trace time is generally shorter. Accordingly, an attenuator is desirable to reduce the voltage from the scanning oscillator to a usable value at the grid of the cathode follower, since this output voltage is generally much larger than the deflection amplifier requires.

This scanning voltage attenuator utilizes the same principles as those described for the *"LOW"* position attenuator, but is adjusted in a somewhat different manner. As shown in Fig. 2C, the smaller of the two attenuator capacities is actually the capacity of the 2 megohm resistor itself, while the larger capacity across the 300,000 ohm resistor is made variable to permit exact adjustment.

Fig. 3A shows the cathode follower itself, the variable amplifier gain control, and the input grid of the first amplifier stage. One unconventional feature will be noted about this arrangement. Instead of connecting the variable control in the cathode circuit and placing a fixed resistor in the grid circuit, illustrated in Fig. 3B,

(*Continued on page* 192)

A Unique A.V.C. AMPLIFIER

An a.v.c. circuit providing essentially constant a.f. or r.f. output for widely varying inputs.

By J. T. GOODE
The Rollin Co.

SOON after the appearance of sensitive-type receivers, the desirability of some method of providing automatic volume control became apparent.

The first type of automatic volume control, which consisted of rectifying the amplified r.f. voltage and controlling the bias of an amplifier stage, is the most widely used a.v.c. method.

Such a method of a.v.c. control is a vast improvement over none, but does have its limitations, the limitations consisting of steadily increasing output as the input is increased.

Amplified a.v.c. control tends to correct this situation. The amplified a.v.c. control described in this article should be classed as an improvement over conventional a.v.c. amplifiers, the word "improvement" meaning an additional stage of amplification, which is used only for the purpose of increasing the voltage before rectification.

The measurements, shown in Table 1, were made on a one-stage audio amplifier with a.v.c. control (see Fig. 1). The measurements were made by increasing the input to the amplifier in one-decibel steps and measuring the db. output change of the amplifier.

On an average the a.v.c. amplifier was able to maintain the output constant within .15 db. when the input was changed 1 db. The obvious error in the output measurements was caused by inability to observe voltage measurements with such a slight change.

The measurements indicate the ability of this type of a.v.c. amplifier to maintain linear increase as the input voltage is varied. The conventional a.v.c. amplifier does not have this linear characteristic nor the ability to maintain reasonably constant output voltages when large input variations are experienced. The stability of the a.v.c. amplifier is excellent.

Tests were conducted over a period of months in a constant level audio application, and the output voltage variation was less than 1 db. During these tests no adjustment was made in any part of the circuit.

INPUT CHANGE (in db.)	OUTPUT CHANGE (in db.)
0	0
1	.1
2	.3
3	.5
4	.8
5	.9
6	1.0
7	1.1
8	1.2
9	1.3
10	1.5
11	1.7
12	1.9
13	2.0
14	2.1
15	2.2
16	2.3
17	2.5

Table 1. Actual measurements made on a one-stage audio amplifier employing the a.v.c. control described.

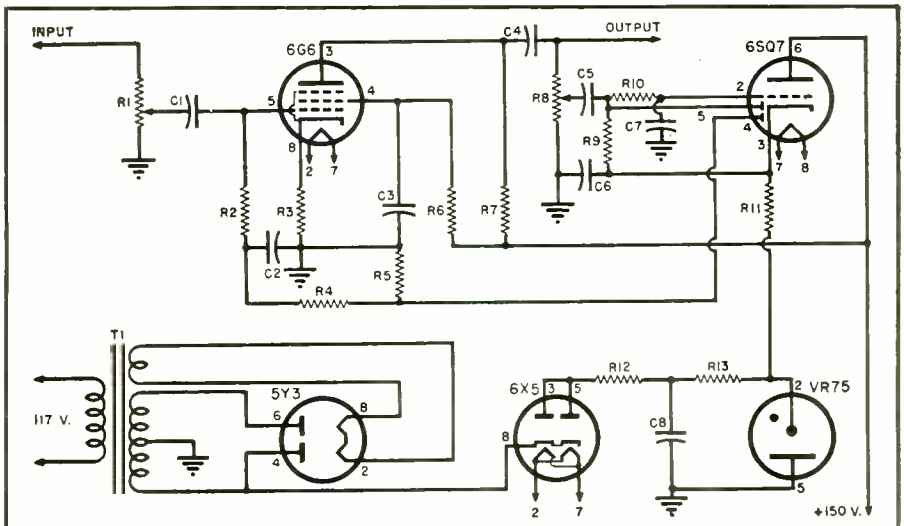
This type a.v.c. amplifier operates with equal stability in r.f. applications. Fig. 2 indicates circuit values for an r.f. application.

This a.v.c. amplifier requires a negative potential of approximately 75 volts. This voltage is not critical but should be maintained at a constant level. The use of a voltage regulator tube to maintain this voltage constant is desirable. The voltage regulator tube is an excellent equivalent filter condenser, producing practically pure d.c. without the use of filter chokes. The amount of current furnished by this bias supply is infinitesimal with the exception of the current drawn by the voltage regulator tube. Such being the case, one-half of the high voltage winding of a power transformer may be used and rectified for this purpose without overloading the transformer.

Another method of obtaining bias without batteries is to build a simple r.f. oscillator and rectify the r.f. This method is less desirable than the circuit indicated in Fig. 1. The r.f. bias supply has definite limitations if the a.v.c. amplifier is to be used in a receiver. Serious beat notes can result

(*Continued on page* 158)

Fig. 1. Diagram of a.v.c. amplifier. Note that bias voltage is obtained from one-half of transformer's high voltage winding. Balance of 5Y3 power supply is not used.



R_1—500,000 ohm pot.
R_2, R_3, R_4, R_5, R_6, R_9, R_{10}—500,000 ohm, ½ w. res.
R_7—75,000 ohm, ½ w. res.
R_8—1 megohm pot.
R_{11}—150,000 ohm, ½ w. res.
R_{12}—10,000 ohm, 2 w. res. (See text)
R_{13}—30,000 ohm, 5 w. wirewound res.

C_1, C_2, C_3, C_4, C_5, C_7—.1 μfd., 200 v. cond.
C_6—.25 μfd., 200 v. cond.
C_8—20 μfd., 150 v. elec. cond.
T_1—Power trans. (See text)
1—6G6 tube
1—6SQ7 tube
1—VR75 tube
1—6X5 tube
1—5Y3 tube

"S" Meter Calibration Techniques for Communications Receivers

The most critical phase in building an "S" meter is its calibration. Here's how it should be done.

By

ROBERT M. BERLER,

W2EPC

A LARGE variety of surplus Army and Navy communications receivers has been placed on the market since the termination of the war. Many of these units make excellent amateur communications receivers after relatively few modifications. Various articles have been written on these conversions and modifications from time to time. Of these modifications, there is one about which very little has been written, namely, the actual calibration of an "S" meter in "S" units for a given receiver.

The purpose of this article is threefold. First, it will tell how an "S" meter can easily be added to any receiver. Second, the method for calibrating the "S" meter will be given, and finally, some interesting and perhaps unfamiliar facts will be brought to the attention of the radio amateur about "S" meters.

Although the following calibration methods for an "S" meter were used by the author for an Army BC-348-Q receiver, the same circuit and calibration methods may be used for almost any other receiver.

One of the chief differences in the "S" meter described here and those that are commonly used in other receivers is that, in this case, the "S" meter actually measures the a.v.c. voltage rather than the change of plate current in the i.f. amplifiers. This "S" meter is incorporated in a balanced bridge vacuum tube voltmeter circuit.

Three advantages of using this type of "S" meter circuit become apparent.

1. The i.f. plate circuit doesn't have to be broken into in order to insert the meter, as is the case with the usual "S" meter and its associated resistor balancing network.

2. The sensitivity of this type of "S" meter can be tailored to fit the particular receiver to which it is being adapted.

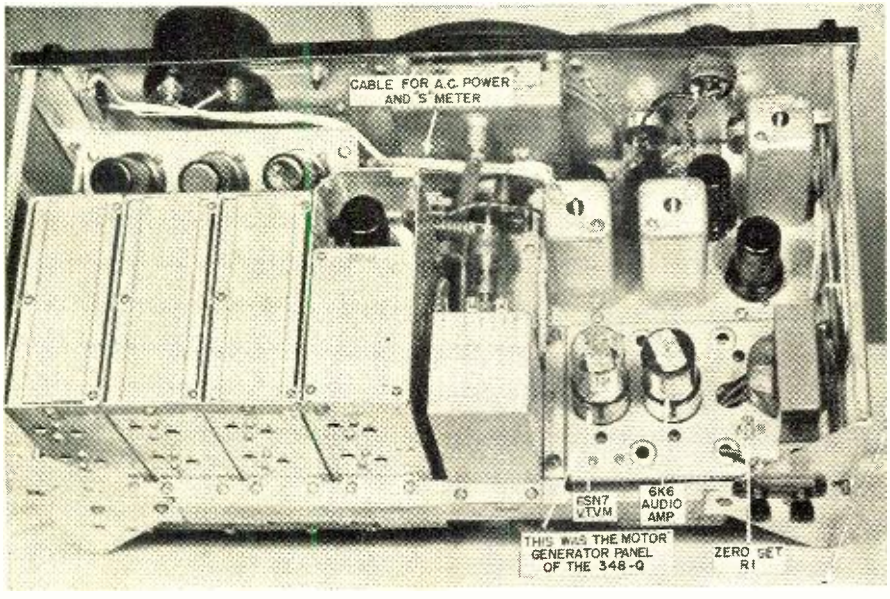
3. Once the bridge is balanced, the "S" meter seldom has to be readjusted for zero setting or for recalibration.

A circuit diagram of the "S" meter v.t.v.m. is shown in Fig. 3A. The vacuum tube bridge consists of a 6SN7 dual triode tube. Each triode section is used as a leg in the bridge. The other two legs of the bridge consist of resistors R_3 and R_4. R_2 is a variable meter shunt resistor and is used to fix the sensitivity of the "S" meter which is a 0-200 microammeter. The bridge is balanced for a zero meter reading by adjusting resistor R_1, a 5000 ohm wirewound pot. Once this bridge is balanced, it seldom needs to be readjusted even though the line voltage may vary. The grid of one section of the 6SN7 is grounded while the grid of the other section is connected to the a.v.c. bus at the point where it is bypassed to ground by the a.v.c. filter condenser.

Since no official standard for the value of an "S" unit has been prescribed, it still remains a more or less arbitrary figure. Two basic "S" meter units are described in the following text. One basic unit may use each microvolt of r.f. input to the receiver as an "S" unit. Using this type of "S" unit, one may give a comparative signal strength report in microvolts increase from one value to another. Another basic "S" unit which may also be used is based on a six decibel increase in microvolts per "S" unit to the receiver. This unit represents an increase in power of four times at the transmitter.

Two pieces of equipment will be needed before the receiver can be calibrated. They are; (a) a signal generator calibrated in microvolt out-

Fig. 1. Rear view of the BC-348-Q chassis. The "S" meter v.t.v.m. and audio power amplifier tube are shown as constructed on the genemotor panel. The slotted control shaft is the zero set for the meter, R_1. The tube at the left is the v.t.v.m.'s 6SN7GT.



put. No modulation is used during calibration; and (b) an RMA standard dummy antenna.

A standard dummy antenna can be put together very simply as shown in Fig. 3B. It is advisable to place the entire dummy antenna inside a shielded box. Connections between the signal generator, dummy antenna, and the receiver, should be made with r.f. shielded wire.

The next step to take is to prepare a chart for the actual calibration of the "S" meter as shown in Fig. 3C. In the first column are listed the "S" units from zero to nine. In the second column is listed the calculated signal generator output setting in microvolts for each "S" unit. The value of these signal generator settings depend on what the basic "S" unit is. The third column lists the reading on the microammeter for each setting of the signal generator in "S" units.

A chart is provided (Fig. 3D) for those who desire to use a six decibel increase per "S" unit. This "Decibels Expressed as Voltage Ratios" chart uses one microvolt as a reference.

Before the actual calibration of the receiver is begun, allow both the signal generator and the receiver to warm up for at least one-half hour. In order to adjust the "S" meter to zero signal strength, short the antenna and ground terminals of the receiver together so that no outside signals will be picked up. With the r.f. gain control set for maximum, adjust resistor R_1 until the meter needle is on the zero mark. The receiver is now ready to be calibrated.

Connect the output of the signal generator through the dummy antenna to the receiver as illustrated in Fig. 5. The r.f. connecting wires should be as short as it is practical to make them so that losses and extraneous pickup will be kept to a minimum value. In fact, if possible, this whole procedure should be carried on in a shielded cage or room for best results.

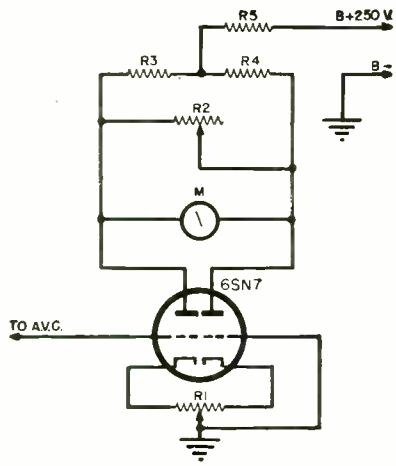
Set both the signal generator and the receiver to a frequency in the center of the amateur band most frequently used. The receiver r.f. gain control is still set for maximum gain. With the signal generator microvolt output control set at its minimum setting, gradually increase this control until the "S" meter just begins to move off the zero mark. Record this setting of the signal generator in microvolts as this value will then become the reference level from which "S" units will be calibrated. Using the chart shown in Fig. 3C, fill in the "S" unit reference level just obtained in the second column opposite "S"-0. From this reference level voltage, all "S" units will be obtained by adding on the value of microvolts needed, which in turn, is decided by the basic "S" unit chosen. Next, the signal generator output control is set for an "S9" signal as taken from the second column in microvolts. Adjust the shunt resistor R_2 so that the meter needle reads 150 microamperes. This point on the meter will represent an "S9" signal. All other "S" units will fall in-between this point and zero. Reduce the signal generator to zero and short the receiver antenna and ground terminals together once again. Check to make sure that the meter needle returns to zero. If not, readjust resistor R_1 slightly to make this correction. The "S" meter is now ready to be calibrated.

Record the meter readings for each value of "S" unit for which the signal generator is set, in the third column. When this chart is completely filled out, enough information will be avail-

(*Continued on page* 204)

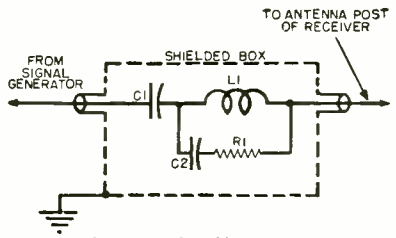
Fig. 2. Front panel view of the BC-348-Q on which the "S" meter was mounted. The panel projection type meter was used in order to avoid a large hole-drilling job.

Fig. 3. (A) Wiring diagram for "S" meter vacuum tube voltmeter. (B) RMA standard dummy antenna. (C) "S" meter calibration chart. (D) "Decibels expressed as voltage ratios" chart. The reference voltage is one microvolt.



R_1—5000 ohm wirewound pot.
R_2—500 ohm wirewound rheostat
R_3, R_4, R_5—50,000 ohm, ½ w. res.
M—0-200 d.c. microammeter
1—6SN7 tube

(A)



R_1—400 ohm, ½ w. res.
C_1—200 μμfd. mica cond.
C_2—400 μμfd. mica cond.
L_1—20 μh. r.f. choke

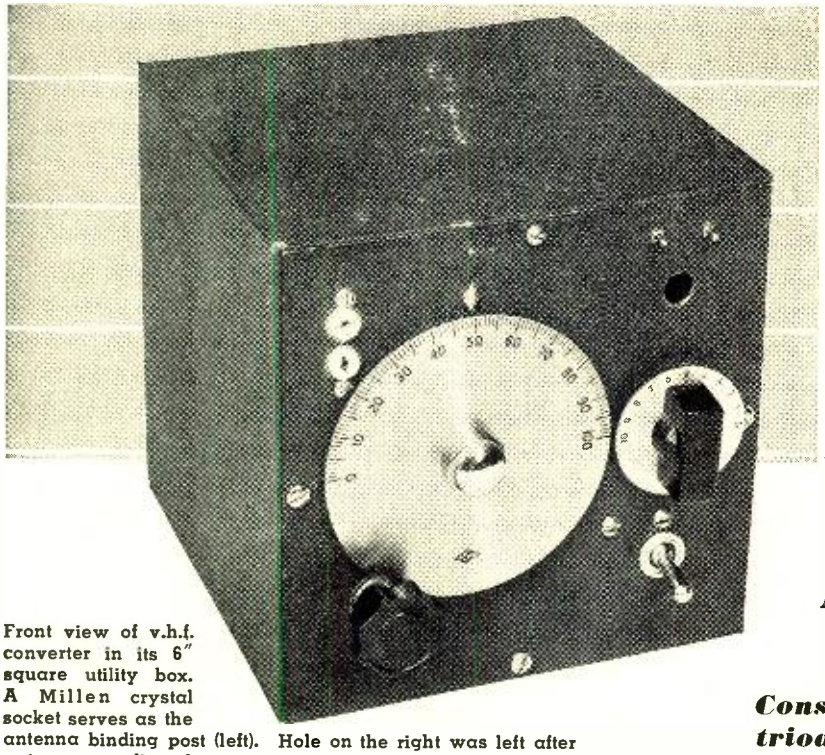
(B)

"S" Units	Calculated Sig. Gen. setting in microvolts	Meter Reading
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		

(C)

"S" Unit	Decibels	Microvolts
1	0	1
2	6	1.99
3	12	3.98
4	18	7.9
5	24	15.9
6	30	31.6
7	36	64.
8	42	125.9
9	48	251

(D)



Front view of v.h.f. converter in its 6" square utility box. A Millen crystal socket serves as the antenna binding post (left). Hole on the right was left after antenna coupling device, now unused, was removed. The small dial at right is on the r.f. mixer condenser and the large dial with vernier drive tunes the oscillator condenser.

A Two-Meter Converter

By
A. DAVID MIDDELTON, W1CA

Construction details for an efficient triode, 144-148 mc. band converter, used in conjunction with a modified G.E. JFM90 "Translator," or an HRO.

SUPERHETS for the 144-148 mc. band are a "must" and many of the gang would like to have one but have hesitated because of the complications arising due to the necessity for building an i.f. system, not to mention the host of other "bugs" present in the construction of v.h.f. supers.

Since 1941, several *simple* superhet systems have been built and used by the writer. All of them consisted of converters fed into a ready-made i.f. system—a *General Electric* JFM90 "Translator." This unit is an excellent prewar-built FM tuner (41-51 mc.) with a self-contained power supply and a low-level audio output adequate for headphone reception. This output may be connected to an amplifier for speaker work, if desired. However, crystal headphones give a fine response.

Of late, this converter has been used, with excellent results, ahead of an *HRO*. The oscillator frequency was shifted to permit the use of a 30 mc. i.f. (on the *HRO*). No other changes were required and reception of "good" 144 mc. signals are now possible.

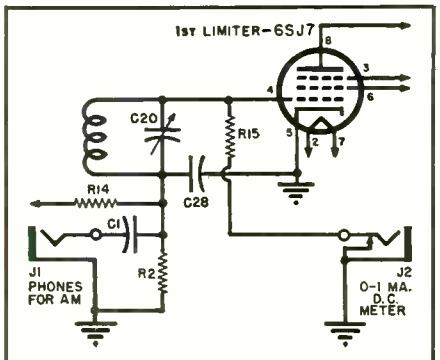
Such a simple v.h.f. converter is diagrammed in Fig. 2, and includes a pair of 955 triode acorns in both mixer and oscillator circuits. The output of the mixer feeds into a tuned circuit, link-coupled to a coax line running to the dipole antenna connection on the JFM90 FM tuner or to the *HRO*.

The high-C oscillator tunes the frequency range 103 to 107 mc. (for an i.f. of 41 mc.) or 114-118 mc. (for use with a 30 mc. i.f.) and is capacitively coupled to the mixer grid. Neither complications nor difficulties arise from this sort of lashup, as "tracking" was not even considered.

The required power (150-200 volts plate and 6.3 volts filament) may be obtained from the "Translator" but at W1CA, an external power supply with a VR150 tube is normally used.

The layout of the converter can follow the dictates of purse and imagination. It is advantageous to enclose it in a metal shield. A 6" x 6" x 6" utility box houses such a unit neatly and easily. The components are mounted on a *subchassis* and on the *front panel*, and *not* on the inside of the can. Naturally, the *L-C* leads of the mixer and the oscillator should be kept short. A variable antenna pickup loop might prove useful, but, at W1CA, the loop is jammed between the turns of L_2, adjusted until the proper coupling is obtained, and left there. The mixer tuning condenser, C_3, is *not* ganged with the oscillator tuning control, thus making a "two-handed" job of tuning, but saving much work and worry in construction. The mixer, by the way, tunes *sharply*, especially when the point of regeneration (which is also maximum gain) is reached. A smooth-working dial is used on the oscillator condenser, C_7. The oscillator bandset condenser is a screwdriver adjusted midget soldered directly onto the terminals of C_7. Large size wire and sturdy construction result in a stable oscillator.

Fig. 1. Schematic diagram of the 6SJ7 first limiter tube in the G.E. JFM90 FM "Translator" showing components added to furnish AM reception and limiter-grid current measurement. The normal low-level a.f. output of the "Translator" is used for FM reception.



R_2—250,000 ohm, ½ w. res. (added)
R_{14}—2.2 megohm, ½ w. res. (in "Translator")
R_{15}—47,000 ohm, ½ w. res. (in "Translator")
C_1—.05 μfd., 400 v. cond. (added)
C_{20}—Trimmer (in "Translator")
C_{28}—47 μμfd. ceramic cond. (in "Translator")
J_1—Open circuit jack (added)
J_2—Closed circuit jack (added)

Adjusting the Converter

After building the converter, the first step in adjustment, is to set L_3-C_4 to the desired i.f. frequency. Set the JFM90 on some point near the low frequency end of the band, say 41 mc. If a suitable signal generator is available, feed a 41 mc. signal into the i.f. system via the i.f. transformer, (L_3-C_4) and adjust C_4 until the maximum response of the limiter-grid current is indicated on a meter plugged into J_2 (Fig. 1.). (This meter installation will be covered later.)

If no signal generator is available, connect an antenna to the plate pin

of the mixer tube socket and tune C_4 for maximum response on any available 40-50 mc. FM signal. The setting for C_1 can be changed to lower the frequency (more capacity) after hitting resonance. This procedure will serve to get a signal through the unit for checking purposes.

The next step is to spot the band, approximately 100 mc., on the oscillator. If a calibrated wavemeter is on hand, this is a simple task, but if not, the job is fairly complicated and you will have to devise some method of checking the 100 mc. point on the oscillator. At W1CA this was done with a lot of luck plus the aid of a pair of black cats, (in push-pull), as the first "two and a half" signal came in on the converter without the writer manually tuning the dial, when a station about 20 miles away "fell in" or drifted onto the spot where the oscillator was sitting. Since this is not likely to happen again, the writer will leave this problem up to the inherent ingenuity of the constructor. But—*don't* despair! You will eventually hit the *right* frequency with the oscillator. Beware of the spurious ones, however, they will only lead you down a blind alley infested with a flock of very-much-unwanted "birdies."

Just as a suggestion, try picking up the 4th subharmonic of the 100 mc. v.h.f. oscillator at 25 mc. on your calibrated low-frequency receiver. Or, if you have a receiver tuning to 33 mc., the 3rd subharmonic will be easier to locate.

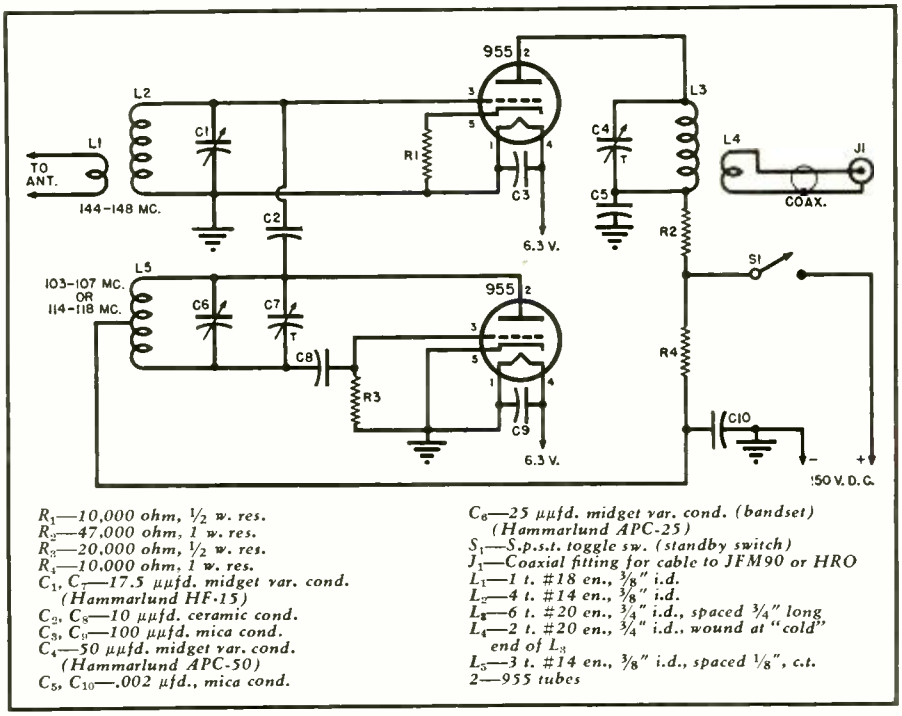
The best method of hitting the right spot is, of course, to rig up a set of Lecher wires and to calibrate an absorption wavemeter covering from—say—95 to 100 mc. This will be a useful gadget around the shack if you are fooling with v.h.f. superhets and it's well worth the time and effort expended in its construction. A four-turn coil (⅜th inch i.d.) spaced about 1 inch long, tuned with a 25 $\mu\mu$fd. midget variable, will do the trick. Adjust the spacing to obtain a bit of bandspread in the vicinity of 100 mc.

The mixer circuit is, of course, tuned to the incoming signal frequency and the 144-148 mc. band should fall in the tuning range of L_2-C_1. It is necessary to have a two meter antenna connected to L_1 during the adjustment procedure as the mixer "takes off" when unloaded.

Once the oscillator is on frequency, and the mixer is on band, reception of loud signals should be accomplished without difficulty. A local two-meter transmitter may be used, or if there are loud signals, they will suffice, except that the usual practice will be that Joe Blow will sign off *just* when you really need his signal!

After getting some sort of a signal through the converter, peak up the i.f. system (by adjusting C_1), trim up the mixer and adjust the antenna coupling plus C_1. Keep trying until

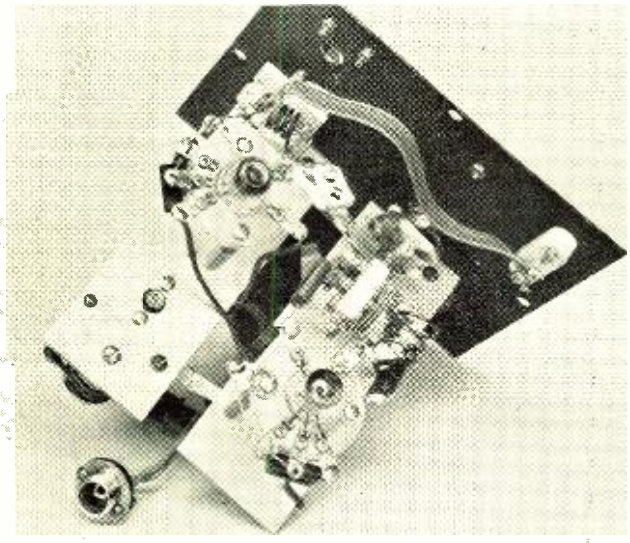
(*Continued on page 80*)

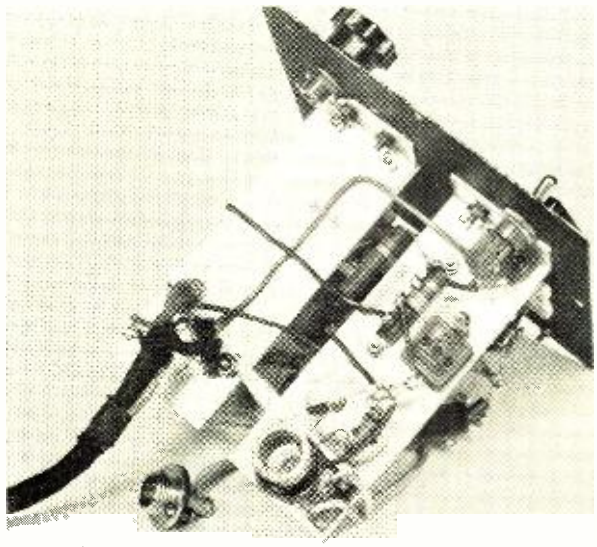


R_1—10,000 ohm, ½ w. res.
R_2—47,000 ohm, 1 w. res.
R_3—20,000 ohm, ½ w. res.
R_4—10,000 ohm, 1 w. res.
C_1, C_7—17.5 $\mu\mu$fd. midget var. cond. (Hammarlund HF-15)
C_2, C_8—10 $\mu\mu$fd. ceramic cond.
C_3, C_6—100 $\mu\mu$fd. mica cond.
C_4—50 $\mu\mu$fd. midget var. cond. (Hammarlund APC-50)
C_5, C_{10}—.002 μfd., mica cond.
C_8—25 $\mu\mu$fd. midget var. cond. (bandset) (Hammarlund APC-25)
S_1—S.p.s.t. toggle sw. (standby switch)
J_1—Coaxial fitting for cable to JFM90 or HRO
L_1—1 t. #18 en., ⅜" i.d.
L_2—4 t. #14 en., ⅜" i.d.
L_3—6 t. #20 en., ¾" i.d., spaced ¾" long
L_4—2 t. #20 en., ¾" i.d., wound at "cold" end of L_3
L_5—3 t. #14 en., ⅜" i.d., spaced ⅛", c.t.
2—955 tubes

Fig. 2. Complete schematic diagram of 2-meter superheterodyne converter.

(Left) Top view of the converter. The high-C oscillator is located on the right hand aluminum strip. The dial is coupled to the tuning condenser through an isolated coupling. Between the two aluminum strips may be seen the mixer-oscillator coupling condenser, a ceramic type. The mixer section is on the left hand strip. A short length of 300 ohm line connects the antenna binding posts to a one-turn antenna pickup loop jammed in between the turns of the mixer tuned circuit. The i.f. transformer's tuning condenser is a screw-adjusted midget located at the rear of the mixer section. The mixer output is terminated in the coaxial fitting shown at the bottom of the photograph. This fitting fastens to the rear panel of the cabinet. (Right) Below chassis view of the converter. The i.f. transformer is shown in the foreground. A power cable, terminated on lugs, runs through a grommetted hole in the rear panel.

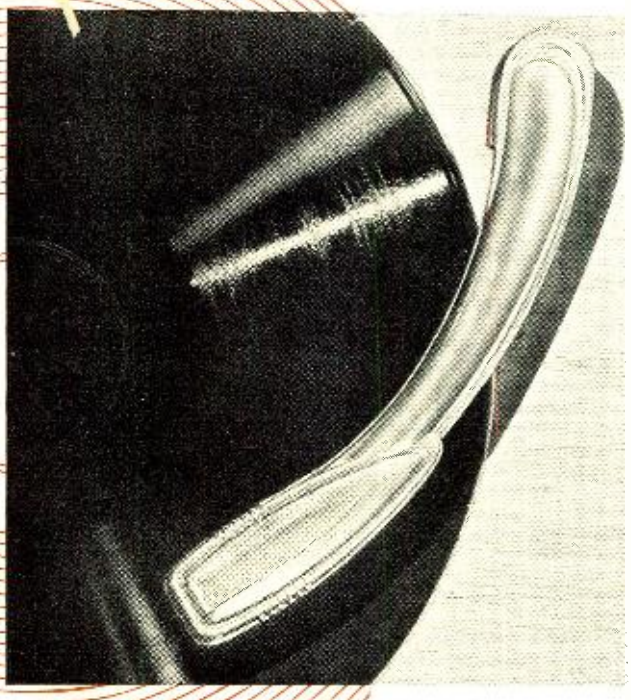




The RECORDING and REPRODUCTION of SOUND

By OLIVER READ
Editor, RADIO NEWS

Part 14. A discussion of phono pickup tracking error, groove skating, and record wear.



Modern offset type tone arm reduces record wear.

ENGINEERS, several years ago, realized that in order to obtain the utmost fidelity and minimum record wear, some means should be provided to offset the tendency of the pickup tone arm to "ride up" on a groove during reproduction. Many theories have been advanced regarding the effects of "tracking error," with the result that the layman is often confused when attempting to understand the fundamental rules that govern the final results.

So-called straight arm phono pickups were commonly used up until a few years ago. Little thought was given to the effects of proper "tracking" and "groove skating." The distortion caused by improperly designed tone arms meant but little as few instruments were capable of attaining high fidelity. The old conventional tone arm was designed somewhat as illustrated in Fig. 1. Note that the tone arm swings in an arc (*A-B*) as indicated. With this type of tone arm there is only one point on the record, that near the center of swing, where the needle or reproducing stylus will be seated correctly within the groove. At any other position of the arm travel, the stylus will either be forced to the right or to the left of that position. In other words, the pickup element or cartridge will not be at right angles to the direction of travel.

This tracking error becomes greater as the two extremes are reached by the needle as the angles become greater with a resulting increase in distortion and record wear. At all positions except that at which the needle appears at right angles to the groove there will be a tendency for the needle to ride up on the walls of the groove. This becomes rather serious as the outside or inside grooves are reached as the action becomes more exaggerated.

Groove Skating

Groove skating results from improper tracking. Under such conditions it is impossible for the needle to reproduce properly as a great part of the applied needle pressure is from the sides or "walls" of the groove. This has a tendency to actually steer the needle away from its normal resting condition (Fig. 1C). There can be only one pivot point for the tone arm. Obviously then, the only remedy to offset the tendency of the needle to ride up on the walls of the groove is to change the straight arm design to one which will "offset" the angle thus enabling the needle to approach a closer correct angle with relationship to the groove.

Fig. 2 illustrates several offset heads of improved design. Further improvement is obtained when the point of the reproducing needle contact is swung through a lower arc, one farther from the normal hub line or center hole of the record, as illustrated in Fig. 3.

We now find that the new arc starts below *D* and the needle travels approximately ⅜" below the arc shown in Fig. 1. Three possible positions for the needle are illustrated; one at the outside groove, another at point *F*, and the other at the inside groove of the record. Note that we approach a right angle to the groove as the arm travels throughout the record and a better average is maintained due to the offset position of the head.

Considerable record wear will result if the foregoing considerations are not met. If a needle, especially a sharp one used on commercial pressings, is allowed to ride up on the sides or walls of the groove, it can only result in continuous wear on the record material at the point of needle contact. Sound modulations are cut into the sides of *each* groove, not at only one side. Naturally then, we must take the required steps and make certain that the needle is allowed to engage both walls at the same time with even pressure or, more accurately, to see that the needle is "seated" properly.

The effects of improper tracking become even more acute with transcription and home recording blanks as the record material is considerably softer and the walls of the groove are more subject to mechanical distortion than are commercial hard shellac pressings.

An improvement can be made in the playback setup by employing pickups of the lightweight class—those

having a needle pressure of from ¼ ounce to 2 ounces. On the other hand, too little pressure is not recommended as this too can actually increase the wear on the groove walls. The pickup, therefore, must have enough point pressure to permit the needle to "seat" in the bottom of the groove and to be able to guide the complete pickup arm across the record in a horizontal plane.

The use of sapphire playback styli (needles) is recommended for all types of soft disc materials, due to the ability of the stylus to maintain a correct shape for hundreds of playings. While these are more expensive initially, the cost is offset by the saving in replacements.

As an analogy, we might point out that in early machines, such as the cylindrical record phonographs and other dictating machines, the locus of the reproducing stylus is in the straight line with perfect tangency to the groove at every point on the record. In the case of reproduction by means of the conventional pivoted tone arm, the locus (the path) of the needle point is the arc of a circle. Perfect tangency to the groove is possible at only one or two points on the record, as previously mentioned. Tracking error is the result of a pivoted tone arm and is obviously an inverse function of the length of the tone arm.

Tone Arm Length

Fig. 4 illustrates a graphical method for determining tone arm length developed by Mr. Roy Dally.[1] To arrive at the proper over-all length of a tone arm, and the included angle of offset, any shape or design of tone arm may be laid out over the backbone as long as the essential dimensions are not disturbed.

First lay out, full size, the outside groove of a twelve inch record. This averages 11½" in diameter. Then lay out the inside groove of a 10" record, which is about 4". The only factor that must be known beforehand is the distance from the center of the record to the lateral bearing which is usually the center of the mounting hole. This is an arbitrary distance and depends upon the space available. Let us use, for illustration, a dimension of 7". Locate this point with reference to the record center. Now construct a center groove which lies equidistant between the outer and inner grooves. Lay in line *A-A* which is a tangent to the center groove. Construct the arc *B-B* whose radius is the distance from the mounting hole to the record center. Using this same radius, locate the compass needle on tangent line *A-A* so that the compass point intersects the tangent point *X* in the center groove.

Construct an arc *C-C* so that both ends intersect *B-B*. Draw the straight line *D-D* which passes through the arc

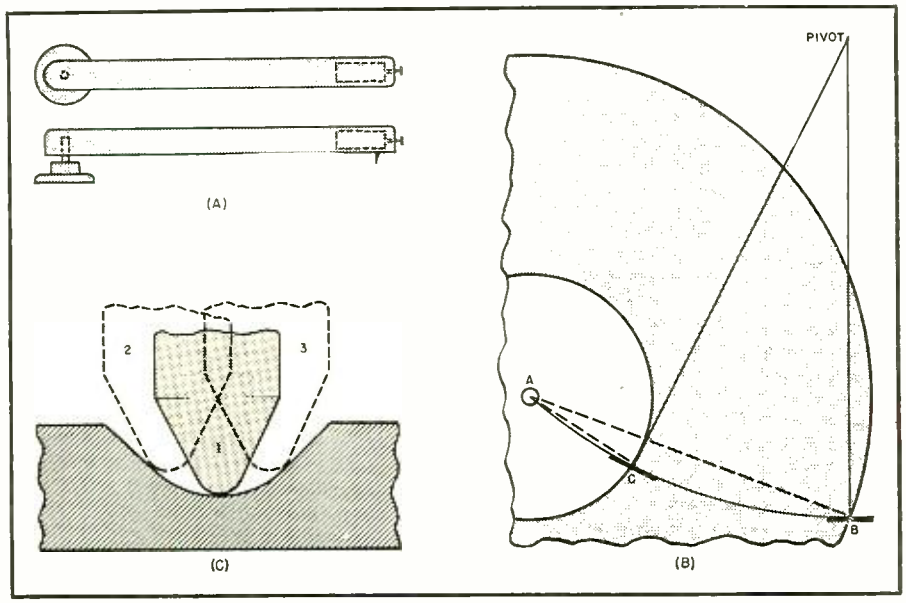


Fig. 1. (A) Straight tone arm. (B) How not to mount a tone arm. (C) Variations of groove skating.

intersections and line *E-E*. The point *Y* then represents the needle point and the distance from *Y* to the mounting hole center becomes $7\frac{11}{16}$". The $\frac{11}{16}$" is the distance the needle point must be beyond the center of the record when the pickup is mounted in order to insure proper tracking.

Next construct the arc *F-F* whose radius is $11\frac{11}{16}$". Draw tangents *G-G*, *H-H*, and *I-I*, using a right triangle between the record center and intersection points of grooves and tangent lines. Then draw lines from the mounting hole center to the same points. The three included angles shown indicate the degree of offset necessary to have perfect tracking at those respective grooves.

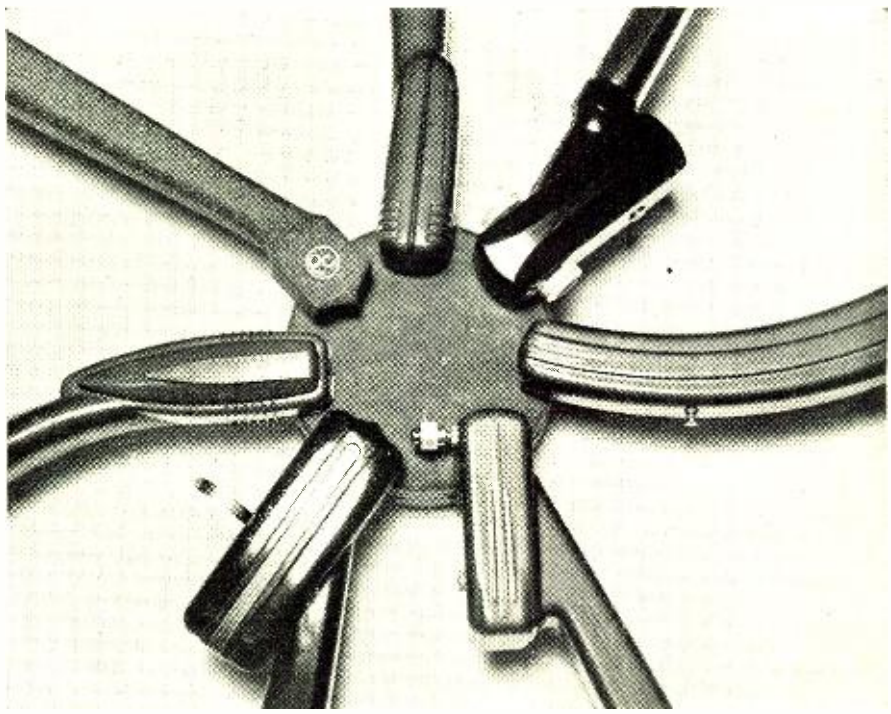
An average included angle would be about 27 degrees which would permit an error on one side of 1 degree and on the other side 1½ degrees. This gives the total tracking error of 2½ degrees.

Styli and Record Wear

The perfect reproducing needle or stylus would be one which would maintain its shape throughout many thousands of playings. Regular commercial records, as purchased in music and radio stores, use a shellac base rather than the soft lacquer material used to coat the surfaces of home and transcription discs. The purpose of the shellac, other than that of a bond-

(*Continued on page* 116)

Fig. 2. Note the variation of offset angles on these modern tone arms.



1. Dally, Roy, Consulting Eng., The Electrovox Co., Inc.: "Tone Arm Design," Radio, July, 1944.

International SHORT-WAVE

***Compiled by* KENNETH R. BOORD**

OUR congratulations go to the Swedish Radio (Radiotjanst), Stockholm, on its weekly program on short-wave dedicated to DX-ers around the world. This special service is heard each Saturday at 0245*, SBO, 6.065, and SBT, 15,155; 1000, SDB-2, 10.780, and SBT, 15.155; 2000, SBU, 9.535, and SDB-2, 10.780. The scripts are prepared by Arne Skoog, president of the "International League of Short-Wave Editors," and one of Sweden's foremost authorities on international radio. They are read by Mr. Bergsten, one of Radiotjanst's *English* announcers. Mr. Skoog advises that "this new service is a tribute to international goodwill, but will also keep short-wave listeners informed regarding broadcasts from Sweden and on DX news from all over the world. The first transmission is intended primarily for the Pacific Area, but also for 'morning owls' in Europe and Africa; the second period is most suitable for listeners in Europe and Africa, but can also be heard well in America; the third transmission is intended for America. Reception reports will be greatly appreciated." *(IRC's should be used.)* A monthly program for short-wave listeners in Sweden (presumably on the *last* Sunday of *each* month) is also being radiated over the Swedish National Network and on short-wave from SBT, 15.155, and SDB-2, 10.780, at 1700-1715; it is in Swedish although on occasion it is planned to include recordings of foreign broadcasts; it is preceded by songs of Vera Lynn.

And now some "press-time" late news:

A program in Esperanto is being broadcast on the *first* Sunday of each month at 1000 (relayed from Malmo) from Swedish outlets of SDB-2, 10.780, and SBT, 15.155; will continue until the International Congress of Esperantists in Malmo in July; consists of talks and messages concerning this Congress and lasts 15 minutes. Danska Brigaderadion (The Danish Forces' Radio) in Germany is back on 6.225 at 0400-0600, 0800-1000, 1400-1600 daily. *Radio Sumatra* is heard in Sweden on 7.210 to 0935. Reykjavik, Iceland, is definitely on the air each Sunday on 12.235 at 1115-1145. (Skoog, Sweden)

A Middle East station heard in Sydney, Australia, has been identified as an oil company's transmitter, HZZ, in Saudi-Arabia; uses 16.400, 12.200, 8.672 for communications and for the broadcasting of aircraft movements. The British voice sometimes heard is that of the Medical Officer, although an American voice is most frequently in use. Sometimes they use Arabic when contacting Cairo. The "Radio Club of Mocambique" is anxious to receive reports from listeners on its *Sunday* transmission over CR7BJ, 9.645, at 0200-0700; QRA is P.O. Box 594, Lourenco Marques, Portuguese East Africa. Paris is using a *new* frequency of 6.120 at 0700-0830. (Radio Australia)

The station heard well in Eastern U.S. afternoons on (measured) 7.953 is *Radio Falange de Alicante,* Spain, signs off 1800; is just *above Radio Bissau,* 7.948. QRA of EAJ-43 is Radio Clube de Tenerife, Estaciones EAJ-43 y EA8AB, Apartado de Correos 225, Santa Cruz de Tenerife, Islas Canarias. (Kary)

An airmail report just in from Dorothy Sanderson, Australia, reports Makassar heard around 14 megacycles at 0730 with news in Dutch and music, fair signal. Other tips from Miss Sanderson include JBBK, 4.400, Korea, news in Russian 0530 (this one is heard in Texas and occasionally I have heard it here in West Virginia, weak at 0730); Pnom-Penh, Fr. Indo-China, on 12.36, news in Chinese at 0615; ZBW3, 9.525, Hongkong, BBC news relay 0600.

Riggle, Ohio, reports an unidentified station at 0145 on 9.54 with rooster crowing following an announcement (*not English*); sounds Middle Eastern or African); closes down shortly, so may be testing. Mozambique?

HCJB, Quito, Ecuador, informs me that its 4.107 outlet was closed down Sunday, February 8, "since we feel that 50 meters (5.995), our *new* outlet, will serve everyone who had been served by our 73-meter outlet, as well or better and should serve many new listeners at greater distances as well; unless we should get a tremendous response from listeners requesting us to return to 73 meters because they cannot receive us on 50 meters, we will no longer use the 73-meter band (which was intended primarily for listeners in Ecuador)." HCJB also advises that within some months they expect to carry on tests in the 16-meter band, and that they should have a new and

(*Continued on page* 146)

This well-equipped listening post and recording laboratory is that of Henry Callahan, Narberth, Pennsylvania. The receiver is a Hammarlund "Super-Pro." The unit in the left foreground is a television set. Mr. Callahan records many overseas broadcasts and sends the recordings (at his own expense) to stations abroad so engineers can "hear" how their signals come in in the Eastern United States. He has furnished many hard-to-find recordings (either originals or dubs) requested by European short-wave stations, and has long been a staunch supporter of PCJ, "The Happy Station," in Hilversum, Holland.

*(Note: Unless otherwise stated, time herein is expressed in American *EST* on a 24-hour clock basis; *add* 5 hours for GCT. "News" means in the *English* language.)

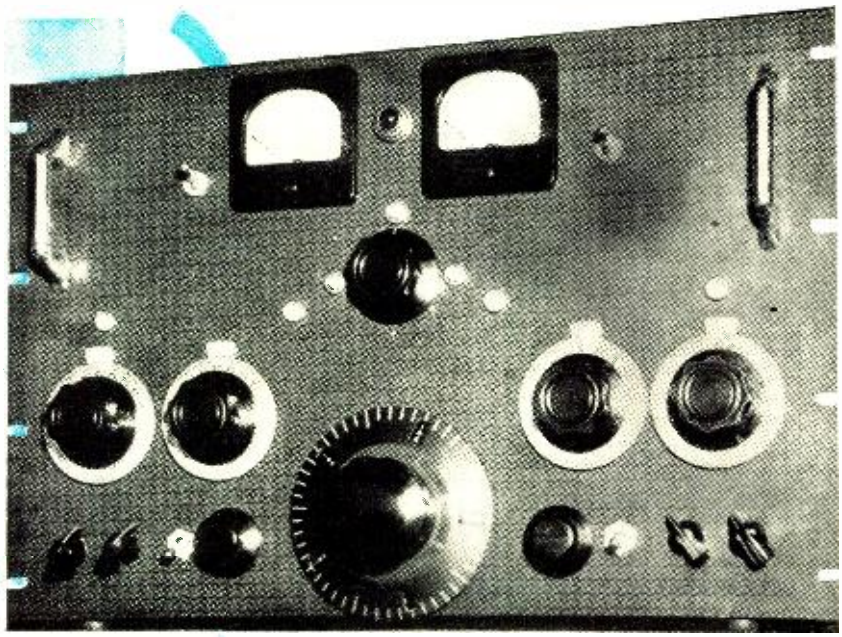


Fig. 1. Front panel view of the home-built receiver.

By CARL V. HAYS, W6RTP

This communications receiver, covering the 10, 20, 40, and 75 meter bands, incorporates many interesting innovations. These features will no doubt give you new ideas for improving your superheterodyne.

THE receiver in question, while an excellent one, is of quite an elaborate and expensive design. It is not intended that the reader copy it as is, but rather study its design for ideas to incorporate in supers of his own choosing. Accordingly the treatment will be confined to a discussion of the many interesting and varied innovations in design.

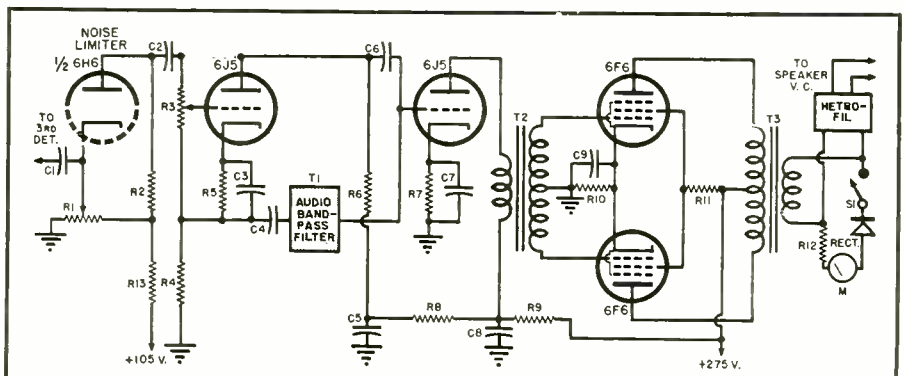
To begin with, the receiver is basically a double-conversion superhet, intended primarily for the reception of phone signals under the most difficult conditions. Considered as a whole it appears highly complicated; actually it is not. The tube lineup, 26 including voltage regulator and rectifiers, is misleading in that of this number, only 17 are used on any one band, certainly not an inordinate number.

The double conversion involves, of course, triple detection. This problem is simplified by having the first detector at all times fixed tuned, reversing the usual procedure in such receivers. It is not a "screwball" circuit; *Collins* uses the idea to excellent advantage in a contemporary design. This design differs only in that self-excited oscillators were used instead of expensive crystals. They have been highly satisfactory.

A look at the *Hammarlund* "Super-Pro" series of receivers will readily show where the grounded-cathode r.f. and i.f. stages were derived. This circuit is superior to all others tried for high gain and extreme quietness, when plate voltages on the order of 200 volts and screen voltages of about 120 volts are used. Such a voltage scheme is used throughout the r.f. and i.f. sections.

Some local amateurs have noted with surprise the lack of a crystal in such an elaborate set-up. Perusal of the schematic of the fixed i.f. will show a twelve-circuit bandpass i.f. which is the only thing we've found that gives the requisite steep-sided, flat-top characteristic absolutely necessary for really good phone reception. The wide-skirted, pinpoint peak of a crystal is simply out of the question for phone work, hence this design. The small

Fig. 2. Schematic diagram of the audio stages of the receiver.



R_1—2000 ohm wirewound pot.
R_2, R_6—50,000 ohm, 1 w. res.
R_3—500,000 ohm pot.
R_4—15,000 ohm, 1 w. res.
R_5, R_7—2500 ohm, 1 w. res.
R_6—100,000 ohm, 1 w. res.
R_8—10,000 ohm, 1 w. res.
R_{10}—300 ohm, 10 w. res.
R_{11}—3000 ohm, 10 w. res.
R_{12}—5000 ohm, ½ w. res.
C_1, C_2, C_6—.05 μfd., 600 v. oil-filled cond.
C_3, C_7—10 μfd., 50 v. elec. cond.
C_4—(In bandpass assembly)
C_5, C_8—8 μfd., 450 v. elec. cond.
C_9—25 μfd., 50 v. elec. cond.
S_1—S.p.s.t. toggle sw.
T_1—Audio bandpass filter (Stancor #C-2332-1)
T_2—Audio input trans. Single plate to P.P. grids (Stancor #A-4401)
T_3—Output trans., 10,000 ohm P.P. plates to 500 ohm line (Stancor #A-3842)
M—0-1 ma. d.c. meter
Hetrofil—Hetrofil filter (Millen #70721)
Rect.—Meter rectifier
2—6J5 tubes
½—6H6 tube
2—6F6 tubes

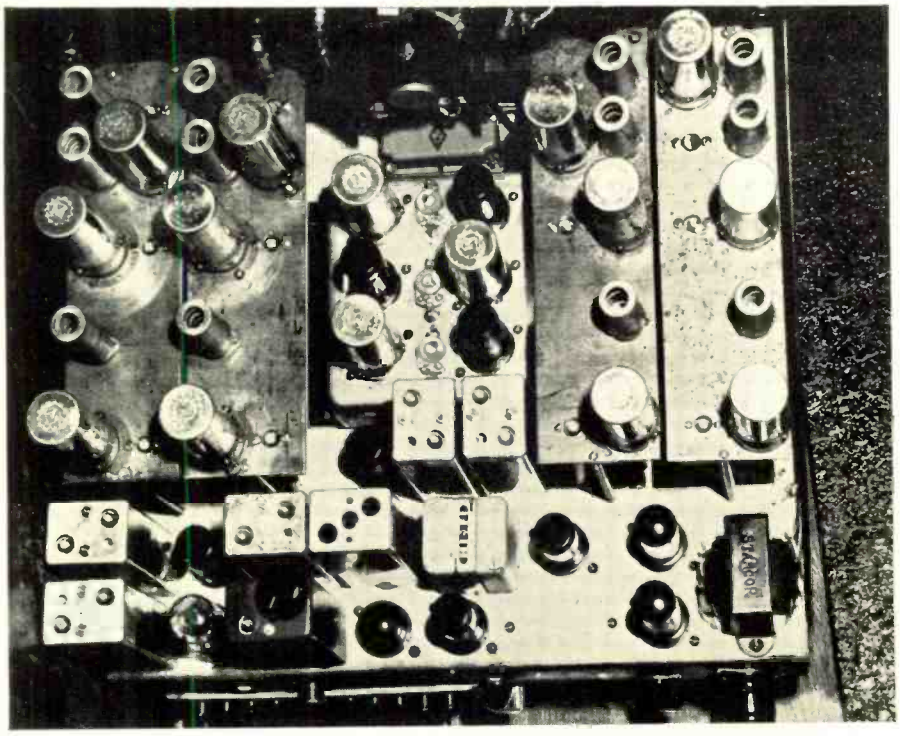


Fig. 3. Top view of chassis shows placement of various components. Four converter chassis, identical in design but covering four separate ham bands, are shown. Bandswitching is accomplished at the outputs of these sections, thus eliminating coil and condenser switching.

trimmers noted in the under chassis view are used to adjust the coupling between stages. With the aid of an oscilloscope and a "wobbulator," the bandwidth has been set for just under five kc., about the optimum for phone.

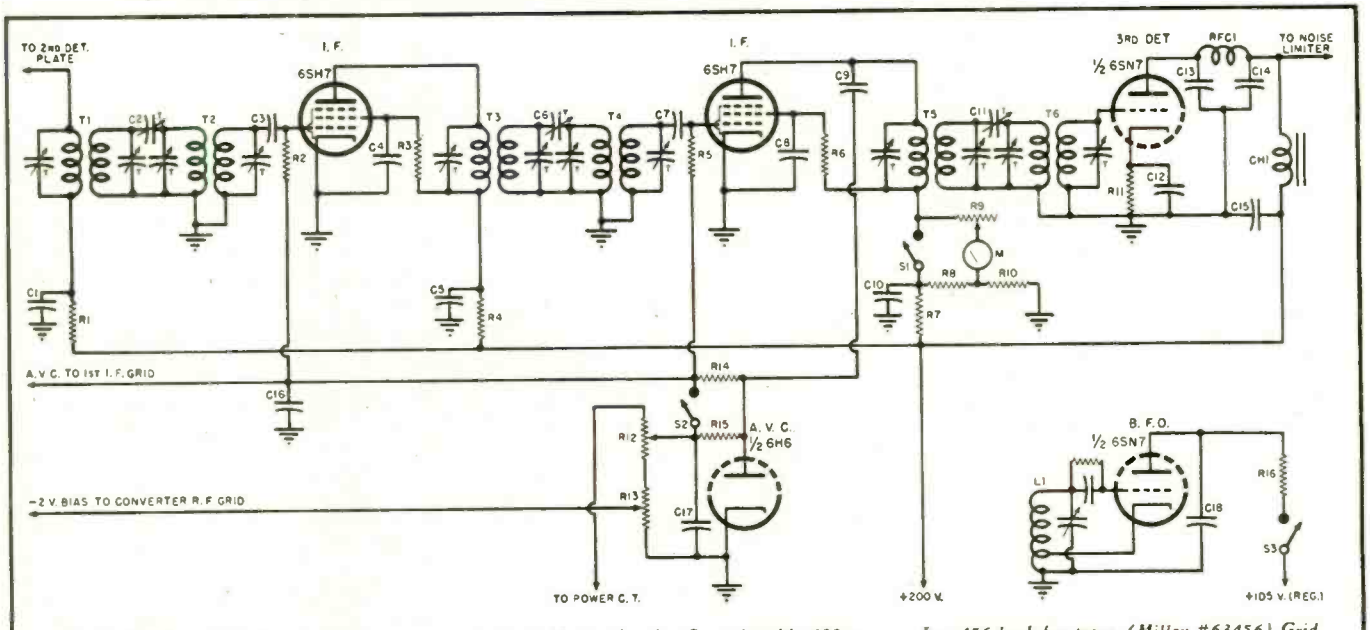
In conjunction with this bandpass, a simple, effective audio bandpass has been incorporated by use of the *Millen* "Hetrofil" across the 500 ohm output and the inclusion of the *Stancor* "Hi-Fi" treble-bass control unit in the audio input stages. They show up to good advantage when the going is tough. Audio selectivity can be adjusted from booming bass, to a "tinpanny" telephone sound, assuring intelligent reception under the worst of crowded conditions. The "Hetrofil" acts precisely like the phasing control of a crystal stage; heterodynes can be practically eliminated with simplicity and low-cost by inclusion of such a unit to any existent receiver. The one shown is included in the basic design, but it can be quickly and simply hooked into the output of any receiver.

A noise limiter on high frequencies is a necessity, and the one incorporated in this receiver is in the circuit at all times. If a noise limiter is needed at all, it should be in the circuit constantly, to grab off the sudden, unexpected blurts of noise that often mean missing an important call sign, etc. The limiter is of the series type, and all constants are standard. Plenty of audio gain was incorporated to preclude its dropping the output to too low a level.

The audio section is conventional, except as previously noted. Precautions were taken, such as elaborate shielding right up to the five hundred ohm output leads to the speaker, as well as thorough filtering and decoupling. Such practice is advocated in the handbooks, and needs no further comment.

The power supply, a husky utility type, utilizes two separate supplies for audio and r.f., i.f. stages. A look at Fig. 8 will show both the power supplies and the simple, relay-controlled remote circuits. The power supplies utilize transformers, chokes, and a single, husky filament transformer, mounted under the receiver chassis. The relays shown are especially selected for the purpose. RL_1 serves to

Fig. 4. Circuit diagram of the fixed frequency i.f., a.v.c., and third detector stages. Diagram for b.f.o. is shown in inset.



R_1, R_4, R_7, R_{14}—1000 ohm, 1 w. res.
R_2, R_5, R_{11}, R_{15}—1 megohm, ½ w. res.
R_3, R_6—68,000 ohm, 1 w. res.
R_8—2000 ohm, 1 w. res.
R_9—1000 ohm wirewound rheostat
R_{10}—50,000 ohm, 1 w. res.
R_{11}—15,000 ohm, 2 w. res.
R_{12}—500 ohm wirewound pot.
R_{13}—50 ohm, 5 w. semi-variable res.

C_1, C_4, C_5, C_8, C_{10}, C_{16}, C_{18}—.05 μfd., 600 v. oil-filled cond.
C_2, C_6, C_{11}—3-30 μμfd. trimmer cond.
C_3, C_7, C_9, C_{13}, C_{14}—100 μμfd. silver mica cond.
C_{12}—10 μfd., 100 v. elec. cond.
C_{15}—8 μfd., 450 v. elec. cond.
C_{17}—.5 μfd., 200 v. cond.
T_1, T_2, T_3, T_4, T_5, T_6—456 kc. i.f. trans. (Millen #60456)

L_1—456 kc. b.f.o. trans. (Millen #63456) Grid leak and cond. in b.f.o. assembly
RFC_1—60 mh. r.f. choke
CH_1—135 hy. audio choke (Stancor #C-2301)
M—0-1 ma. d.c. meter ("S" meter)
S_1, S_2, S_3—S.p.s.t. toggle sw.
2—6SH7 tubes
1—6SN7 tube
½—6H6 tube

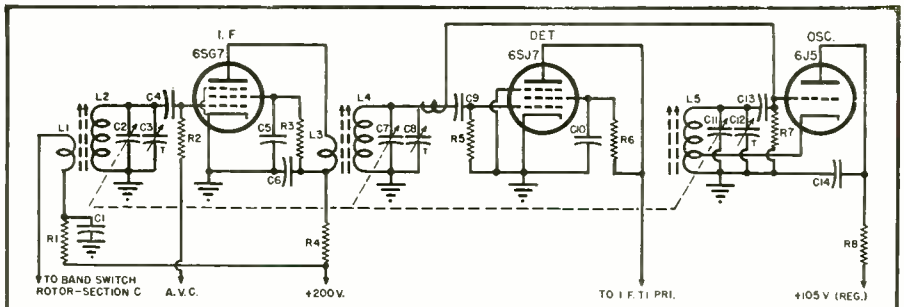
ground directly the centertap of power supply T_2, the audio supply, and to connect the centertap of power supply T_1, the r.f./i.f. supply, to the bias/a.v.c. circuits on the receiver chassis proper; the antenna relay (see also Fig. 10) grounds the antenna, when the transmitter is on the air, for protection.

The power supply filters are husky units as are all bypass and coupling condensers throughout. These bypasses should be noted carefully, for circuit operation is dependent on the choice of the best units obtainable. We chose 600 volt, oil-filled, metal-cased types in .05 and .01 μfd. and silver-capped micas in 500 volt type for 100 μμfd. use. These are used for grid-blocking in the converter stages, oscillators, and tuned and fixed i.f. stages.

An inspection of Fig. 5 will show how the tunable i.f., second detectors, and oscillator operate to convert incoming 1500-3500 kc. signal-channel signals to the fixed-i.f. frequency of 456 kc. These circuits comprise the main tuning dial of the receiver, on which all actual tuning is performed. A three-gang, s.l.f. condenser of 140 μμfd. per section used in conjunction with the coils wound on *Millen* type 74001 shielded forms, enables the operator to calculate frequency at a glance, since each dial division of the *National* NPW-0 drive unit is exactly 5 kc. on all bands, and each amateur band starts at 100 on the dial. The 2000 kc. between 1500/3500 kc. is spread over exactly 400 dial divisions since perfectly linear tuning is provided by means of the s.l.f. condenser. While this dial is covering, at all times, the range 1500-3500 kc., one rapidly becomes used to thinking of it as covering the actual ham bands in use.

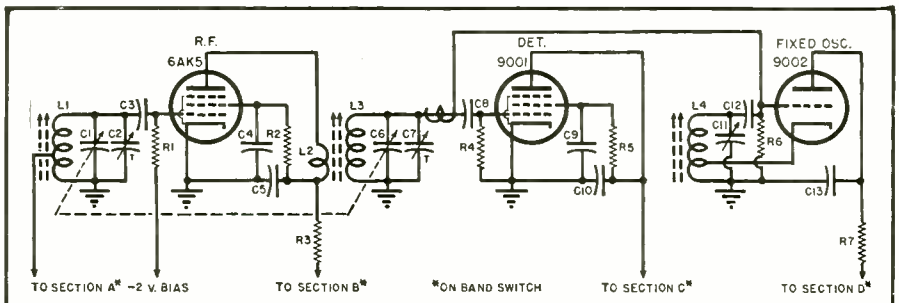
The tuned i.f. section is fed proper signal frequency, as desired, by the bandswitch shown in Fig. 10. By means of this device used in conjunction with separate converter chassis for each band it is not necessary to switch coils and condensers at any time. It gives bandswitching with none of the usual losses. The only leads carrying r.f. which are switched are the antenna and detector "B plus"/output leads, as shown. This has resulted in no apparent losses of any kind, since signal strength is the same through the switching arrangement as when the circuit was wired directly during experiments. The sensitivity of the tuned i.f. section is such that, trimmed to hit 75 meters and with fifteen feet of wire capacity-coupled to the hot side of the primary of the 6SG7 tuned i.f. coil, house-volume phone signals were copied from practically all districts, the "S" meter showing readings of S7/9 plus on an average. A good deal of the signal transfer to this section can be credited to the use of the excellent, quickly installed ceramic feed-throughs which show no bypass capacity effects when used for r.f.

The four converter chassis are all identical in design, with appropriate sizes of condensers (padding) used to



R_1, R_4, R_8—1000 ohm, 1 w. res.
R_2—1 megohm, ½ w. res.
R_3, R_6, R_7—50,000 ohm. 1 w. res.
R_5—5 megohm, ½ w. res.
C_1, C_5, C_{11}, C_{14}—.05 μfd., 600 v. oil-filled cond.
C_2, C_7, C_{11}—140 μμfd./sec. s.l.f. 3-gang tuning cond.
C_3, C_6, C_{12}—5-50 μμfd. silver ceramic trimmer cond.
C_4, C_9, C_{13}—100 μμfd. silver mica cond.
L_1, L_3—30 t. #40 en., closewound at cold end of L_2, L_4
L_2, L_4—110 t. #40 en., closewound on ½" form with tuning slug.
L_5—110 t. #40 en., tapped at 35 t., closewound on ½" form with tuning slug.
Coils wound on Millen #74001 shielded forms
1—6SG7 tube
1—6SJ7 tube
1—6J5 tube

Fig. 5. Schematic diagram of tuned i.f., second detector, and second oscillator stages.

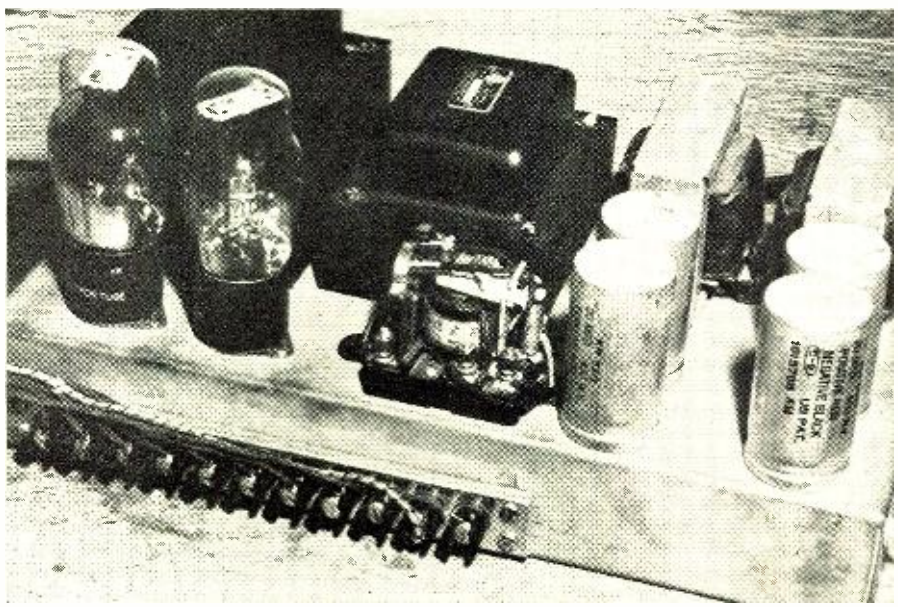


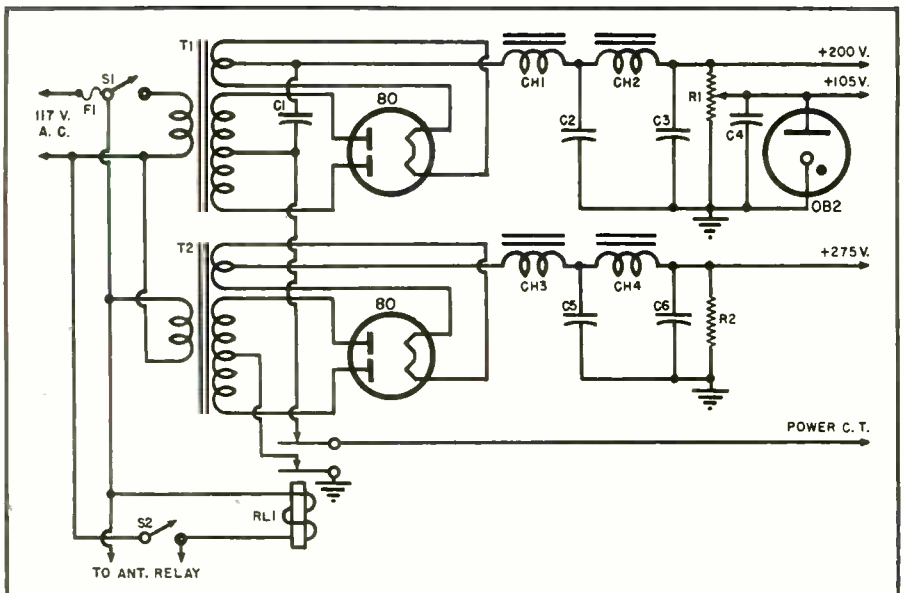
R_1—1 megohm, ½ w. res.
R_2—47,000 ohm, 1 w. res.
R_3, R_7—1000 ohm, 1 w. res.
R_4—5 megohm, ½ w. res.
R_5—70,000 ohm, 1 w. res.
R_6—50,000 ohm, 1 w. res.
C_1, C_6—35 μμfd. tuning cond. (all chassis) (Millen #23935)
C_2, C_7, C_{11}—Air trimmer; 35 μμfd. for 10 meter; 50 μμfd. for 20 meter; 75 μμfd. for 40 meter; 100 μμfd. for 75 meter. (Millen Series 29000)
C_3, C_8, C_{12}—100 μμfd. silver mica cond.
C_4, C_5, C_9, C_{10}, C_{13}—.05 μfd., 600 v. oil-filled cond.
L_1, L_3, L_4—10 t. for 10 meter; 18 t. for 20 meter; 38 t. for 40 meter; 65 t. for 75 meter.
L_2—4 t. for 10 meter; 7 t. for 20 meter; 9 t. for 40 meter; 20 t. for 75 meter.
All coils wound with #40 en., closewound on ½" diam. forms with tuning slug. (Millen type 74001.) Coils L_1 and L_3 to be tapped 1/3 of the turns from ground end.
1—6AK5 tube
1—9001 tube
1—9002 tube

Fig. 6. Schematic diagram of r.f., detector, and fixed oscillator stages.

hit all bands. Again, as can be seen from inspection of the top chassis photograph, neat and compact high-gain coil forms in their self-contained shields have been used. It is probable that the receiver, in its present form,

Fig. 7. Top view of the power supply and control circuit unit.





R_1, R_2—50,000 ohm, 25 w. semi-variable res.
C_1—8 μfd., 600 v. elec. cond.
C_2, C_3, C_5, C_6—20 μfd., 450 v. elec. cond.
C_4—.05 μfd., 600 v. oil-filled cond.
RL_1—115 v. a.c. relay, d.p.s.t. sw., normally closed (Ward-Leonard 507-511)
S_1—S.p.s.t. toggle sw.
S_2—S.p.s.t. 117 v. a.c. rotary sw.
T_1—Power trans., 350-0-350 v. @ 120 ma.; 5 v. c.t. @ 2 amps.
T_2—Power trans., 370-0-370 v. @ 150 ma.; 5 v. c.t. @ 2 amps.
CH_1, CH_2—10.5 hy., 110 ma. filter choke
CH_3, CH_4—7 hy., 150 ma. filter choke
2—80 tubes
1—0B2 tube (Hytron)

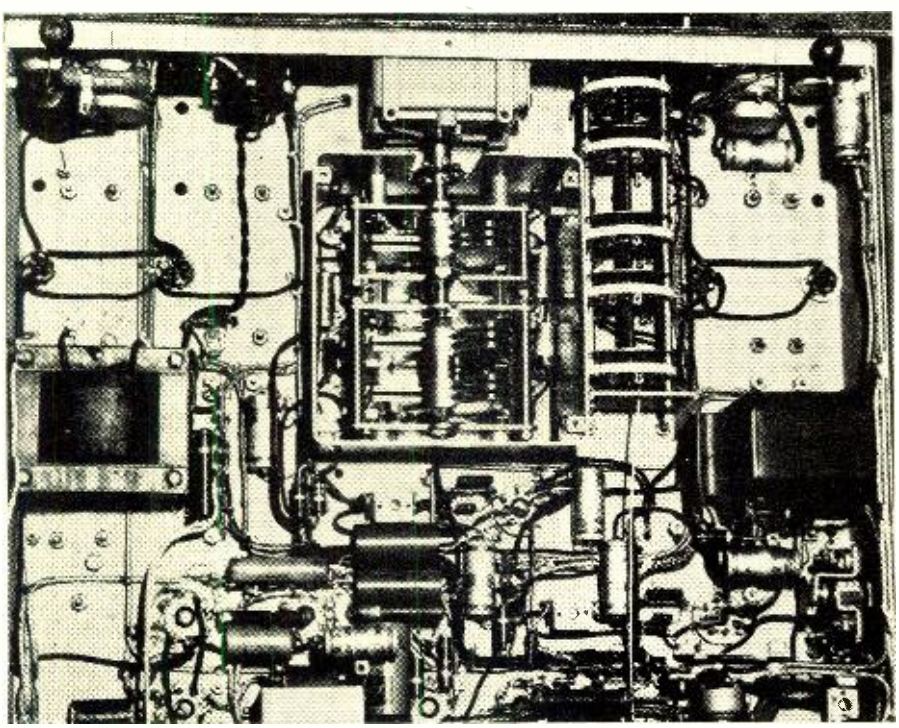
Fig. 8. Wiring diagram for the power and control circuit unit.

would not have been possible without the use of these well designed and conceived products. The tunable iron slug incorporated in them allows precise matching of inductances.

All tuning condensers on the four converter chassis are double spaced, isolantite insulated 35 μμfd. affairs, ganged by means of insulated flexible couplings, and mounted from the main chassis, directly under their respective converter sections by means of L-shaped pieces of aluminum. All trimming and padding is done by silver-plated, isolantite mounted condensers, of appropriate capacity for the frequencies involved.

Actual circuits of the converter chassis duplicate those of the tuned i.f. section, being of the quiet, high-gain type made possible by the use of power-bias on r.f. and detector stages. The oscillators are conventional Hartley triode types, fixed tuned to frequencies 1500 kc. below their respective converter tubes. The tube types

Fig. 9. Under chassis view of the home-built deluxe superheterodyne receiver.



Dial drive unit	National Company Type NPW-0
Panel	Croname #27083
Pilot Light	Croname #27075
Dials	Croname #298
Knobs	Croname #6102
Ceramic feedthroughs	Millen #32150
Octal sockets	Millen #33008
Octal socket shields	Millen #33888
Miniature sockets	Millen #33307

Miscellaneous components used in construction of the deluxe receiver.

used are familiar, and excellent for the purposes. All sockets for the miniatures (6AK5, 9001, 9002) and the octal sockets for the coil forms are of steatite, thus insuring no losses from this source.

Such an elaborate and long-planned receiver needs a "front" to match the "innards," if for no other reason than vanity. A distinctive, and attractive, black anodized aluminum panel was secured for the job. A machined design surfaced on the blackened aluminum makes an extremely attractive front for the receiver, as do the four chrome planetary dials and drives. These four controls tune the ganged condensers under their respective converter chassis, and provide smooth, easy control of this critical function. The pilot light, between the two meters, is a clever device. By means of variable polaroid discs incorporated in it, the operator does not have to look at a blazing crimson eye continually—a slight twist of the bezel serves to dim the light to any desired degree.

Controls for the receiver (Fig. 1) are as follows: Top, from left to right, "S" meter switch; "S" meter; variable intensity pilot light; audio output meter; and audio meter switch. Below the meters, center, is the knob for the "Hetrofil." Below this, from left to right, are the 80, 40, 20 and 10 meter converter controls. Below these, again, left to right, r.f. gain; audio treble; a.v.c. switch; filaments and "B-plus" control switch; main tuning dial; bandswitch; standby switch, audio bass; and audio gain. Knobs visible on the back of the chassis are for noise-limiter threshold setting, and "S" meter zero.

Theory of operation, briefly, is as follows: Imagine you are tuned, and switched, to 14,000 kc. This represents the frequency the converter section (20 meter) is receiving, and converting to a suitable i.f. frequency for the tunable i.f. section to handle (Fig. 5). Now, since all fixed oscillators of the converter sections (Fig. 6) are tuned 1500 kc. lower than the bottom-edge frequency of the respective band covered, your twenty-meter oscillator is fixed-tuned to 12,500 kc., giving a frequency difference of 1500 kc. which is received on the main tuning dial of the tuned i.f. section (Fig. 5) by tuning to its lower-frequency range, namely, 1500 kc. Any signal, then, on 14,000 kc. will be received at this point. When the converter section (20 meter) is tuned to the *high* end of its range, 14,000/14,400 kc., an i.f. frequency-difference of 14,400 minus 12,500 kc.

(*Continued on page* 130)

Model VH-15 Speech Master, a new *completely weatherproof* 15-inch Hypex, is the latest addition to the JENSEN Hypex family, thus expanding this line of projectors to cover a wide range of sizes and prices. Designed only for speech reproduction, without compromise to music requirements, it affords greater naturalness in the low frequencies than do other Speech Masters. Model VH-15 is recommended for sound reinforcement, indoors and out, where distinct natural speech reproduction is required to carry through high noise levels.

Developed acoustic length, 36 inches. Useful response, 190 to 6,000 cps. Voice coil impedance, 8 ohms. Polar coverage angle, 90 degrees. Power rating 15 watts maximum speech signal input. Mouth diameter 15⅝"; overall length 15".

	List Price
Model VH-15 Speech Master (ST-757)	**$47.00**

Model VH-91 Speech Master List Price $32.50

*Hypex and Speech Master are Registered Jensen Trade Marks.

NOTE THESE FEATURES

- *Horn designed to JENSEN Hypex formula (Pat. 2,338,262) for improved acoustical performance.*
- *Alnico V driver unit completely enclosed, yet replaceable without special tools.*
- *Trunnions adjustable through 180 degrees, lock projector in position simply by tightening two nuts with small wrench.*
- *Non-ferrous and stainless steel rustproof fittings. Phenolic diaphragm.*
- *Rustproof, weatherproof terminal box; no exposed terminals. No soldering needed to connect.*
- *Improved weatherproof finish on all metal parts. Horn finished in two-tone baked enamel.*
- *Power rating 15 watts maximum speech signal input.*

Jensen SPEAKERS WITH ALNICO 5

JENSEN MANUFACTURING COMPANY
6617 S. LARAMIE AVE., CHICAGO 38
In Canada: Copper Wire Products, Ltd., 11 King St. W., Toronto

Designers and Manufacturers of Fine Acoustic Equipment

2-Meter Converter

(*Continued from page* 71)

maximum signal response is obtained as indicated by the limiter-grid current. At W1CA a Lighthouse tube oscillator will push the meter up to 0.9 ma., when the converter is lined up properly. Distant signals will vary from 0.1 upward, depending on their power, antennas, polarization, and other variable factors.

AM reception is accomplished by making an addition to the JFM90 as shown in Fig. 1. A condenser, C_1, and a resistor, R_2 are added to a conveniently-located junction of C_{28} and C_{20} and R_{14} in the "Translator." Those component numbers were obtained from *G.E.'s* published schematic diagram. The values of these components and the associated circuits are shown, so that no difficulty should be had in locating them in the JFM90. The addition of J_2 will permit the measurement (on a 1 ma. d.c. meter) of the limiter-grid current. This will be a most welcome addition as it permits the *accurate* determination of received signal levels.

To obtain maximum performance from this v.h.f. converter, it is desirable to adjust the amount of coupling between L_1 and L_2 until the mixer is just *below* the point of regeneration. It may be necessary to vary the resistance in the cathode (R_1) to bring the tube up to this "hot" point. At W1CA, with a four-element beam, fed with 300 ohm line, the mixer is adjusted so that oscillation does not occur *in* the band. What happens outside does not matter, but such a procedure will really "warm" up the unit—on the band!

The sensitivity is increased tremendously by these adjustments. For example, a signal before peaking, may be pushing the grid meter up to 0.1 or so, and after proper adjustments, this same signal will be 0.7 or 0.8 milliamperes.

Care in construction and particularly in peaking up all the circuits will really pay off. The excellent performance of this converter is surprising. The advantages of a super will be immediately apparent when you hear some of those weak signals you never heard before. Try "FM" reception on the modulated oscillators, and "AM" on the stable AM signals.

When the converter is used with the *HRO*, the oscillator is changed to cover the 114-118 mc. range (by decreasing capacity of C_6) and the coax output cable is connected to the *HRO* antenna posts. The "ground" side of the coax is grounded at the *HRO*. Place the *HRO* on approximately 30 mc. and operate the converter in the usual manner. Crystal-controlled and other stable 2-meter signals will be received as easily as those on the lower frequency bands.

Good luck!

—30—

Army BC-645 I.F.F. TRANSMITTER RECEIVER $9.95

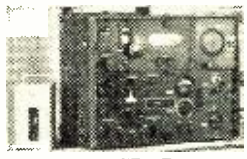
Brand New 450 M.C.

2 big units; all in one. A 10 tube superhet receiver for 450 Megacycle, a 5 tube 450 megacycle tuned line transmitter. Both are two channel. 4-7F7, 4-7H7, 2-7E6, 2-6F6, 2-955, 1-WE 316A. The tubes that come with this unit are worth more than our sale price. This unit originally designed for identification "Friend or Foe" Army BC-645. Brand new factory cartoned, weight 25 lbs. Furnished with four page conversion instructions for a CW or MCW or phone transmitter. How to build a 110 volt AC power supply, etc. 12 volt dynamotor, $2.95 extra. WE-316A tube $.99, BC-645..**$9.95. 2 for $19.00.**

Army BC-654 80 METER XMITTER RECEIVER $12.95

BC-654—Two for $25.00

Portable voice and CW transmitter and receiver for portable, mobile, and fixed station operation. 7-tube superheterodyne receiver with 3.5 microvolt sensitivity on voice and 0.5 microvolt sensitivity on CW, and 100 milliwatts undistorted power output. 455 KC IF. Uses 3—1N5GT, 1—1A7GT, 2—3Q5GT, 1—H5GT tubes. 6 tube transmitter, with antenna tuning network. Colpitts thermal compensated oscillator, class C final with 2—307A tubes in parallel, and crystal oscillator for checking frequency every 200 KC. 25 watts output on CW and 11.2 watts output on voice. Frequency range, transmitter and receiver, 3800 to 5800 KC. Ideal for Hams! Comes complete with cover; furnished with all tubes necessary for the operation of the trans. and rec. Less power supplies. These units are used but in good condition. Shipping weight 50 lbs.....**$12.95; 2 for $25.00.** 654 Vibrator Pack 6 for 12 V.D.C. input $4.95 extra.



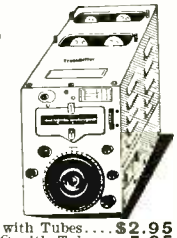
SCOOP. BC-654 Less all tubes. Net.....**$7.95**

MAGUIRE AUTOMATIC RECORD CHANGER $9.95

Brand new factory cartoned. This changer should sell for three times our price. Latest two-post, quick change type. Has permanent built-in needle, shuts off on the last record. Plays 12 10" or 10 12" records.

Aero Changer, Base size 12 x 13 inches....**$12.95**
VM-800 Changer, Base size 13 x 14 inches.. **14.95**
Oak twin-post changer Base size 14 x 14 inches..... **17.95**
Aviola Changer, Base size 11½ x 12 inches.. **14.95**
Detrola Changer, Base size 11½ x 12 inches **$12.95**.....2 for **25.00**
Made to fit leatherette bases for above changers..... **1.95**
Specify type of changer for base.

NEW COMMAND XMITTERS $5.95



With each command transmitter, we furnish a schematic of the BC-458 (All command Transmitters are essentially the same; except for frequency.)

Near New BC-457, 4 to 5.3 MC with Tubes....**$2.95**
Brand New BC-457, 4 to 5.3 MC with Tubes. **5.95**
Near New BC-458, 5 to 7 MC with Tubes.... **2.95**
Brand New BC-458, 5 to 7 MC with Tubes... **5.95**
Twin Rack for 2 Transmitters..... **.99**
Antenna Current Meter..... **1.95**
Near New BC-456 Modulator, with 28 v dynamotor..... **2.95**

COMMAND REC. with Diagrams

Order your Aircraft command receivers from McGee. We furnish you a schematic of the BC-454 (all are the same except for frequency). Also, a diagram showing how to convert receivers for 110 volt operation.

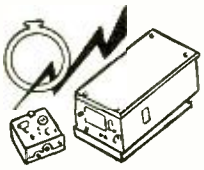
Brand New BC-453, 200 to 500 KC with Tubes **$7.95**
Near New BC-453, 200 to 500 KC with Tubes **4.95**
Brand New BC-454, 3 to 6 MC with Tubes.. **4.95**
Near New BC-454, 3 to 6 MC with Tubes.. **2.95**
Near New BC-455, 6 to 9 MC with Tubes.. **3.95**
Brand New BC-946, Broadcast 550 to 1500 KC, with Tubes and Instructions..... **12.95**
Triple Remot Control Head for 3 receivers... **1.95**
Triple Mounting Rack for 3 receivers..... **.99**
28 volt Rec. Dynamotor..... **.99**

Brand New

ELECTRONIC MEGAPHONE SCOOP PRICE $39.95

Only 50 of these to sell. Amplifier straps on shoulder, then just hold megaphone and speak into mike, mounted on rear of projector. These units are brand new. Amplifier is dry battery operated. Just pull trigger switch, amplifier comes on immediately. Net.....**$39.95**

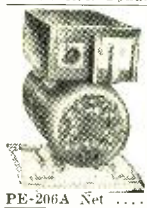
RDF RECEIVER $19.95



MM-26-C Compass Receiver. Brand new factory cartoned. This unit covers from 150 to 1500 KC inclusive; in three bands. Complete with eleven tubes of the 6 volt type; 6SA7, 6SK7, 6F6, etc. Has 28 volt built-in dynamotor. There is no dial built on unit and no remote cables are provided. MM-26-C receiver $19.95. Remote control $3.95 extra,

Manually operated loop.....**$6.95 extra**

PE 206A INVERTER— BRAND NEW $4.95



P.E.-206A Inverter. Brand new factory cartoned. For 25 to 28.5 volts input. Output of 80 volts (plus or minus 3 volts) at 800 cycles, at 500 volt amperes. This is a perfect inverter. Has carbon pile regulator, built-in voltage control. A 20 stack selenium rectifier. Shipping weight 45 lbs.

PE-206A Net.....**$4.95**

PE 101C DYNAMOTOR BRAND NEW $2.95

Dynamotor PE-101C. Input voltage 13 or 26 volts DC, at 12.6 or 6.3 amps. Output voltage 400 volts DC at 135 Mils and 800 volts at 20 Mils, 9 volts AC at 1.2 amps. Brand new factory cartoned. Shipping weight 13 lbs. PE-101C Net.....**$2.95**

MARKER BEACON REC. $2.95

BC 1023 A Marker beacon receiver. Designed for reception of modulated signals of the 75 MC band. Variable tuning permits coverage of 62 to 80 MC. Brand new factory cartoned. With tubes 6SQ7, 6U6, 6SC7 and 12SH7. Operates directly from 12 or 14 volts DC. Priced for quick sale only **$2.95.**

SCR 269G A.D.F. $39.50

SCR-269G Automatic Radio Direction Finder has 17 tubes. Frequency coverage from 200 to 1750 KC, inclusive. Receivers are in perfect condition. All of the component parts are new. Consists of receiver, new RDF loop, remote control, relay, dehydrator, cables, plugs, etc. This is a terrific value at only **$39.50. Only 50 are available.**

TURBO AMPLIFIER $1.95

Aircraft Turbo Amplifier, complete with 4 tubes. 7F7, 7Y4 and 2—7C5. Terrific salvage scoop. Ideal to wreck for parts. Priced new with tubes.....**$1.95**
Monthly Special, Turbo amplifier less tubes. Only..... **.69**

PULSE FORMING NETWORKS

Used in small radar modulators, available in three sizes, 67 ohms impedance. 7.5 Kilowatt rating.
H-603, one micro second, 200 pulses per second.....**$1.95**
H-601, three micro seconds, 200 pulses per second.....**$2.95**
H-602, 16 micro seconds, 60 pulses per second **3.95**
All three of above for only..... **5.95**

SCOOP! 110 M.C. REC. $6.95

BC-733 D Localizer Receiver

Freq. 108-110 Mc; Tube complement; 10 tubes—1—12SQ7, 2—12SR7, 1—12A6, 1—AH7GT, 2—12SG7, 3—717A. Now only...**$6.95** NEAR NEW CONDITION. A RED HOT VALUE.

We guarantee every condenser to be of fresh stock. Made by nationally known manufacturers. No junk.

F.P. Electrolytics

40x20 MFD 150V..**$.39** 20 MFD 350V, 20x
40x20 150V 10-25V **.49** 20 25V .....**$.19**
40x20 150V, 200-6V **.59** 20x20 300V, 25-25V **.39**

Tubular Electrolytics

Exactly as you buy every day. Best National Brand. If these are not brands you prefer, your money back.
8 Mfd 450v Aluminum Tubular.....**$0.39**
20 Mfd 150v Aluminum Tubular..... **.39**
10 for **$3.50**

Compact Paper Tubular Electrolytics Condensers, Flexible Leads

8x8x8 MFD 400 Volt, Long leads...**$0.49**; 10 for **$4.50**
40x20x10 MFD 150 Volt..... **.39**; 10 for **3.50**
50x30 MFD 150 Volt..... **.49**; 10 for **4.50**
50x30 MFD 150 V. 25 MFD 25V.... **.59**; 10 for **5.25**
HOT ITEM DELUXE

8x8x8 MFD Inverted Aluminum Can Condenser 450 Volt, Standard Screw Mounting. Made by Aerovox. Special, **$0.69**; 10 for.....**$6.25**

Buy the best 600 volt Tubular condensers ever made. All plastic covered. ½ the regular price.
.001, .002, .005, .01, .02 at.....**10c**
.05.....**11c** .1.....**12c**
Best Standard Brand. You like 'em, or money back.

SCR-518 ALTIMETER $29.50

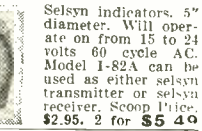
Brand New

Famous SCR 518 Altimeter. Brand new factory cartoned. Worth over $900.00. Made by RCA. Complete as pictured. Has 29 tubes. Works in the 500 MC region. This is the complete unit. Transmitter, receiver, power supply and 3" scope indicator. Reads altitude up to 30,000 ft. Operates on 28 volts. D.C. Complete with tubes, 6SK7, 2 8012, 2 6SJ7, 6C8, 6SN7, 6F8, 23D4, 6Y6, 6V6, 10 6AC7 3 2X2, 954, 955, 956, 6J5 and 3 in. CR tube 1808P. A RED hot scoop at **only $29.95** complete.

Crystal Calibrator $2.95

Crystal Calibrator, gives 50 Kc beat note through an Xtal synced, multivibrator. Furnished complete, less 200 KC Crystal. With tubes 12SA7 and 2—12SL7. A handy item to have. Scoop price.....**$2.95**

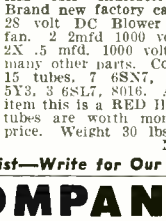
PORTA-POWER



Electro Porta Power. Converts any 4, 5, or 6 tube 1½ volt, 90 volt portable or farm radio to 110 volt AC operation. Multiple socket arrangement makes easy, quick connection possible. Every shop should have one of these. Regular $9.95 value. Scoop price.....**$5.95**

ARMY $6.95

Field Telephones



EE-8 Army field telephone. These units are used, but in good condition. Priced complete with telephone hand set, hand powered magneto and canvas carrying bag; as pictured. Net **$6.95**, each.

SELSYN INDICATORS $2.95

Selsyn indicators, 5" diameter. Will operate on from 15 to 24 volts 60 cycle AC. Model 1-82A can be used as either selsyn transmitter or selsyn receiver. Scoop Price. **$2.95.** 2 for **$5.49**

$4.95 EACH 3 FOR $14.00

Super value. Folded Di-pole antenna, for FM and Television. Complete with 60 feet of twin 300 ohm line and 4 low-loss stand-off insulators. This folded di-pole covers frequencies 42 through 108 megacycles. Trombone action makes exact tuning to any one weak station. Furnished with adjustable mounting bracket. Has 5 foot mast. Made for Stromberg-Carlson. Stock No. Mt-300—Net, **$4.95**; lots of three, **$4.50** each. Weight 4 lbs. Individually packed.

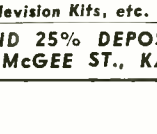
15 TUBE SCOOP $9.95

BRAND NEW

AM 61A Indicator Amplifier. Brand new factory cartoned. Has 28 volt DC Blower motor and fan. 2 2mfd 1000 volt cond. 2 2X .5 mfd. 1000 volt cond. and many other parts. Complete with 15 tubes, 7 6SN7, 3 VR 105, 5Y3, 3 6SL7, 8016. As a salvage item this is a RED Hot Buy The tubes are worth more than our price. Weight 30 lbs.

Net **$9.95**

VIBRATOR SCOOP $1.99



Heavy Duty Vibrator—Made for 6-110 volt amplifiers. Freq. 60 CPS. Scoop price..... **$1.99**

135 ma 6-110 volt conventional power transformer, with all windings; will run phono motor. **$5.95**

(Use with above vibrator.)

SMALL PHONO MOTOR. This 110 volt AC, 60 cycle phono motor is used on 80% of all automatic changers. Order one just to have around for replacement. Scoop price. **$1.49**; Two for.....**$2.79**

Get On Our Mailing List—Write for Our New Flyer—New Low Priced Television Kits, etc.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY

SEND 25% DEPOSIT—BALANCE C.O.D.
1225 McGEE ST., KANSAS CITY, MISSOURI

PERSONAL PORTABLE RADIO KIT MAKES A $32.50 RADIO $14.95

Size: 6½" x 3¼" x 4⅛" Weighs Only 3½ Lbs.

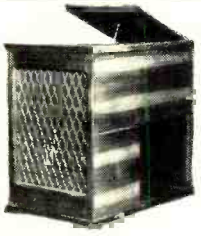
Complete with Batteries

- Two-Tone Ivory, Red Plastic Cab. • Loop Aerial, Built-in Lid
- 4-Tube Superhet • AVC. • Looks like and is a Commercial Radio Kit
- Two-Gang Cond., Lucite Dial • Simple Assembly and Wiring Instructions

This kit is ready for immediate delivery. The same nationally known factory that manufactures tens of thousands of this radio, is line-producing this radio kit for us. Every part, from the cabinet down to the last resistor, is matched. The chassis is ready punched; all you do, is mount the parts and wire. This radio kit will assemble into a beautiful personal radio for you, just the same as it does for the factory. We furnish you a diagram, photograph of the completed chassis and full assembly instructions so that those with a minimum knowledge of radio may wire this kit. The beautiful case is made of metal with plastic hinged lid and snap on back. The lucite face of the receiver has an inlaid gold design. The circuit is the conventional two gang superhet type, with A.V.C. Receives the broadcast band, 540 to 1650 KC. Uses miniature tubes: 1R5 converter, 1S5 detector A.V.C., 1T4 amplifier and 3S4 power amplifier. Alnico V PM speaker. The loop antenna is built in the lid. Radio comes on automatically when lid opens. Operates on **self-contained batteries.** Priced complete with tubes and 67½ volt "B" battery and flash cell (Not AC-DC) Nothing else to buy. **Model X-45. Price $14.95.** Shipping weight 6 lbs.

SCOOP MODEL X-45 PERSONAL PORTABLE KIT WIRED AND TESTED WITH BATTERIES. NET $17.95

ARMCHAIR CABINET ONLY $29.95

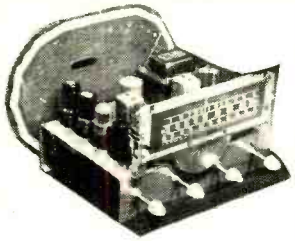


Beautifully made walnut armchair cabinet. Outside dimensions 24" high, 16½" deep, and 27" wide. Ample room for radio receiver 14" long, 9" high and 10" deep. Will hold a changer up to 14" square. Will accommodate speaker up to 12". Has record album storage compartment. Hinged lid covers changer compartment. Cabinet Ar-15 Net **$29.95.** Detrola automatic changer **$12.95** extra. Twin post Oak changer **$17.95** extra.

20-WATT UTILITY AMP. KIT, $17.95

Build this 20 watt utility 110 volt AC. 20 Watt power amplifier. Ready punched chassis, size 12 x 6 x 2½ inches. Has two input circuits, one mike and one phono. Mike stage has 135 DB gain, for crystal or dynamic mike. Has bass and treble controls. Designed for use with PM speakers; has 8-16 ohm output transformer. All parts and easy-to-follow diagram furnished, including tubes: 2—6SN7, 6J5, 2—6L6GA, 5Z3. Kit Model 20-LX .....Net **$17.95**

8-TUBE RADIO KIT WITH COAXIAL SPEAKER, $37.95



A COMBINED BROADCAST SUPERHET RADIO CHASSIS AND 15 WATT P. A. SYSTEM

HEAVY DUTY 12" P.M. SPEAKER

CROW 8" SLIDE RULE DIAL. 2 GANG COND.

REC. BROAD, 550 TO 1700 KC AND 19 TO 49 METERS

PUSH PULL 6V6—TONE CONTROLS

INPUTS FOR CRYSTAL OR DYN. MIKES AND PHONO-PICKUP. WE FURNISH EVERYTHING TO BUILD THIS DELUXE CHASSIS

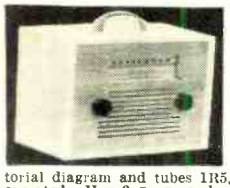
- **WHY NOT ORDER THE ARMCHAIR CABINET WITH THIS KIT**
- **HAS INPUT GAIN FOR THE G.E. VARIABLE RELUCTANCE PICKUP**
- **CHASSIS SIZE 9½ x 11 x 8" HIGH**

Here is something new in radio. A real 15 watt power amplifier with bass and treble controls. Has extra gain stage for crystal or dynamic mikes. And on the same chassis, a standard superhet radio receiver. We furnish all parts, knobs, escutcheon plate and tubes: 6SA7, 6SK7, 6SR7, 6SN7, 6SJ7, two 6V6 and 5Y3. No cabinet. Extra care in designing the power supply section assures low hum level, making this unit ideal for recording as well as P.A. use. We furnish everything as well as schematic diagram and photos of the completed chassis. Weight 35 lbs.

PRK-10 Radio-Amp. Kit with 12" P.M. speaker. With tubes .....Net **$29.95**

CPR-15. Exactly the same kit as the PRK-10 kit; except it is furnished with a 12" Cinaudagraph wide range speaker. (Has built-in high frequency tweeter.) This is our finest kit.....Net **$37.95**

SMALL PORTABLE KIT, $10.95



- **4-Tube Broadcast Superhet**
- **Priced Complete with Batteries**
- **Dynamic Speaker • Slide Rule Dial**

PORTABLE KIT MODEL K-PX. Small size leatherette covered case 9x5½x5. Easy to build. Operates on self contained B and A batteries. Rec. Broadcast 550 to 1600 K.C. Incorporates a standard superhet circuit with avc. Has 3 inch Alnico five PM speaker. Priced complete with batteries, pictorial diagram and tubes 1R5, 1S5, 1T4 and 3S4. Not AC DC, but straight battery operated. Has 2 gang cond. Everyone should have one of these personal portables. Everything furnished. Kit K-PX.....Net **$10.95**

3-WAY PORTABLE KIT, $16.95

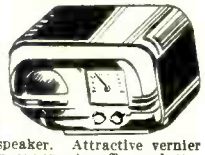
- **4 Tubes Plus Disc Rectifier**
- **300 Hour Battery Pack Included**
- **Beautifully Built Portable Case**

Build this powerful, 4-tube, 3-way portable kit. Operates on 110 volts AC or DC or self contained batteries. Receives broadcast 550 to 1650 K.C. Incorporates a standard superhet circuit with AVC and loop Ant. Has Alnico 5 PM Speaker, 2 gang condenser. All Parts and batteries are furnished including tubes, Disc Rectifier, 1R5, 1T4, 1S5 and 3S4. Has attractive leatherette portable cabinet size 7x9x9. Weight 14 lbs. Kit Model 3-ZA.

Net **$16.95**

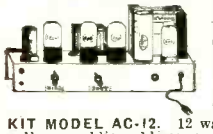
5-Tube AC-DC Broadcast Kit, $9.95

BEAUTIFUL 10" PLASTIC CABINET
LOOP AERIAL • VERNIER DIAL
DYNAMIC SPEAKER • EASY TO BUILD



Kit Model P-85. We have finally been able to achieve our goal. Here it is. A good 5-tube broadcast AC DC superhet radio receiver for less than ten dollars. The beautiful 10 inch plastic cabinet is made of the finest material. The chassis is of the standard accepted superhet design. 456 KC ifs AVC and 5 inch Alnico 5 PM speaker. Attractive vernier dial. Two gang tuning condenser. Loop ant. We defy anyone to offer a better working AC DC receiver kit. Priced complete with diagram, photos and tubes 12BE6, 12BA6, 12AT6, 50B5 and 35W4. Nothing else to buy. You can't go wrong on this value. Kit Model P-85.....Net **$9.95**

12-WATT AMPLIFIER KIT, $10.95



PUSH PULL 6V6 OUTPUT TUBES
GAIN FOR MIKE AND PICK-UP
EVERYTHING FURNISHED. EASY TO WIRE
FINE TONE QUALITY

KIT MODEL AC-12. 12 watt amplifier kit. Ideal for high quality record player as well as public address or recording amplifier. Matched component parts, ready punched chassis pan. One control fades from phono to microphone. Gain enough for crystal or dynamic microphone, 100 mil power transformer, for 110 volt AC 60 cycle operation. Priced complete with tubes: 2—6V6, 6SN7, 6SH7 and rectifier. Diagrams and photos furnished. Kit AC-12. Net **$10.95.** 12" Alnico 5 PM speaker **$6.95** extra; crystal microphone and desk stand **$4.95** extra.

1949 MODEL AC-DC KIT $12.95

This is our latest and finest AC-DC radio kit. Receives Broadcast, 540 to 1650 KC. Has full length illuminated slide rule dial. Choice of Ivory or Walnut plastic cabinet. Full high efficiency 2 gang superhet circuit, with loop antenna. Ready punched chassis, full 5" PM speaker. Every part fits. Everything furnished, including tubes, 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6. This kit will go together just like it would on the production line. Diagram, photos and instructions are furnished. Shipping weight 9 lbs. Kit model XA-49. Net **$12.95.**

AMERICAN AND FOREIGN KIT $14.95

550 to 1600 KC and 6 to 18 MC

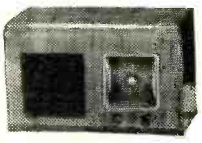
This radio kit is housed in an attractive grey opalescent finished metal cabinet. Incorporates a standard 2 gang superhet circuit. Receives Broadcast (550 to 1600 KC) and foreign short wave (6 to 18 Megacycles). This kit is complete, nothing else to buy; just as all our kits. Ready-punched chassis. It will go together just as it would down a production line. Has full 5" PM speaker. Complete with tubes: 12SA7, 12SK7, 12SQ7, 35Z5, 50L6. Diagram, photos and instructions are furnished. Shipping weight 10 lbs. Kit model DT-5. Net **$14.95.**

WALNUT CABINET KIT $11.95

Attractive 13" walnut cabinet AC-DC radio kit, with illuminated slide rule dial. Has made-to-fit metal front grille. Incorporates a standard 2 gang superhet circuit. Loop antenna, ready-punched chassis. This is another one of our line production radio kits. Every part is furnished. Includes tubes: 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6. Diagram, photos and instructions are included. Has full 5" Alnico 5 PM speaker. Receives broadcast 550 to 1650 KC. Shipping weight 9 lbs. Model ES-6. Net **$11.95.**

SCOOP. The above model ES-6 WIRED AND TESTED, in either Blond or Walnut cabinet. Net **$14.95.**

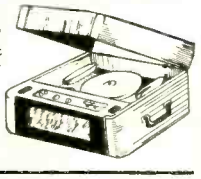
7-TUBE AC-KIT, $19.95



KIT K-7A. Easily assembled into a fine working, attractive, transformer type AC, broadcast receiver; 550 to 1700 KC. Has push-pull audio, tone control and 6½" Alnico 5 PM speaker. Beautifully made 14" walnut cabinet. Incorporates a standard superhet circuit, with AVC and loop antenna. All parts, schematic and tubes 6SA7, 6SK7, 6H6, 6SN7, 2—6V6's and 5Y3 furnished. Has full 90 mil. power trans. Weight 17 lbs.

Dealers Net **$19.95**

PORTABLE RADIO RECORDER KIT, $54.95

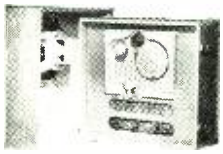


$90.00 value for only $54.95. We furnish every part to build a powerful radio and dual speed recorder. The attractive leatherette case houses the sensitive superhet broadcast radio and General Industries R90L 33½ and 78 RPM dual speed recorder; play back mechanism. The 6 tube receiver and amplifier is all on one chassis: 12SA7, 12SQ7, 12SK7, 12SL7, mike gain; two 35L6 push-pull output; plus disc rectifier. Has plenty of gain for crystal or dynamic mike. Has 6" heavy duty PM speaker and tone control. Kit G-31, everything complete, with tubes and diagram, **$54.95.** Crystal mike and desk stand **$4.95** extra. This is without a doubt one of the best values in kits we have ever offered. Wt. 40 lbs.

McGEE RADIO COMPANY

WRITE FOR CATALOG *SEND 25% DEPOSIT — BALANCE C. O. D.*
PRICES F. O. B. K. C. *1225 McGEE ST., KANSAS CITY, MISSOURI*

PORTABLE WIRE RECORDER $69.95



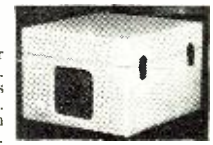
DELUXE WIRE RECORDER, $79.95

This wire recorder incorporates all necessary circuits for recording and playbacks. Has built-in eraser circuit. The amplifier is of the AC transformer type, with push-pull 6V6 output tubes. Has tone control and fader control. Input stage for wire recording from either crystal mike, radio receiver or phono pick-up. Amplifier is wired, tested and ready to operate. This unit is classified as a kit, only because you have to mount the Webster wire recording mechanism, amplifier and speaker. Everything is furnished, including a 15 minute spool of recording wire.

Kit includes wired and tested 12 watt amplifier, expressly made for wire recording and public address use. Leatherette split type case and 10" PM speaker, furnished with regular $52.92 Webster wire recording mechanism. Kit model GN-12. Net **$79.95.** Crystal mike and desk stand **$4.95** extra.

STANDARD PORTABLE MODEL, $69.95

Portable Wire Recorder Model GN-11



Has ready wired and tested 5 tube AC type amplifier with push-pull 6V6 tubes. Built-in eraser circuit. Input for crystal mike or phono pick-up. Diagrams show how you can record from any radio receiver. 3 position switch enables you to quickly change from record to playback or conventional P. A. system. This amp delivers 12 watts of good clean audio. Here is what you get: Webster 79 recording mechanism, with 15 minute spool of wire, attractive leatherette covered case, 6" heavy duty PM speaker and wired and tested 12 watt AC wire recording amplifier. All you do is mount the amp, recording mechanism and speaker. Simple instructions furnished. Portable Recorder Model GN-11 Net **$69.95.** Crystal mike **$4.95** extra.

12" 3 Lb. Magnet $9.95

12" 3 pound Alnico three magnet with 1¼", 8 ohm voice coil. A top quality PM speaker for public address and fine home reproduction use. You can't go wrong on this nationally known speaker value. Every speaker guaranteed brand new, factory cartoned and of latest production. A $20.00 value. Stock No. 12P8. Net **$9.95.**

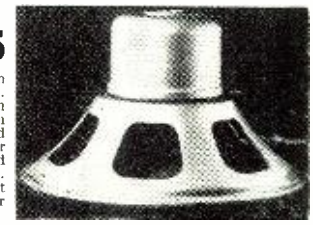
15" 7 Lb. Magnet $21.95

A $40.00 value 15" high fidelity, super heavy duty 45 watt permanent magnet speaker. This speaker is tops. Has a 1½", 8 ohm voice coil and a 7 pound Alnico 3 magnet. The 7 pound magnet in this speaker produces a force factor, that is unexcelled by any other speaker magnet. Guaranteed to be a name brand speaker. Every speaker brand new and factory cartoned. Stock No. 15PV. Net **$21.95** each. Two for **$41.95.**

15" 1000 Ohm Field $13.95

15" high fidelity dynamic speaker. Guaranteed top quality and made by a nationally known manufacturer. Latest production, brand new factory cartoned. A full 15" speaker, with 1000 ohm field and a 1½", 16 ohm voice coil. This speaker will take 30 watts, with exceptional high and low frequency reproduction. Well worth twice our price. Stock No. 15UZ. Net **$13.95**, each. Two for **$26.50.** Every speaker guaranteed.

15" CINAUDAGRAPH JUKE BOX SPEAKER $9.95



Here is without a doubt the best barrain in the whole U. S., A Jumbo 15 in. speaker made for the famous Aireon Juke box. Has standard 1½ in. 16 ohm voice coil and 12000 ohm field. The field may be easily excited by hooking to your radio or amplifier as a bleeder. Packed in original cartons. Fully guaranteed. Here is your chance to get a speaker that will bring out those low notes. Our scoop price, $9.95 each.

CARTONED RADIO TUBES 39c EACH

How can you go wrong. Every tube guaranteed. Full replacement.

100 "HY-VAC" ASSORTED FOR ONLY $35.00

YOU PICK TYPES FROM THIS LIST

HY-VAC

12SA7 GT	6Q7 GT	25L6 GT	50B5	12K8	6BA6
12SK7 GT	6K6 GT	7017 GT	1T4	12A6	6BE6
12SQ7 GT	6V6 GT	117L7 GT	1L4	12SF7	6AT6
35L6 GT	6X5 GT	117Z3	1U4	6F5	6X4
35Z5 GT	6SA7 GT	12AT6	1R5	6J5	6BJ6
50L6 GT	6SD7 GT	12BA6	1S5	6SJ7	6AK5
6K7 GT	6SK7 GT	12BE6	3Q4	12SJ7	6BH6
6A8 GT	6SN7 GT	35W4	3S4	6AJ5	6C5
5Y3 GT	6SQ7 GT	35B5	1B4	6SF5	

75% OF ALL THE TUBES YOU USE FOR 49c each

Guaranteed Standard Brands Cartoned and Uncartoned

49c Each

3S4	1625	6SL7	12J5 GT	14Q7
5U4G	954	6SN7	12SG7	14A7
5Y3G	955	6SQ7	12SH7	14B6
6AC7	6SA7	6SR7	12SJ7	25L6 GT
6C5	6SC7	6V6 GT	12SA7	35L6 GT
6H6	6SD7	6X5 GT	12SL7	35Z5 GT
6J5	6SF7	6AB7	12SC7	35W4
6K7	6SQ7	12AT6	12SQ7	50B5
9001	6SH7	12BA6	12SR7	35Y4
9002	6SJ7	12BE6	50L6	
9003	6SK7	12H6	12SK7	

59c each — 1½ Volt Octal: 1N5 GT, 1H5 GT, 1A7 GT, 1A5 GT, 3Q5 GT

69c each — Loctal Tubes: 50A5, 35A5, 7A7, 7B7, 7E7, 7F7, 7N7, 7C5, 7Y4, 0Z4

79c each — 1½ Volt Loctal Tubes: 1LN5, 1LC6, 1LH4, 1LB4, 1LA4, 1LD5

Popular P.M. Speakers

AT LESS THAN HALF PRICE
EVERY SPEAKER GUARANTEED

4 in. P.M. 1 oz. Alnico V. mag. **$0.99**
5 in. P.M. 1 oz. Alnico V. mag. **$0.99**
5 in. P.M. 1.47 oz. Alnico V. mag. **$1.19**
5 in. P.M. 2.15 oz. Alnico V. mag. **1.49**
6 in. P.M. 1.47 oz. Alnico V. mag. **1.49**
6 in. P.M. 2.15 oz. Alnico V. mag. **1.98**
6 in. P.M. 3.16 oz. Alnico V. mag. **2.95**
8 in. P.M. 2.15 oz. Alnico V. mag. **2.95**
8 in. P.M. 3.16 oz. Alnico V. mag. **3.45**
10 in. P.M. 20 oz. Alnico 3. mag. **4.45**
12 in. P.M. 20 oz. Alnico 3. mag. **4.95**
12 in. P.M. 7 oz. Alnico V. mag. **5.95**
12 in. P.M. 46 oz. Alnico 3. mag. **9.95**

SAVE ON FIELD SPEAKERS

4 in. Dynamic. 450 ohm field **$1.89**
5 in. Dynamic. 450 ohm field **1.89**
5 in. Dynamic. 3000 ohm field **1.89**
8 in. 2 ohm field for heavy duty auto radio use **2.95**
8 in. Dynamic. 1000 ohm field **2.95**
12 in. Dynamic. 1000 ohm field **4.95**
12 in. RCA 450 ~ Reg. 10.00 net 1¼" Voice Coil. Scoop Price **4.95**

"HOTTEST PICK ME UP RADIO IN AMERICA"

NO TALLER THAN A PEN

NET EACH $22.95

IN LOTS OF 3 $21.95

Model 747—3 way personal radio. Receives broadcast 550 to 1650 KC. Small size only 4x5x8 inches. However, uses full size parts with 2-gang condenser and loop. Priced complete with 4 miniature tubes and disc rectifier. These sets are only slightly larger than the smallest personal radio. Volume and tone like a big set. Kit of batteries $2.05 extra.

MECK PEE WEE SUPER $11.95

Meck. 5 tube superhet; using miniature tubes. Small plastic cabinet (7x4x5"), 2 gang condenser, loop antenna. Alnico 5 PM speaker. This is a red hot value in a small radio receiver; broadcast 550 to 1650 KC. Priced with tubes; ready to play.

Model 800B. Black plastic cabinet **$11.95**
Lots of 3 ..... **$10.95**
Model 800W. White plastic cabinet **$12.95**
Lots of 3 ..... **$11.95**
Weight **5 lbs.** These are Dealer's Prices.

SCOOP! ON NEW C.R. TUBES

Brand New Fully Guaranteed

3 BP1	**$1.95**	5 FP7	**$1.95**
3 BP1	**1.95**	7 FP7	**2.95**
5 CP1	**1.95**	9 LD7	**2.95**

5 BP4—Has white screen; ideal for television.. **$2.95**

2 Band coil, condenser kit. Consists of a matched 2 gang condenser, band switch and antenna and oscillator coil; for broadcast and foreign short wave. Scoop price **$1.95.**

Crystal hand mike, with 12 feet of cable. A handy item to have around. Scoop price; while they last, **$3.95. each.**

SPEAKERS WITH OUTPUT ATTACHED

5 in. P.M. 1.47 oz. Alnico V. mag. with 50L6 output. Special **$1.49**
5 in. P.M. 1.47 oz. Alnico V. mag. with Push-Pull output trans. ..... Scoop **$1.69**
5½ in. G.E. P.M. Square with 50L6 output trans. mounts in place of regular 6 in. speaker..... **$1.95**
6 in. P.M. 1.47 Alnico V. magnet with 7000 ohm primary output trans. ..... Special **$2.25**
Heavy Duty 8" 450 Ohm Speaker with 6V6 output **$2.95**

POPULAR OVAL SPEAKERS

4x6 in. P.M. 1.47 oz. Alnico V. mag..... **$1.49**
5x7 in. P.M. 2.15 oz. Alnico V. mag..... **1.95**
4x6 Dynamic. 450 ohm field..... **1.95**

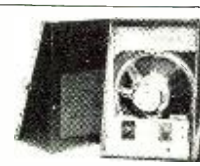
PORTABLE RECORD PLAYER KITS

KIT MODEL J-41. Our leader record player kit. Fine tone, low needle scratch. Includes two-tone leatherette covered portable case, rim-drive photo motor, high output crystal pick-up and 5" Alnico 5 PM speaker. 70L7 ready wired and tested amplifier. No wiring to do, just mount the parts in the case. Has the tone and volume controls. Kit Model J-41...Net **$14.95**

Kit model 61-X. Has a beautifully made leatherette covered portable case; similar in appearance to our model J-41. Has an even speed 78 RPM phono motor, light weight crystal pick-up and a powerful, 4 tube transformer type; wired and tested, push-pull 7C5 phono amplifier. Has separate tone and volume controls. Full 6½", heavy duty PM speaker. All you do, is mount the amplifier, motor and pick-up. This is the last word in portable record players. Kit 61-X. Net **$22.95.** Above kit model 61-X, with single post automatic record changer **$29.95.**

POWERFUL SINGLE RECORD PLAYER KIT Z-26. Housed in an attractive leatherette covered cabinet. Latest 78 RPM rim drive motor and light weight pick-up. Ready wired and tested 70L7 type tube amplifier. Tone and volume control, 5" PM speaker (Alnico V). This kit easily slips together. Priced complete with tubes and hook-up instructions. Kit Z-26.....Net **$9.95**

PORTABLE P.A. $39.95



18 watt complete portable public address system. Has inputs for a crystal or dynamic mike and phono pick-up. Has push-pull 7C5 tubes in output. Attractive leatherette covered split type case. Priced complete with two 10" PM speakers. This is a complete public address system wired ready to play. Stock No. RC-18. Net **$39.95.** Priced complete with crystal mike and desk stand.

G.E. Variable Reluctance Pick-up ...$4.65

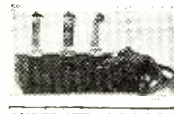
Scoop—Pre-amplifier for General Electric Variable Reluctance pick-up. Easily connected to any AC or AC-DC amplifier. Wired and Tested, with 6SC7 or (12SC7) tube. Diagram for connections is furnished. Specify whether you want pre-amplifier for AC or AC-DC use. Net price, Preamp. with Tube and G.E. Pick-up—**$6.95.**

G.E. Variable reluctance pick-up cartridge with permanent needle. Net **$4.69.**

1948 MODEL—MIKE-BROADCASTER ONLY $7.95

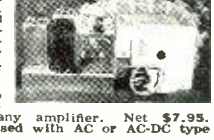
Broadcasts 800 to 1500 KC from either a phonograph pick-up or a crystal or dynamic mike. Makes any radio receiver a P.A. system, record player or recording amplifier. Gives broadcast quality. Has fader control from mike to record, simulating a regular broadcast station. This is a powerful model; using 2-35L6 12SA7 and 35Z5 tubes. Priced with tubes and connecting instructions. Wired and tested. Works on 110 volts AC-DC. Crystal mike and desk stand $4.95 extra. Model DE-5 truly a de-luxe mike-phono oscillator.

3-TUBE PHONO OSC. ONLY $4.95



Model DE-4 — Phonograph oscillator. Broadcasts from 800 to 1500 KC. Gain for any crystal pick-up. A new powerful circuit is used to assure plenty of power. Has variable gain control for proper modulation. Priced with tubes ready to operate, two 6C5S and 34W4. Model DE-4 Net..... **$4.95**

SUPERHET BROADCAST TUNER for connection to phono amp. or P.A. system. Compact chassis 5x3½x3 inches. May be mounted inside the record player cabinet. Requires only three connections to amplifier. Uses 6SA7 or 12SA7; 6SK7 or 12SK7 and crystal diode. Complete with tubes, loop antenna, dial and instructions for connecting to any amplifier. Net **$7.95.** Specify if tuner is to be used with AC or AC-DC type amplifier.



McGEE RADIO COMPANY

WRITE FOR CATALOG
Prices F.O.B. K.C.

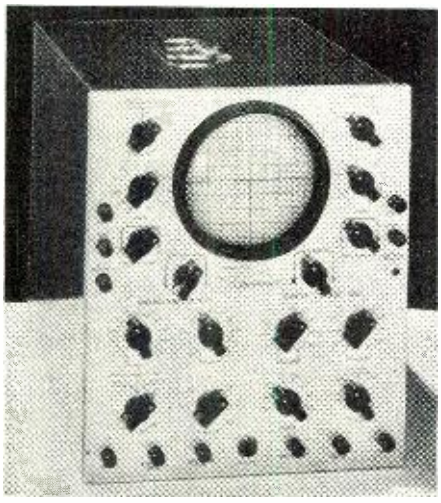
SEND 25% DEPOSIT—BALANCE C. O. D.
1225 McGEE ST., KANSAS CITY, MISSOURI

What's New in Radio

HICKOK OSCILLOGRAPH

The new *Hickok* Model 505 cathode-ray oscillograph utilizes the new 5UP-1 tube with a 5" screen.

The Model 505 features a wide and



narrow band FM oscillator which makes a separate FM oscillator unnecessary; a wide-band, high gain vertical amplifier up to 1 megacycle; a modulation circuit which permits the FM oscillator to be either internally or externally modulated; a demodulator which permits any modulated r.f. signal to be viewed; a self-contained mixer circuit which permits FM output with any good signal generator; a signal tracer jack; sinusoidal sweep with phasing control; and a three-range frequency compensated attenuator network for the vertical amplifier.

For detailed literature on the Model 505 write the *Hickok Electrical Instrument Co.,* 10524 Dupont Avenue, Cleveland 8, Ohio.

"POCKETRACER"

Radex Corporation of Chicago is now marketing a pocket-sized universal signal generator which has been designed for all types of trouble-shooting.

The r.f. and audio signal source of

the multivibrator type can be used for the quick analysis of circuit difficulties. The unit generates a universal frequency which can be used for alignment or test purposes, while an audio frequency is generated in addition to r.f. and i.f. Total current consumption of the unit is only 140 ma.

A single penlite type flashlight battery is used to power the unit.

Additional information on the "Pocketracer" may be secured from *Radex Corporation,* 2076 Elston Avenue, Chicago 14, Illinois.

"MEGA-PIPPER"

Kay Electric Company is currently in production on a new instrument for the quick and accurate alignment of television receivers.

Known as the "Mega-Pipper," this unit gives four precise crystal controlled pips which are independent of the circuit under test. These pips establish the picture, sound carrier, and also the adjacent channel points. No switching or adjustment is necessary for frequency control. Since the pips are fed directly into an oscilloscope, the pips are visible at all times, even in the traps where the highest precision is required.

The "Mega-Pipper" is designed to be used with the company's "Mega-Sweep" or "Mega-Match" instruments.

Prices and additional information on this unit will be supplied by *Kay Electric Company,* Pine Brook, New Jersey.

TELE-BOOSTER

Vision Research Laboratories has developed a device which is said to

boost weak stations to a point where suitable reception is possible.

Known as the "Tele-Booster," the unit is a compact, simply-installed r.f. amplifier with self-contained power supply. It is connected to the television receiver by installing the unit in series with the receiving antenna. Since the "Tele-Booster" is a selective amplifier, it increases the strength of the desired signal and tends to reject unwanted off-channel interference. A two-position switch on the front panel of the wooden cabinet cuts the unit in and out of the circuit at will. When in the "off" position the antenna is connected directly to the television receiver and has no effect upon normal signals which require no boosting.

The cabinet, which measures 3" x 5" x 6", is available in either walnut or mahogany finish. The "Tele-Booster" is furnished in three models; Model TVL for Channels 1 through 6; Model TVH for Channels 7 through 13; and Model FM for 88 to 108 mc.

Additional information will be supplied by *Vision Research Laboratories,* 87-50 Lefferts Boulevard, Richmond Hill, New York.

SWEEP CALIBRATOR

The Model GL-22 sweep calibrator has been added to the *Browning* line of electronic equipment.

This is a pulsed timing marker oscillator designed for use with standard

oscilloscopes and synchroscopes for the measurement of time intervals on either triggered or recurrent sweeps. Variable amplitude markers of either polarity are provided with sufficient amplitude for use as intensity markers or directly on the cathode-ray tube plates as deflection markers.

Available markers include; .1, .5, 1, 10, and 100 microseconds. A positive or negative variable width gate pulse output is provided for test purposes. The duration of this pulse corresponds to the duration of the marker group. Operation of the calibrator may be by use of external synchronizing triggers or from its own trigger generator with output triggers of both polarities available at front panel connections.

Additional information on the Model GL-22 may be secured from *Browning Laboratories, Inc.,* Winchester, Massachusetts.

PORTABLE P.A. SYSTEM

The Siltronic Company of Pittsburgh, Pennsylvania, has developed a fully portable public address system which is particularly suited for industrial plants, carnivals, municipal agencies, crowd control, instruction, sales meetings, etc.

The PA-4 is housed in a sturdily built carrying case and is completely self-contained. The unit measures 9" x 7½" x 12" and weighs, complete with batteries, just 12 pounds.

The unit has a high gain, three-stage amplifier; crystal, high fidelity

"REACH FOR KEN-RAD--
You'll never find a better tube!"

Ken-Rad tubes have been built for 26 years on the idea that when you please the serviceman—you please everybody!

By actual tube experience, servicemen know Ken-Rad research and engineering are outstanding. They know Ken-Rad production is painstaking—with test after test to make doubly sure there's no higher standard of performance.

Dependability, above everything else, is why servicemen everywhere say, "Reach for Ken-Rad—you'll never find a better tube."

"We build tubes to build YOUR REPUTATION"

C.A. MEGUIAR, Shop Foreman, Metal Mounting Dept., where grid turns are accurately aligned in beam type mounts. (Below) Aligning grid turns in special jig before welding to supports.

Practically every radio serviceman knows Ken-Rad tubes. He depends on them.

And there's plenty of reason for this confidence. Ken-Rads are made exclusively to meet the exacting demands of servicemen. They're *quality* tubes, with *stamina* and *endurance*.

This is important. Because it takes more than good service to build repeat business.

It takes good tubes, too. Ken-Rad tubes.

Use them and you can count on customers coming back, satisfied.

KEN-RAD *Radio Tubes*

PRODUCT OF GENERAL ELECTRIC COMPANY

Schenectady 5, New York

The Serviceman's Tube

microphone cased in a streamlined die cast housing; and a heavy-duty 6" PM speaker. The PA-4 uses three

tubes and three easily replaced, long life batteries.

Additional details and literature on the PA-4 are available from *The Siltronic Company*, Point Building, Pittsburgh 22, Pennsylvania.

TIRE STATIC POWDER KITS

General Cement Mfg. Co. has recently developed a tire static powder which is said to improve auto radio reception and eliminate contact shock.

The new kits include an easy-to-use injector for introducing the static powder into tire tubes without completely deflating the tires. The powder is blown into the tire's inner tube under air pressure. The tire air pressure is merely reduced 5 to 10 pounds, the injector is attached to the tube valve stem and the proper air pressure is again adjusted in the tire. The powder is automatically blown and distributed into the inner tube.

The kit includes an injector and sufficient static powder for five tires. Further information on the kits will be furnished by *General Cement Mfg. Co.*, 919 Taylor Ave., Rockford, Ill.

PIN STRAIGHTENER

The second of a series of specially designed servicemen's shop tools, a miniature pin straightener, has been announced by *Hytron Radio & Electronics Corp.* of Salem, Massachusetts.

Designed to make the serviceman's job easier and more profitable, this new tool is built of special stainless steel and aluminum for long life and trouble-free performance.

Special mounting holes are provided to permit the straightener to be fastened to the service bench. The units are priced to permit each serviceman to have one for the bench, one for the tool kit, and one for the counter near the tube tester.

Distribution of these miniature pin straighteners is being made through *Hytron* jobbers.

V.O.M.-TUBE TESTER

A combination tester which provides complete voltage, current, and resistance analyses in addition to tube testing has been announced by *The Triplett Electrical Instrument Co.* of Bluffton, Ohio.

The tube tester has a fully-balanced, multi-purpose test circuit for checking emission, short, and open elements in tubes. The company's lever switching makes possible an exclusive combination of tube testing advantages including maximum circuit flexibility, simplicity of operation, and anti-obsolescence. Only one socket is used for each tube base type thus eliminating the possibility of plugging a tube into the wrong socket. The unit tests all receiving type tubes, gaseous rectifiers, resistor and ballast tube con-

tinuity, and pilot lamps. A conveniently located roll tube chart simplifies testing.

The v.o.m. provides a.c.-d.c. voltage ranges from 0 to 1200 at 10,000 ohms-per-volt for d.c. and 2000 ohms-per-volt for a.c.; while d.c. milliamperes from 0-120; d.c. amperes from 0-12; ohms from 0-1000-100,000; and megohms from 0-1-50 may be measured with this instrument.

Additional information on the Model 3480 may be secured from *The Triplett Electrical Instrument Co.*, Bluffton, Ohio.

WIRE RECORDING HEADS

A new line of wire recording heads has been announced by *Shure Brothers, Inc.* of Chicago.

The units combine recording, playback, and erasing features in a single head. Mechanical construction permits a variety of shielding and mounting arrangements.

These new heads offer versatility of recording and playback circuits. Impedances and internal connections may be varied to suit individual needs. Other features include uniform per-

(*Continued on page* 132)

The New Model 777

TUBE & SET TESTER

20,000 OHMS PER VOLT!!

TUBE TESTER SPECIFICATIONS:

- Tests all tubes including 4, 5, 6, 7, 7L, Octals, Loctals, Television, Magic Eye, Thyratrons, Single Ended, Floating Filament, Mercury Vapor Rectifiers, New Miniatures, etc. Also Pilot Lights.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests leakages and shorts of any one element against all elements in all tubes.
- Tests both plates in rectifiers.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- New type line voltage adjuster.

Model 777 operates on 90-120 Volts 60 cycles AC. Housed in beautiful hand-rubbed cabinet. Complete with test leads, tubes, charts and detailed operating instructions. Size 13" x 12½" x 6".

V. O. M. SPECIFICATIONS:

- DC Volts: (at 20,000 Ohms per Volt) 0 to 7.5/15/75/150/750/1,500 Volts
- AC VOLTS: (At 10,000 Ohms per Volt) 0 to 15/30/150/300/1,500/3,000 Volts
- DC CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes
- RESISTANCE: 0 to 5,000/50,000/500,000 Ohms. 0 to 50 Megohms
- DECIBELS: (Based on zero decibels equals .006 Watts into a 500-Ohm line.) −10 to + 18 db., + 10 to + 38 db., + 30 to + 58 db.

$59.95 NET PRICE

Distributed by the following jobbers:

ALABAMA
Bessemer Radio Supply Co., 116-118 N. 20th St., Bessemer, Ala.
Forbes Distributing Co., Inc., 1912 Fourth Ave. North, Birmingham, Ala.
Bill Erwin Radio Co., 926 First Ave., Gadsden, Ala.
Allen & Jemison Co., 620 Greensboro Ave., Tuscaloosa, Ala.

COLORADO
Western Electronic Laboratories Co., 909 Eighteenth St., Denver, Colorado

CALIFORNIA
Valley Electronic Supply Co., 1302 W. Magnolia Blvd., Burbank, Calif.
El Monte Electronics Co., 992 East Valley Blvd., El Monte, Calif.
Valley Radio Supply, 449 Blackstone Ave., Fresno 3, Calif.
Hagerty Radio Supply, 6826 San Fernando Rd., Glendale 1, Calif.
Hollywood Radio Supply Co., 5521 Hollywood Blvd., Hollywood 28, Calif.
Pacific Radio Exchange, Inc., 1407 Cahuenga Blvd., Hollywood 28, Calif.
Alvarado Supply Co., 903 S. Alvarado, Los Angeles 6, Calif.
V & H Radio & Electronic Supply, 2033 W. Venice Blvd., Los Angeles 6, Calif.
Universal Radio Supply Co., 1404-1406 Venice Blvd., Los Angeles 6, Calif.
Figart's Radio Supply Co., 6320 Commodore Sloat Dr., Los Angeles 36, Calif.
Kierulff & Co., 820 W. Olympic Blvd., Los Angeles, Calif.
Radio Parts Sales Co., 5220 So. Vermont Ave., Los Angeles 37, Calif.
Electronic Sales Co., 5559 West Adams Blvd., Los Angeles 16, Calif.
Electric Supply Co., 143 12th Street, Oakland 7, Calif.
Pasadena Radio Supply & Equipment Co., 30 W. Colorado St., Pasadena, Calif.
Sacramento Electric Supply, 711 Capital Ave., Sacramento, Calif.
Arrowhead Radio & Television Supply, 1216 D St., San Bernardino, Calif.
Electronic Equipment Distributors, 1228 2nd. Ave., San Diego 1, Calif.
San Francisco Radio & Supply Co., 1282 Market St., San Francisco 2, Calif.
Offenbach Reimus Co., 372 Ellis St., San Francisco, Calif.
Frank Quement, Inc., 161 West San Fernando St., San Jose, Calif.
E. B. Abbett Co., 345 Francisco Blvd., San Rafael, Calif.
G & M Equipment Co., 4505 Van Noys Blvd., Sherman Oaks, Calif.

CONNECTICUT
L. N. Waldhaus, 1132 Norman St., Bridgeport, Conn.

DISTRICT OF COLUMBIA
Capitol Radio Wholesalers, 2120 14th St., N. W., Washington, D. C.
Kenyon Radio Supply, 2214 14th St., N. W., Washington, D. C.
Rucker Radio Wholesalers, Inc., 1312 14th St., N. W., Washington, D. C.
Silberne Radio & Electric Co., 3523 14th St., N. W., Washington, D. C.
Sun Radio of Washington, D. C., 938 F St., N. W., Washington, D. C.

ILLINOIS
Belmont Radio Supply, 1921 W. Belmont St., Chicago 13, Ill.
Crescent Radio Components, 4324 W. Fullerton Ave., Chicago 39, Ill.
Radio Doctors' Supply House, 220 East Station, Kankakee, Ill.
Lofgren Motorola Distributing Co., 1202 4th Ave., Moline, Ill.
Hornback Supply Co., 2009 30th St., Rock Island, Ill.

INDIANA
Radio Service Headquarters, 725 S. Main St., Elkhart, Ind.
Van Sickle Radio Supply Co., 34 W. Ohio, Indianapolis 4, Ind.
Clingaman Radio, 814 W. Main St., Peru, Ind.

KANSAS
Overton Electric Co., Inc., 522 Jackson St., Topeka, Kansas

MASSACHUSETTS
Radio Shack Corp., 167 Washington St., Boston, Mass.
Harolds Radio Distributors, 46 Brattle St., Boston, Mass.
Springfield Sound Co., 147 Dwight St., Springfield 3, Mass.

MICHIGAN
Mark's Stores, Inc., 1333 Broadway, Detroit 26, Mich.
Fulton Radio Supply Co., 265 W. Cortland St., Jackson, Mich.
Electric Products Sales Co., 427 E. Michigan Ave., Lansing 29, Mich.
Orem Distributing Co., 801 E. Genesee Ave., Saginaw, Mich.

MARYLAND
Lytron Distributing Co., 1829 N. Fulton St., Baltimore, Md.

MISSOURI
Tri-State Radio & Supply, 136 Bartlet St., Poplar Bluff, Mo.
Walter Ashe, 1125 Pine St., St. Louis 1, Mo.

NEBRASKA
Arbor Co., 823 Central Ave., Nebraska City, Nebr.
Radio Supply Co., 618 Lincoln Blvd., York, Nebraska

NEW JERSEY
General Radio Supply, 207 N. Broadway, Camden, N. J.
Nidisco, Inc., 658 Anderson Ave., Cliffside, N. J.
Trade Radio, 10 Morris St., Hackensack, N. J.
Nidisco, Inc., 713 Newark Ave., Jersey City, N. J.
Variety Electric Co., Inc., 601 Broad St., Newark, N. J.
Continental Sales Co., 195 Central Ave., Newark, N. J.
William Radio Supply, 210 French St., New Brunswick, N. J.
Nidisco, Inc., 205 Madison St., Passaic, N. J.
Monmouth Radio Supply, 396 Shrewsbury Rd., Red Bank, N. J.
Nidisco Trenton, Inc., 126 So. Warren St., Trenton, N. J.

NEW YORK
Hudson Valley Asbestos Corp., 170 Central Ave., Albany 6, N. Y.
Scheller Radio Co., 263 Oak St., Buffalo 3, N. Y.
C. A. Winchell Radio Supply Co., 37 Central Ave., Cortland, N. Y.
W. Rd. Radio Laboratory, 6 Hamilton Ave., Croton-on-Hudson, N. Y.
F. C. Harrison Co., 108 W. Church St., Elmira, N. Y.
Arace Brothers, 562 Broadway, Kingston, N. Y.
Metropolitan Elect. & Distributing Co., 42 Warren St., New York 7, N. Y.
Brooks Radio Distributing Corp., 80 Vesey St., New York 7, N. Y.
Arrow Electronics, 82 Cortlandt St., New York 7, N. Y.
General Electronic Distributing Co., 98 Park Pl., New York 7, N. Y.
Legri S. Co., Inc., 846 Amsterdam Ave., New York 25, N. Y.
National Radio Distributing Co., 899 So. Blvd., New York 59, N. Y.
Moss Electronic Distributing Co., 229 Fulton St., New York 7, N. Y.
Roy C. Stage, 265 Erie Blvd., West, Syracuse, N. Y.
Trojan Radio Co., 426 River St., Troy, N. Y.

NEW MEXICO
Supreme Radio Supply, 129 West 2nd. St., Roswell, N. M.

NORTH CAROLINA
Eastern Radio Supply, 459 Hay St., Fayetteville, N. C.

OHIO
Olson Radio Warehouse, Inc., 73 East Mill St., Akron, Ohio
Olson Radio Warehouse of Cleveland, 2020 Euclid Ave., Cleveland, Ohio
Progress Radio Supply Co., 413 Huron Road, Cleveland 15, Ohio
Whitehead Radio Co., 120 East Long St., Columbus 15, Ohio
Lifetime Sound Equipment Co., 911 Jefferson Ave., Toledo, Ohio
Steward Electric Service, 116 Seroto St., Urbana, Ohio

PENNSYLVANIA
The Spence Electric Store, 1310 12th Ave., Altoona, Pa.
Williams Auto Sales Co., Clearfield, Pa.
Kratz Bros., Kohn & Oak Sts., Norristown, Pa.
Nat Lazar Radio Co., 42-41 Lancaster Ave., Philadelphia 4, Pa.
Almo Radio Co., 509 Arch St., Philadelphia 6, Pa.
Barnett Bros. Radio Co., 145 N. 7th St., Philadelphia 6, Pa.
Radio 437 Store, 437 Market St., Philadelphia 6, Pa.
M & H Sporting Goods Co., 512 Market St., Philadelphia 6, Pa.
Warner Radio Co., 631 Market St., Philadelphia 6, Pa.
Lectronic Research Laboratories, 5832 Hegerman St., Philadelphia 24, Pa.
York Radio & Refrigeration Parts, 265 W. Market St., York, Pa.
J. R. S. Distributors, 644 W. Market St., York, Pa.

SOUTH CAROLINA
Bates Radio & Supply Co., 7 South Main St., Greenville, S. C.

TENNESSEE
Chemcity Radio & Electric Co., 12 Emory Park, Knoxville 17, Tenn.
Hermitage Music Co., 423 Broad St., Nashville 3, Tenn.

TEXAS
Electronic Equip. & Engineering, 1322½ S.E. Elizabeth St., Brownsville, Tex.
Electronic Equip. & Engineering, 1310 S. Staples St., Corpus Christi, Tex.
Paul Blackwell Co., 2016 Richardson St., Dallas 1, Tex.
Wilkinson Bros., 2406 Ross St., Dallas, Tex.
Car Parts Depot, Inc., 721 Texas St., El Paso, Tex.
Mission Radio, Inc., 814 S. Presa St., San Antonio 5, Tex.
The Hargis Company, Inc., 1305 Austin Ave., Waco, Texas

VIRGINIA
Ashman Dist. Co., 807 Granby St., Norfolk 10, Va.
D. R. Johnston Co., 1315 East Cary St., Richmond 19, Va.
Mattson's Radio, 519-21-23 W. Broad St., Richmond 22, Va.

WASHINGTON
White's Htg., Radio & Appliance Store, W. 908 First Ave., Spokane 8, Wash.

WISCONSIN
Valley Radio Distributors, 518 N. Appleton St., Appleton, Wisc.
Standard Radio Parts Co., 1244 State St., Racine, Wisc.

MANUFACTURED BY SUPERIOR INSTRUMENTS CO. 227 FULTON STREET NEW YORK 7, N. Y.

"ARROW" leads with Better Buys!

BRAND NEW! TUBES BRAND NEW!

304TL
Transmitting Tube $1.95 ea.

CATHODE RAY TUBES
5CP1 5FP7
5BP1 7BP7
3FP7
$1.19 each

5BP4
Cathode Ray Tube $1.95 ea.

RECEIVING TUBES

39c each — lots of 50—10% discount

954	2051	12BE6	12J5	6G6
957	12AT6	864	6AT6	Amperite
9003	12SR7	RK34	6SF7	10T1
9006	12C8	12A6	5R4	110AC
35W4	12K8	6SJ7	36	Neon Light

39c each — lots of 50—10% discount

1629 .....19c each 1625 .....19c each 7193 .....19c each

SPECIAL TUBE OFFERS

841—79c ea.
839—$2.95 ea.
837—$1.95 ea.
832A—$2.95 ea.
2J32—$20.00 ea.
869B—$25.00
2C26A—49c ea.

AN/APN-9 LORAN

BRAND NEW . . . R-65/APN-9 Receiver-Indicator and 115 V. 400 Cyc. power supply; complete in one chassis. With 35 tubes including 6SK7's, 2X2, etc. 3BP1 (fast screen) CR tube has magnifying lens. Factory termination, less outer case. Excellent foundation for test scope..... **$24.95**

BIAS METER
Brand New

Originally used for measuring voltages and teletype and telephone equipment. Can be used for measuring DC voltages and bias voltages also checking polarity of DC voltages. Complete with adaptor plug and schematic. Enclosed in metal carrying case. Requires no batteries for operation .....$3.95 ea.

BC-223 AX TRANSMITTER

801 Oscillator and 801 Power Amplifiers, 2—46 modulators and 1—46 speech amplifier; 4 Xtal Frequencies and Master Oscillator on selector switch 10 to 30 watts output. Tone voice or C.W. Mod. Ideal for Ham Use. Black wrinkle case. Tubes included, packed in original cases, less crystals, only..... **$11.95**
Transmitter less tubes. Tuning unit and crystal 5.95

ARC 4 TRANSMITTER and RECEIVER

For operation VHF frequencies in range of 140-144 mc. Four channel crystal controlled, manufactured by Western Electric—24V operation. Complete with crystal and dynamotor. Used. Good condition..... **$19.95**

INTERPHONE AMPLIFIER

Comes in an aluminum cabinet 9¾x4¾x5½". DC output at 60MA, less tubes. Yours for only..... **95c**
Complete with tubes.....$1.95 ea.

SCR-522 VHF COMMAND UNIT

2-Way Radio; freq. range 100-156 MC.; complete with crystals, tubes, plugs, dynamotor . . . used, in excellent condition..... **$24.95**

LP-21 ADF LOOP

Low impedance loop, good for direction finder, one Selsyn motor, one Selsyn transmitter, freq. range of loop 100 Kc to 1750 Kc.; BRAND NEW in original cartons, each..... **$6.95**

PE-117 UNIVERSAL POWER SUPPLY

6 or 12 volt input; output 145 volts and 90 volts; less vibrator, voltage regulator and rectifier tube; ideal mobile power supply unit; excellent condition, each **$2.95**

TURBO AMPLIFIERS

Use for parts or small phono amplifier, shipped complete with the following tubes: 2—7C5's, 1—7Y4, 1—7F7. Each..... **$1.65**

INTERPHONE AMPLIFIER

Type AM-26/AIC with 28 V. DC dynamotor. Contains 2—12A6 and 2—12J7 tubes. Easily converted for phonograph or intercommunication amplifier..... **$1.75**

RA-10 BENDIX RECEIVER

3 band, good cond., 7 tube super heterodyne circuit, direction finder and communication receiver, freq. range 200 to 110 KC and 2 MC to 10 MC, complete with dynamotor and tubes, easily converted to operate from 110 volt AC-DC **$14.95**

SELSYN INDICATORS

For use with beam rotators for indication of direction of beam. Operate from 15-24V. 60 cycle AC supply. Small model, 3 inch diameter, only **$2.45**
Large model, 5 inch diameter, only..... **2.95**

GE METER

0-10 amps., DC.....each **$2.29**

RADIO SET SCR-AR-283

BRAND NEW . . . transmitter and coil sets to cover 2.5-7 MC., transmitter tubes 2 No. 10 special and 2 No. 45 special, receiver (less the 2 receiver coil sets), receiver tubes 1—37, 1—38, 4—39/44, shock mounts, dynamotor (24 V.), antenna switching relay, receiver control box, transmitter control box, charts, dials, and instruction manual . . . ONLY..... **$14.95**

PHANTOM ANTENNA
Brand New

Used with any 80 meter transmitter as a dummy load for adjusting transmitter for maximum output before going on air. Freq. range: 2MC to 4.5MC. with instruc. manual, enclosed in metal case with cover.....$1.95 ea.

REMOTE CONTROL BOX

BC-450-A Remote Control Box; can be adapted to make an FT-260 local control for all command receivers..... **$1.95**

SPRAGUE PULSE FORMING NETWORKS

Used in small radar modulators, available in 3 sizes, 67 ohms impedance, 7.5 Kilowatt rating.

H-603, one micro second, 200 pulses per second	**$1.95**
H-601, 3 micro seconds, 200 pulses per second	**2.95**
H-602, 16 micro seconds, 60 pulses per second	**3.95**
ALL THREE ABOVE FOR ONLY...	**4.95**

OIL-FILLED CONDENSERS

.25 MFD at 1500 VDC..... 59c
.25 MFD at 15,000 VDC.....$4.95
2 MFD 220 VAC 29c

ARROW SALES, INC.

MAIN OFFICE
59 WEST HUBBARD ST., CHICAGO 10, ILL.
Telephone SUPerior 5575

SOUTH SIDE BRANCH
8310 SOUTH HALSTED ST.

NORTH SIDE BRANCH
1802 NORTH HUMBOLDT BLVD.

"ARROW" leads with Better Buys!

SCR-274 MEDIUM FREQUENCY COMMAND SET

Complete installation with 2 transmitters, 3 receivers, racks, tubes, crystals, control box and plugs.
Excellent condition..... **$19.50**

BLOWER MOTOR

24V, small portable with fan, ideal for defroster or ventilator unit, 17,000 RPM, BRAND NEW..... **$1.95**

TEST CABLE

Coaxial cable used for correcting signal generator to receiver, complete with PL-55 on one end, 2 spare terminals on other end; shielded, 6 ft. long, NEW..... **19c**

CD-307 Phone Extension Cord PL-55 on one end and JK-26 on other end, 8 ft. long, used for extension of headsets or speaker..... **29c**

OYNAMOTOR

DM 32A. Each 95c; 3 for..... $2.00

ANTENNA THERMO-COUPLE METER

BC-442; 0-10 amps, with extra relay and 50 MMFD 5000 Volt condenser . . . used with command transmitters. BRAND NEW..... **$1.95**

ARB AIRCRAFT RADIO RECEIVER

The ARB is a six tube, four band, superhererodyne Aircraft Radio Receiver with built-in dynamotor, designed for the reception of MCW (tone or voice) or CW within the frequency range 195 Kc to 9.05 megacycles. Used..... **$15.95**

AUTOMATIC FREQUENCY CONTROL UNIT

Western Electric type used for controlling frequency for teletype and telephone work, complete with 3—6SJ7 and 2—6H6 tubes. Complete unit, brand new in original box... **$4.95**

BC-604 FM 35 WATT TRANSMITTER

A-1 condition, complete with tubes, 10 channel push buttons, less crystals and power supply, each..... **$10.95**
Set of 80 crystals for above..... $14.95
BC-603 Receiver for above..... 10.95

TRANSFORMER

High voltage scope transformer, 90V 60 cps, primary: 6400V secondary: 4 stand-off terminals ..... each **$2.95**

FILTER CHOKES—All Fully Enclosed

3.7 H. @ 145 MA. DC., 125 ohms DC. Res. 4 MTG. Studs, each..... **59c**
100 mi 10H 59c

APN-1 RADIO ALTIMETER

Complete 420 MC transmitter-receiver unit, complete with all plugs, indicators. BRAND NEW..... **$29.95**

AN/PRS-1 MINE DETECTOR—BRAND NEW $9.50

PE-103 DYNAMOTOR . . . used..... 5.95

BC-929-A

Contains power supply 110 V. 400 cycles, has 7 tubes such as 3CP1, brand new, complete with tubes. Each $17.95; Used, ea..... $14.95

R-78/APS-15

Has 45 tubes, one 5" scope tube, one 2" scope tube, has 3 meters, 4 power supply units 110V 400 cycles, complete with tubes.
Each **$39.50**

BENDIX COMPASS RECEIVER MN-26

Remote control commercial type navigational receiver. Indicates direction of any desired transmitting station. 3 bands—frequency range: 150 Kc to 1500 Kc; has 12—6 V. type tubes. Brand new, original cost $600.
Now **$24.95**
Accessories for Above:
Loop MN-20 ..... $6.95
MN-28 Control Box..... 5.95
MN-52 Loop Control Unit..... 1.95

COMMAND RECEIVERS and TRANSMITTERS

(274N Series)—Complete with Tubes

	NEW
BC-454A; 3 to 6 MC.....	**$5.95**
BC-458; 5.3 to 7 MC.....	**5.95**
BC-457; 4 to 5.3 MC.....	**5.95**
BC-456 MODULATOR. Brand New	**2.95**

RECEIVER

Low impedance, magnetic type receiver, ideal unit for pillow receiver or small microphone, NEW..... **39c**

VHF RECEIVER BC-701

Frequency range 170-180 Mc; IF 30.5 Mc; complete with 11 tubes; self-contained power supply; brand new in beautiful wooden carrying case **$9.95**

ANI8/APT-10

Pre-amplifier Model K-1, designed to raise output level of magnetic type microphone, complete with 2 tubes 6SL7GT and 28D7 and hand switch, brand new in original cartons.
Each **$1.95** 3 for **$5.00**

VHF TRANSMITTERS

T-26/APT-2 = 450 — 710 mc = $ 9.95
T-27/APT-3 = 85-135 mc = 10.95

Above transmitters are amplitude modulated radar transmitters. Complete with all tubes such as 829, 832, 931, 6AC7, 6AG7, 5R4GY. Also 110 volt 400 cps. power supply. Brand new in original cartons. Manuals included.

GO-9

Navy type low and high frequency transmitter with power supply and tubes. Operates from 200 Kc to 18,100 Kc; requires 115V, 800 cycles. Used. Complete with tubes..... **$29.50**

RCA AVT-112A—AIRCRAFT TRANSMITTER

For radio-telephone communication; for 6, 12 or 24 volt source freq. range from 2,500 to 6,500 Kc. Small in size and wt. (wt. 6 lbs.). Complete with 6 tubes, oscillator circuit, power amplifier modulators, dual tuning indicator and amplifier, with instruction manual, less crystal. BRAND NEW in ORIGINAL CARTONS— ONLY. Each **$12.95**

ALTIMETER TRANSCEIVER RT-7/APN-1

Frequency 418-462 Mc FM, with 14 tubes: 3—12SJ7; 4—12SH7; 2—12H6; 1—VR150; 2—955, 2—9004; 27 V. Dynamotor, used in working condition **$7.95**

RECEIVER-POWER SUPPLY UNIT

For the APN-4 indicator; complete with 16 tubes, 110 V. 400 cycles.
BRAND NEW **$10.95**

MONTHLY SPECIALS

Wave Meters

		Each
Freq. range:	22 to 30 meg.	**$795**
Freq. range:	37 to 53 meg.	
Freq. range:	155 to 230 meg.	

AC operated, complete with carrying case and magic eye for tuning indicator, vernier tuning dial.

BC-732 CONTROL BOX

With 6 position, selective switch, volume control and toggle switch..... each **59c**

450-TH TRANSMITTING TUBE

Each $9.95

AM-61 INDICATOR AMPLIFIER

15 tubes including two VR105; 6L7GT; 6SN7GT; with blower motor, brand new in original carton, with metal cover, each..... **$9.95**

All shipments F.O.B. Chicago—20% Deposit Required on all orders. Minimum order accepted $5.00.

REMOTE CONTROL BOX

BC-450—Triple receiver control box, can be modified to a FT-260 local control for command receivers,
NEW..... **$1.95**

SETCHELL CARLSON RADIO RECEIVER

Designed to receive A-N beam signals. 24-28 vdc 21.6 watts. Tube complement: 14H7 or 14A7, RF amplifier; 14H7 or 14J7, mixer; 14A7 or 14H7, IF amplifier; 14R7, detector and 1st audio amplifier, 28D7, output amplifier, 195 to 420 kc. 4" high x 4" wide x 6⅝" long—wt. 3 lbs., 4 oz.
BRAND NEW in original carton..... **$5.95**

RADIO TRANSMITTER and RECEIVER APS-13

Light weight air-borne radar system, radio transmitter and receiver APS-13; tube complement: 5—6J6, 9—6AG5, 1—VR105, 2—D21, unit is brand new, complete with tubes, the tubes alone are worth more than this LOW PRICE OF ONLY **$10.95**
Rack for above $1.95
Antenna for above 1.95

GLIOE PATH RECEIVER R-89/ARN-5

Glide Path Receiver used in the Instrument Landing System covering the frequency range 332 to 335 mc; complete with the following tubes: 7—6AJ5, 1—12SH7, 2—12SN7, 1—28D7, and including three crystals 6497KC, 6522KC, 6457KC units are in A-1 condition for ONLY..... **$6.95**
Complete with Tubes and Crystals

BC-733 D LOCALIZER RECEIVER

Freq. 108-110 Mc; Tube complement: 10 tubes—1—12SQ7, 2—12SR7, 1—12A6, 1—AH7GT, 2—12SG7, 3—717A;
NOW ONLY **$6.95**
Complete with Tubes and Crystals

VEEDER-ROOT METER AND CASE

Counts up to 1000,
Each **59c**

WESTON OUTPUT METER No. 687

3 scales 0-50. A-1 Condition.
ONLY $5.95

HAND-TYPE MICROPHONE RS-38

Carbon type, with PL-68 plug, brand new....$1.95
Used 1.00

BC-645 TRANSMITTER-RECEIVER

BRAND NEW . . . 15 tubes interrogator-transmitter designed for airborne use, 435 to 500MC frequency range. With some modifications the set can be used for 2-way communication, voice or code, on the following bands: ham band: 420-450mc; fixed and mobile: 450-460mc; citizens radio band: 460-470mc; television experimental: 470-500mc; complete with all tubes, including WE Doorknob tube. Size 10½x13½x4¾". Net wt. only 25 lbs. Your cost.....only **$9.95**
DYNAMOTOR FOR ABOVE Model PE-101-C $2.95

RADIO PARTS

100 Resistors ⅛ to 1 watt..... **95c**
100 Tubular bypass condensers, assorted. .01 to .1. all 600 Volt..... **$4.69**
Electrolytic condensers 50-30. 150 Volt.....10 for **$2.89**
½ Meg. Volume Controls 1" shaft with switch. 10 for..... **$3.00**
½ Meg. Volume Controls 1" shaft without switch. 10 for..... **1.95**
Crystal Pick-up, new light wt.....each **1.79**

400 CYCLE AUTOSYN MOTOR

Ideal for indicating direction of antenna systems—BRAND NEW.....each **$2.95**

HEADPHONES

Signal Corps. 8000 ohms or 200 ohms, each.....used **79c**

T-17B HAND MIKE

BRAND NEW . . . perfect carbon hand mikes, light wt., 200 ohms, single button, press to talk switch, 5 ft. rubber cord, plug, dust cover. ONLY **89c**

ARROW SALES, INC.

SOUTH SIDE BRANCH
8310 SOUTH HALSTED ST.

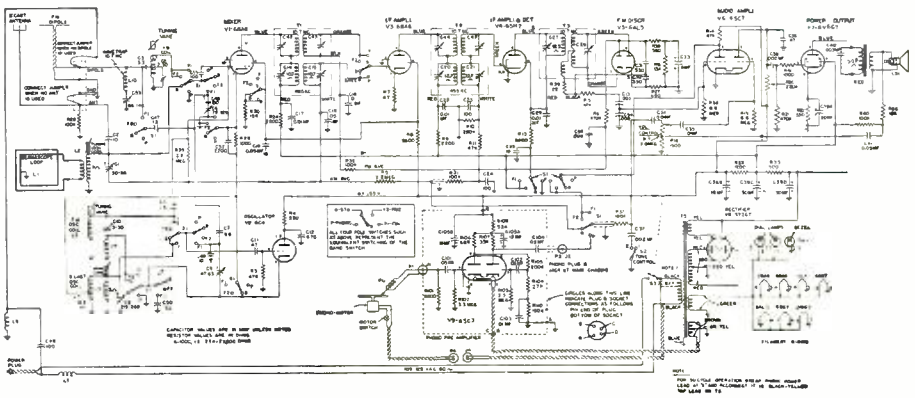
MAIN OFFICE
59 WEST HUBBARD ST., CHICAGO 10, ILL.
Telephone SUPerior 5575

NORTH SIDE BRANCH
1802 NORTH HUMBOLDT BLVD.

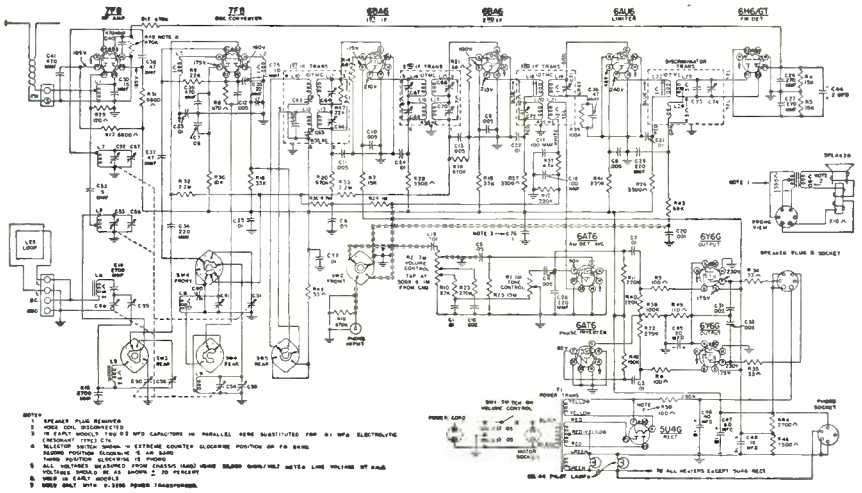
the RN CIRCUIT PAGE

(FOR PARTS LISTS SEE PAGE 100)

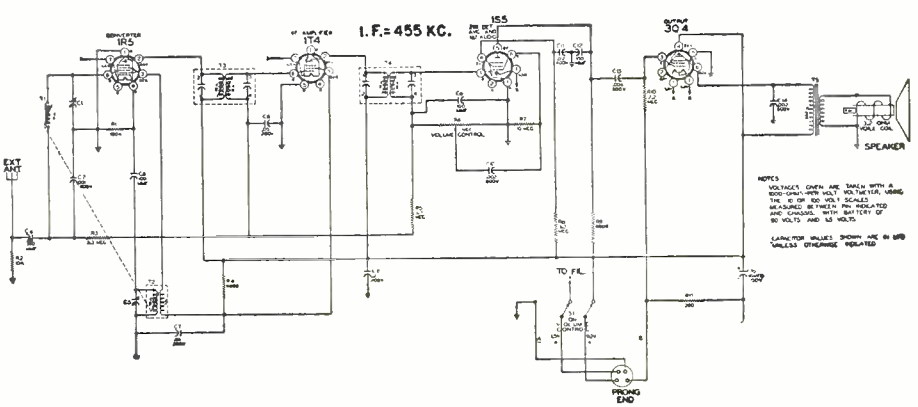
RADIO NEWS, APRIL, 1948 — GENERAL ELECTRIC MODELS 354, 355



RADIO NEWS, APRIL, 1948 — WESTINGHOUSE MODELS H-164, H-166, H-167

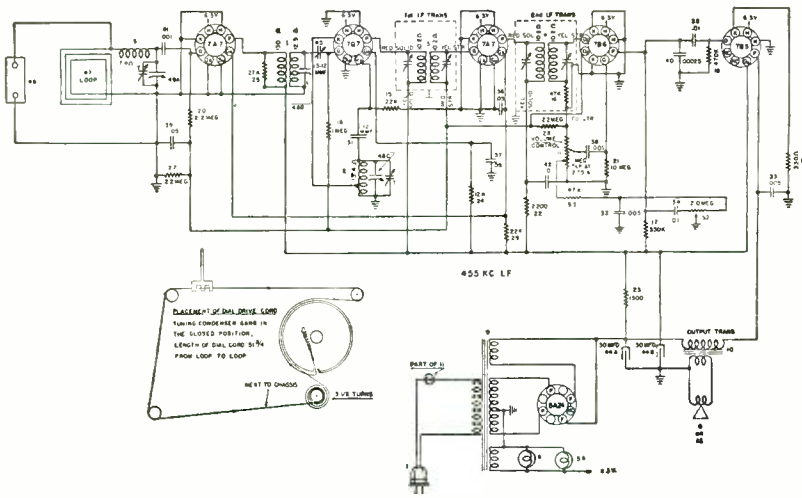


RADIO NEWS, APRIL, 1948 — BELMONT MODEL 4B115

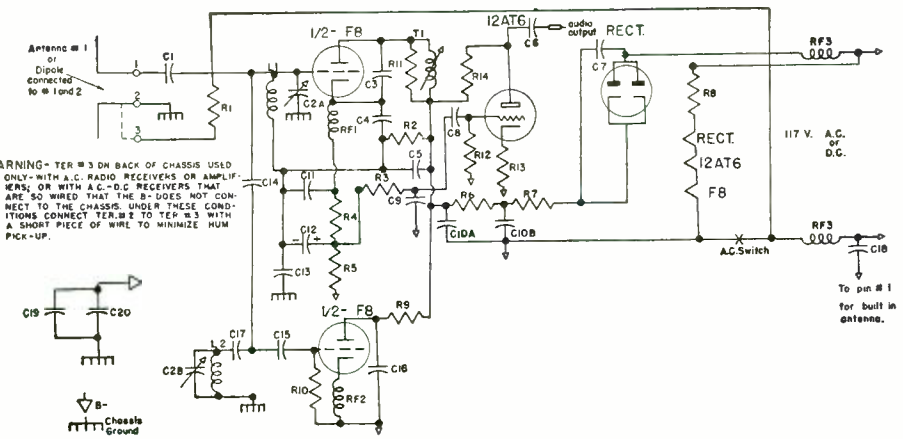


Here, and on following pages, are circuit diagrams and parts lists of many new postwar radio receivers. Radio News will bring to you other circuits as quickly as possible after we receive them from manufacturers.

RADIO NEWS, APRIL, 1948 — **CROSLEY MODELS 68TA, 68TW**

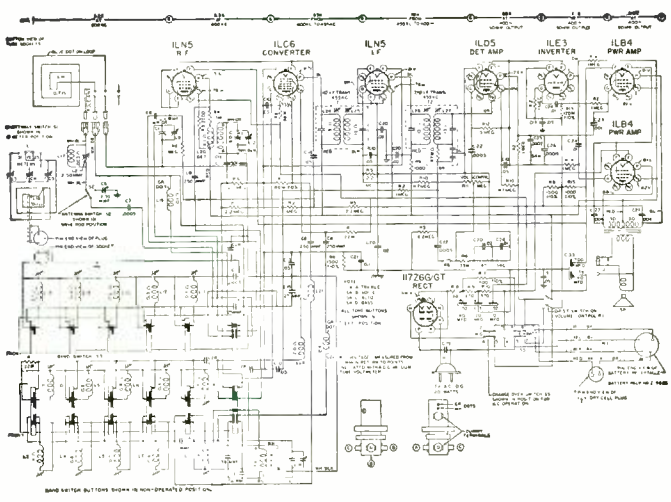


RADIO NEWS, APRIL, 1948 — **MECK FM CONVERTER**



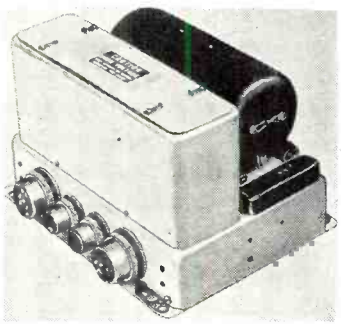
WARNING- TER # 3 ON BACK OF CHASSIS USED ONLY WITH A.C. RADIO RECEIVERS OR AMPLIFIERS; OR WITH A.C.-D.C. RECEIVERS THAT ARE SO WIRED THAT THE B- DOES NOT CONNECT TO THE CHASSIS. UNDER THESE CONDITIONS CONNECT TER. # 2 TO TER # 3 WITH A SHORT PIECE OF WIRE TO MINIMIZE HUM PICK-UP.

RADIO NEWS, APRIL, 1948 — **ZENITH MODEL 8G005**



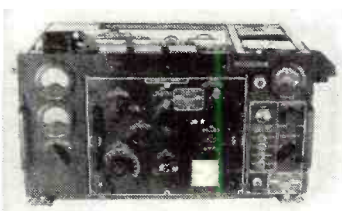
More for Your Money
R & M RADIO

Satisfaction Guaranteed or your money back



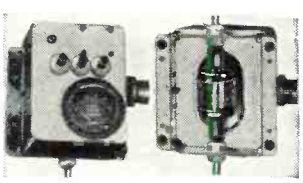
SPEECH AMPLIFIER
Modulator for Transmitter

High Volt. DC Power Supply Model unit, BC-456-A or B with dynamotor DM-33-A, plugs and tubes. Approx. wt. 17 lbs. Tube line-up, 12J5GT, 1625, VR150, and many other parts make this ideal purchase for spare parts alone. Diagram furnished. **$2.75**



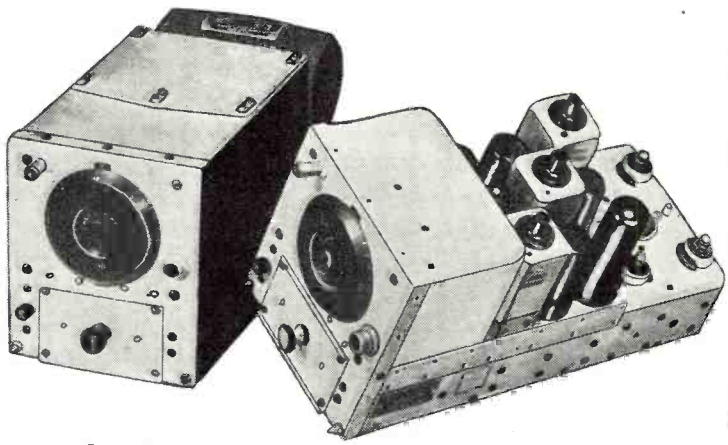
NAVY TRANSMITTER GP-7

125 watt xmtr., self-contained AC, 400 cycle power supply; uses suppressor grid modulation for phone, VFO controlled, 803 in final; built of std. parts. **$17.50**



ANTENNA RELAY

BC-442-A, SWITCHING RELAY, ANTENNA CURRENT INDICATOR with 19.5 millivolt movement, current transformer and thermocouple, 50 MMFD vacuum condenser, fixed, 5000 volt rating (CAN BE USED WITH ANY RIG). **$2.45**



BC-453
190-550 kc.

BC-454
75 meters

BC-455
40 meters

Slight conversion for 10 and 20 meters

$5.50
(all 3 for $15)

Proclaimed "best buy" by Hams from coast to coast

FOR PERFECT SINGLE SIGNAL RECEPTION

Says Jan. *QST* (p. 40, Tech. Topics): ". . . (BC-453A) will perk up that old broadband superhet of yours and make it cut through the QRM and pull out the desired signal like nothing you ever saw or heard." BC-455 is easily adapted to 10 and 20 meter reception as well as it works on 40 meters. Then all you need is one BC-454 to cover 75 meters and you have covered almost all of the Ham bands. Order yours today!

Be sure to write for details of our complete AMATEUR RADIO STATION

CONVERSION BOOK

$2.00

(with a purchase of $5 or more, available to you at just $1.00)

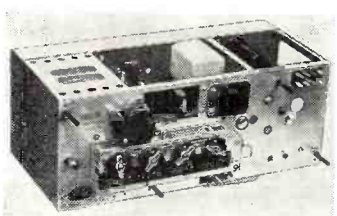
Data on conversion, with schematic diagrams, instructions, and discussion, on the following:
Diag. and Conversions: BC-348, SCR-522, BC-375, SCR-274, SCR-274-10 meter mobile.
Diagrams for: BC-221, ART-13 Collins Xmtr., APN-1, APN-4, SCR-718.
Save $1 by ordering when you purchase $5 (or more) worth of equipment.

T-17 CARBON MICROPHONE

Brand new

$1.85
each

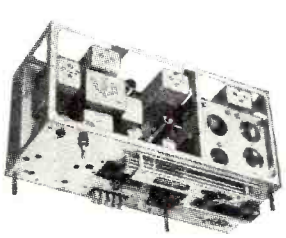
Used $1.00 each



2 or 6 METER RADIO TRANSMITTER
BC-625-A

The famous SCR-522 transmitter only, covers from 100-156 mc., crystal control, four crystal channels, seven tubes, two of which are 832's. 8 watts power output, 100% modulation, built-in modulator. Steady, reliable, beautifully made of finest components. Can be made to furnish 50 mc. and 144 mc. Can be used as drive for any frequency above.

$8.95



BC-624 VHF RECEIVER
2 METER

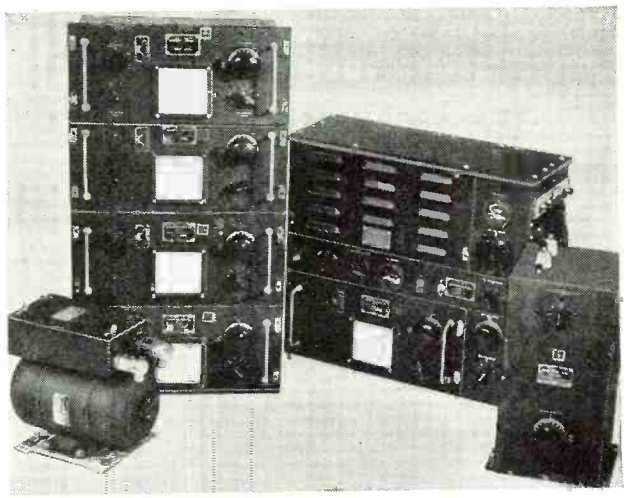
10 tubes, 4 crystal channels, tunes from 100 to 156 mc. Excellent receiver for the VHF experimenter. Does a fine job on 144 mc. Makes basic unit for conversion of FM or television.

$9.95

WAR SURPLUS BC-375-E TRANSMITTER

WITH THOUSANDS OF USABLE STANDARD RADIO PARTS

(Gov't cost, $1800) $24.50 COMPLETE



It's been written about and talked about—just the thing for beginner or old-timer; has five tubes, five tuning units. Xmtr. designed to operate from 200 kc. to 12 mc. (less BC band). Equipped with antenna tuning unit BC-306-A — variometer and tap switch. Dynamotor (PE-73-C) complete with relay, fuses and filter. Diagram and instructions for its use supplied with each set. Weight: approx. 275 lbs.

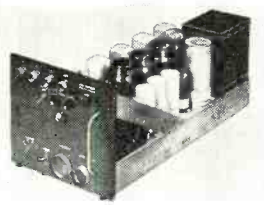
Shipment from our nearest warehouse—East, Mid-West, or West Coast

HEADPHONES

69c

HS-33 with cord and plug, 600 ohms — Used, in A-1 condition.

APN-4 RECEIVER-OSCILLOSCOPE POWER SUPPLY

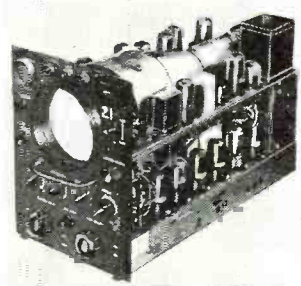


Has four screw-driver tuned R.F. channels selected by switch — I.F. frequency 1050 kc, I.F. band width 45 to 60 kc, R.F. frequencies 1600 kc to 2000 kc. Tube lineup: (2) 2Y2, (1) 5U4, (3) 6B4, (1) 6SU7, (1) 6SA7, (4) 6SK7, (1) 6SN7, (1) 6SL7, (1) 6H6 and (1) VR150. The components of this receiver are the finest money can buy. Makes excellent fixed tuner for medium frequency police calls or public address system. Has power supply for 5 inch scope—just the set to make a panoramic scope for those high frequency I.F. receivers—power transformer 400 cycle. Low voltage supply is electronically controlled and delivers 260 v.d.c. 150 mils regulated to .01%. The power supply alone is worth more than the price. Only

$12.50

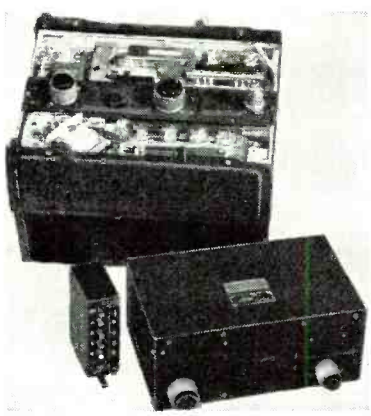
APN-4 INDICATOR—PRECISION OSCILLOSCOPE

Special for amateurs, experimenters and repairmen; can be converted into the following:



5-inch panoramic set with marker pips at 100 kc - 20 kc - 2 kc to enable you to observe crystal and V.F.O. drift and width of frequency deviation of FM; a precision sweep scope that is accurate with electronic switch for observing two signals simultaneously, and 100 kc lab. type crystal with TPTG oscillator circuit feeding six frequency divider stages. Tube lineup: (1) 5CP1, (3) 6SL7, (14) 6SN7, (6) 6H6 and (1) 6SJ7. Only

$19.50



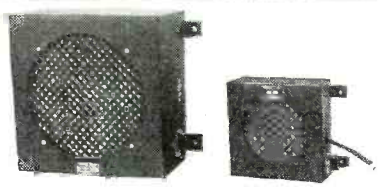
TWO METER MOBILE OR GROUND STATION

SCR-522, designed to operate from 100-156 mc. makes an ideal two-meter rig for two-way mobile radio; has one of the finest two-meter receivers ever designed. Complete trans. and rec., remote control Dynamotor PE-94 and all plugs.

$24.50

PE-98 Dynamotor, 12 v. input, for use with SCR-522 ..... **$12.50**

PE-94 Dynamotor, 24 v. input **$3.95**



HIGH FIDELITY SPEAKERS

6-inch, 10-watt PM Speaker, ea. **$7.95**

12-inch, 15-watt PM Speaker, ea. **$14.50**

Brand new in Heavy Duty Steel Cabinets with beautiful black wrinkle finish.

Also has T-pad volume control and 600 ohm line to speaker transformer. Wall mounting brackets and slope front.

HEADPHONE EXTENSION CORDS....25c

Approx. 72" long, rubber cov., with JK-26 & PL-55 plugs

HEADPHONE ADAPTERS MC-385....30c

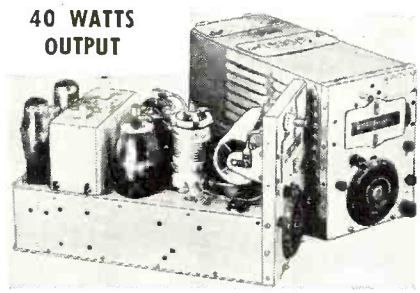
(4 for $1)

From high to low impedance, 4000 to 600 ohms; contains matching transformer.

ANTENNA SWITCHES

- Single pole, double throw **39c**
- Double pole, double throw **49c**
- Triple pole, double throw **$1.25**

40 WATTS OUTPUT



These famous VFO Drivers available:

BC-696 75 meters **$8.50**

BC-457 75 meters with slight conversion .. **$6.00**

BC-458 40 meters with slight conversion .. **$6.00**

● SAVE C.O.D. CHARGES by remitting in full, or send 25% deposit with orders. Please don't send money for postage; we ship "transportation charges collect".

R & M RADIO COMPANY

1426 N. QUINCY ST. ARLINGTON, VIRGINIA

R & M RADIO COMPANY, Dept. RN-48,
1426 N. Quincy St., Arlington, Va.

☐ Send Conversion Book. ☐ $2 inclosed.
☐ Send C.O.D. Send FREE catalogue on kits:
☐ Xmtr. ☐ Receiver. ☐ Television.
☐ I am a licensed amateur. ☐ Beginner.

Name.....

Address.....

City.....

Zone..... State.....

High Speed Receiver Squelch

By H. W. KLINE, W2DKE

Automatic key click eliminator with normal receiver operation characterizes this novel break-in system.

A RECEIVER silencing system has been developed and is now in continuous use at W2DKE for high speed, thumpless, break-in operation, including operation on the transmitter frequency. The system employs automatic cut-off bias developed by the transmitter to stop the first detector element of the receiver conversion system.

Over a period of years, many systems of receiver switching were tried. Some were partially satisfactory while others were found to be useless. Some of the last methods tried included the use of switching tubes, called "TR tubes" in radar language. It was found, however, that in practically every case, if the receiver gain control was adjusted for high sensitivity or for receiving signals of but a few microvolts intensity, the injection of several volts from the nearby transmitter, due to residual "TR tube" voltage drop, would cause serious blocking of the receiver, thereby preventing good break-in operation.

Unfortunately, the best "TR tubes" have an appreciable drop due to internal resistance after ionization. The loss in transmitting power due to this may be quite serious for even if a tube is placed at the current loop in a quarter-wave long stub, the power loss will be I^2 times the internal resistance of the tube. Since the current at the loop is at maximum, the amateur who is limited in the total power he has, may object to the losses incurred. He does not want to burn up twenty per-cent or more in such a device.

For radar applications, where the receiver recovery period is extremely short due to employment of a 30 megacycle intermediate frequency amplifier having low values of d.c. blocking condensers in a fast a.v.c. system, the "TR tube" performs well because the a.v.c. system can handle the residual signal drop across the TR box and return the receiver to normal operation in a period of but a fraction of a microsecond.

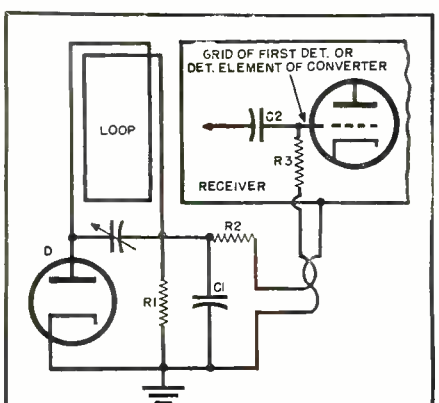
This condition does not occur in communications receivers where a.v.c. systems cannot operate fast enough to follow code keying. Once blocked, these receivers are sluggish in recovery. This is mainly due to the high values of the a.v.c. network bypass condensers which are necessary when intermediate frequencies are as low as a half megacycle.

Since this mode of operation is inherently normal for communications receivers the obvious expedient was to develop a means of inactivating the receiver at its input, thus preventing its operation from the input during transmitting periods. The control circuit was to be automatic, without relays, stable, and straightforward. Thumps and clicks were to be nondetectable when listening with headphones during relay switching to monitor. Most systems caused hang-fire thumping of the receiver, extremely bothersome during relay switching from monitor to receiver. As a result of these requirements, a squelch system for fast break-in operation was developed with results more gratifying than at first anticipated. Fig. 1 shows the wiring of this system.

Referring to Fig. 1, the loop antenna for the 7 megacycle band consists of 2 turns of wire wound on a frame having an aperture one foot by two feet in dimensions, with the turns spaced one-half inch apart. It is tuned by a 100 $\mu\mu$fd. midget condenser. The rest of the circuit is a simple diode circuit. A high negative d.c. bias is developed across R_1 which can be made to hold the bias constant on the first detector or cause entire cut-off, as desired, each time the transmitter key is touched. The amount of bias obtained can be regulated by turning the loop with respect to the nearby transmitter.

The operation of the system is as follows: The receiver uses a separate antenna, preferably at a greater distance from the transmitting antenna than the loop. The loop antenna is placed near the receiver which, in turn, is located near the transmitter

Fig. 1.



R_1, R_3—½ megohm, ½ w. res.
R_2—1 megohm, ½ w. res.
C_1—.005 µfd. mica cond.
C_2—500 µµfd. mica cond.
D—6H6 diode or equivalent

For every radio receiver, there's a Ward Aerial which gets more stations, gets them clearer and more dependably. You'd naturally expect that from Ward, the world's leading mass producer of radio aerials exclusively. But, large as Ward is, this organization always has believed that resting on your laurels invites rust. Especially so in the fast changing FM and television fields. Accordingly, the Ward experimental laboratory constantly is probing the electronic horizon with the fervor of the true scientist. Many aerial developments still to be unveiled would, if revealed today, cause many a raised eyebrow. Tomorrow, these new developments will mean finer performance at lower cost for the radios you build or install. This same technical know-how is available to design and mass produce custom-designed aerials for anyone needing them in quantity. If you have an aerial problem, bring it to Ward. Your inquiries are invited.

WARD AERIALS

THE WARD PRODUCTS CORPORATION
1524 EAST 45th ST. CLEVELAND 3, OHIO
DIVISION OF THE GABRIEL CO.

Export Department: C. W. Brandes, Manager, 4900 Euclid Avenue, Cleveland 3, Ohio
In Canada: Atlas Radio Corp., 560 King Street, W., Toronto 1, Ontario, Canada

AS NATIONALLY ADVERTISED IN THE SATURDAY EVENING POST, COLLIERS AND THE AMERICAN WEEKLY

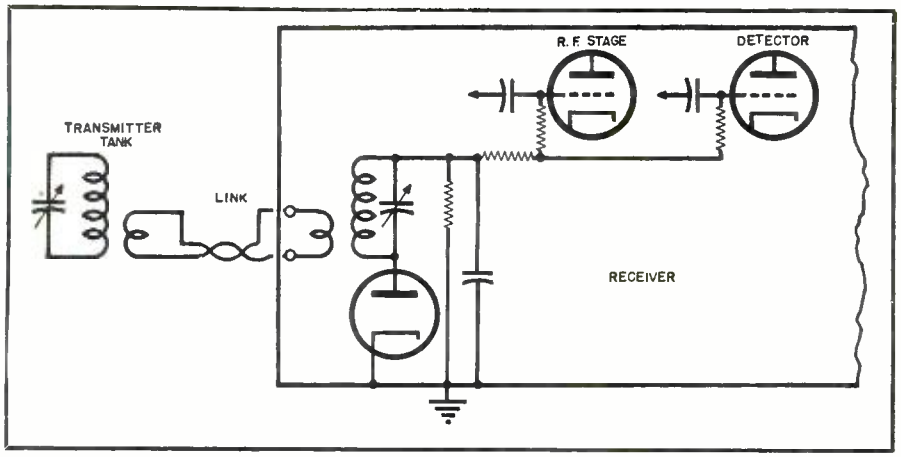


Fig. 2.

The loop is resonated to the transmitter frequency. It is oriented to pick up the necessary r.f. signal directly from the transmitter. Correct orientation can be determined immediately by listening. The receiver will be silenced as soon as the key is pressed.

It was decided to inactivate the receiver by biasing the first detector because the plate current of the first detector or the detector element of the converter is normally near cut-off. If an amplifier was suddenly cut off, a surge of plate voltage would occur causing an undesirable thump. Obviously, this system permits the holding of the detector plate current at its normal level thus preventing its operation while keying. This operation does not result in receiver paralysis. Similarly, the first r.f. stages of the receiver may be cut off, along with the detector if desired.

The only changes necessary in the receiver are the insertion of the condenser C_2 in series with the grid of the first detector and the addition of the resistor R_3 with similar treatment to the r.f. stage if desired. It is not advisable to apply this bias to other stages of the receiver as nothing will be gained by so doing.

The transmitter output power of W2DKE is 300 watts. The system was found adequate for fast break-in operation even on the same frequency as the transmitter. The bias was applied to the converter detector only. Fig. 2 shows how this system could be installed in conventional communications receivers as an additional feature.

In this instance, the loop has been eliminated and a conventional receiver coil which is loosely link-coupled to the transmitter tank substituted. The remote link coil is mounted so that the coupling to the transmitter tank circuit can be varied.

The success of this squelch system depends on having the d.c. bias developed by the transmitter equal to or exceed the peak value of r.f. signal voltage applied to the controlled tubes. This trick can only be done reasonably by the circuits shown. If the peak value of grid signal voltage at the detector is 100 volts, 100 volts of d.c. bias must be obtained to stop the detector. Voltages of this order are obtained with transmitters of several hundred watts output. 100 volt neon tubes break down when connected across receiver circuits which are tuned to the transmitter frequency. The system uses but a few milliwatts, robbed from the transmitter.

No change in the normal operation of the receiver is caused by installation of this system providing usual care is employed in installing the additional components C_2 and R_3. The receiver alignment will not be affected. The system will follow the fastest operation of an automatic *Vibroplex* key. —30—

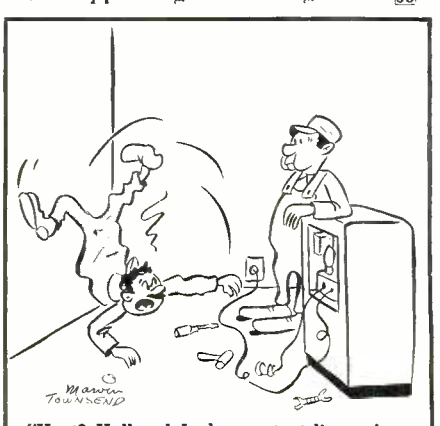
HYTRON CONTEST

HYTRON Radio & Electronics Corp. of Salem, Massachusetts, is planning a radio serviceman's contest to start in May and run for six months.

Winners will receive valuable and worthwhile prizes. Awards will be made each month with all winners of the monthly contests being eligible to compete for the grand prize.

Entries are to be judged by Oliver Read, Editor, RADIO NEWS; Joseph Roche, Editor, "Radio Maintenance"; Lewis Winner, Editor, "Service"; W. W. MacDonald, Managing Editor, "Electronics"; and J. L. Stoutenburgh, Executive Editor, "Radio & Television Retailing."

Full details on the contest will be announced in the company's advertisements appearing in this magazine.—30—



"Hurt? Hell no! I always test live wires this way!"

Edw. H. Guilford, Vice President

How to Pass FCC Commercial Radio Operator License Exams

I can train you to pass your FCC License Exams in a few short weeks if you've had any practical radio experience—amateur, Army, Navy, radio servicing, or other. My time-proven plan can help put *you*, too, on the road to success.

Let me send you FREE the entire story

Just fill out the coupon and mail it. I will send you, free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam and Catalog A, describing opportunities for you.

FREE

Tells where to apply for and take the examinations, location of examining offices, scope of knowledge required, approved way to prepare for FCC examinations, positive method of checking your knowledge before taking the examinations.

Get your FCC ticket in a FEW SHORT WEEKS

IT'S EASY IF YOU USE CIRE SIMPLIFIED TRAINING AND COACHING METHODS AT HOME IN YOUR SPARE TIME

Get your license easily and quickly and be ready for the $3000 to $7500 jobs that are open to ticket holders. CIRE training is the only planned course of coaching and training that leads directly to an FCC license. Your FCC ticket is recognized in all radio fields as proof of your technical ability. Employers often give preference to license holders, even though a license is not required for the job. Hold an FCC "ticket" and the job is yours!

Look at the job opportunities you will have when you get your FCC ticket

Forestry and conservation	Bus and truck fleets
Ambulances and hospitals	Police and fire depts.
Gas and electric utilities	Telephone companies
Gas and oil pipe lines	Merchant marine
Private automobiles	Highway Patrol
Street railways	Railroads
Taxicab fleets	Airlines

Look at these average pay schedules for Broadcast Jobs

Reported by FCC Nationwide Survey

Position	Big Stations	Little Stations
Transmitter Engineer	$4800	$3000
Studio Engineer	5000	3650
Chief Engineer	7700	4300

Other jobs requiring FCC commercial licenses pay similar salaries.

Look what these students say:

"Thanks to this course, I now have a very good job in a local power plant's test department. I couldn't have obtained this job without the math and basic electrical theories in the first part of Section I of this course."

Stud. #2893N12

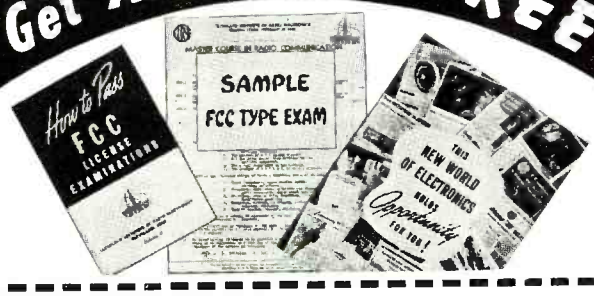
"I have been working for Police Radio Station WPFS in Asheville for five months since getting my second-class ticket."

Stud. #2858N12

"You may be interested to know that I am employed at the local broadcast station, where I am a transmitter operator. I took and passed the FCC examinations last February."

Stud. #2754N12

Get ALL THREE FREE



Don't Waste Valuable Time

MAIL COUPON TODAY!

Don't put off getting this valuable information. Good jobs in radio need men like you. You can earn higher income, have a bank account, enjoy vacations, and have easier and better living. But you must have your FCC License. Hurry! Fill out the coupon right now and mail it. There is no obligation. You owe it to yourself to get the full story NOW.

RN-4 Terminal Tower **Cleveland 13, Ohio**

Approved for Training under "G.I. Bill of Rights"

CLEVELAND INSTITUTE OF RADIO ELECTRONICS

RN-4 Terminal Tower **Cleveland 13, Ohio**

I want to know how I can get my FCC ticket in a few short weeks. Send me your FREE booklet "How to Pass FCC License Examinations" (does not cover exams for Amateur License) as well as a sample FCC-type exam and Catalog A, describing opportunities in Radio-Electronics.

NAME .....

ADDRESS .....

CITY .....ZONE.....STATE.....

☐ Veterans check for enrollment information under G.I. Bill.
NO OBLIGATION—NO SALESMEN.

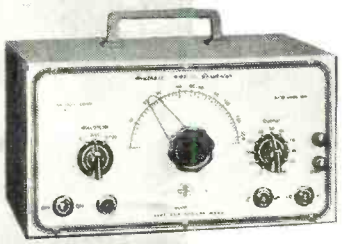
Why YOU SHOULD BUILD YOUR OWN TEST EQUIPMENT

1. You save two-thirds in cost. With increasing prices of most everything, labor costs are an important factor. Eliminating assembly labor costs, we can offer Heathkits at about one-third the cost of factory built equipment.
2. You have all the fun and learn while you save. Through knowledge of construction gained in assembly, better use can be made of the instruments.

Build YOUR OWN TEST EQUIPMENT *with* HEATHKITS

IDEAL TELEVISION and FM SERVICING COMBINATION

HEATHKIT SINE AND SQUARE WAVE AUDIO GENERATOR



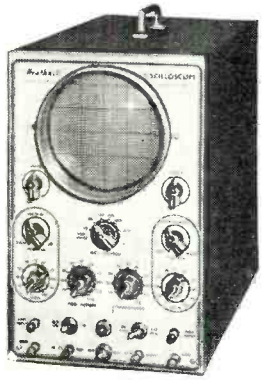
The ideal matching instrument to the Heathkit Oscilloscope for advanced service technique in television and FM servicing. Supplies sine or square wave 20 cycles to 20,000 cycles. Excellent wave form and extremely low distortion. Everything supplied. Grey crackle cabinet, beautiful two color calibrated panel, 5 tubes, 110V power transformer, 1% calibrating resistors, all other parts and detailed blueprints and instructions.

Only $34.50

The NEW 1948 HEATHKIT 5 INCH OSCILLOSCOPE KIT

Features

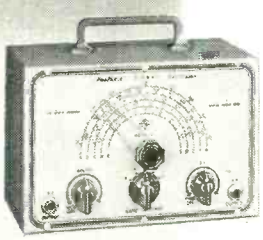
- Frequency compensated vertical and horizontal amplifiers.
- Beautiful two color panel.
- Sweep circuit supplying 15 to 30,000 cycles.
- All controls on front panel.
- Ideal for television and radio trouble shooting.
- Convenient portable size—weighs only 26 pounds.
- Cabinet dimensions 8½" x 13" high by 17" deep.
- Provision for external synchronization.
- Test voltage post on front panel.
- Deflection sensitivity .65 volts per inch full gain.
- Frequency response plus or minus 20% from 50 cycles to 50 KC.
- Input impedance 1 megohm and 50 MMF.
- Tubes supplied: 2 6SJ7, 2 5Y3, 1 884, 1 5BP1.
- Operates from 110 volt 60 cycle AC.
- Power supply delivers 1100 volts negative, 350 volts positive, making 1450 volts available for the CR tube.
- All oil filled condensers used, assuring long life.



$39.50

Nothing ELSE TO BUY...

HEATHKIT SIGNAL GENERATOR KIT



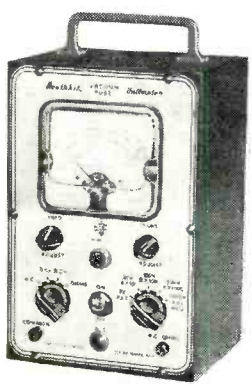
Features

- 110 Volt 60 cycle operation with transformer power supply.
- Completely isolated from power line.
- Can be used on any type receiver.
- Supplies fundamentals from 150 KC to 34 MC in five bands.
- Useful harmonics to over 100 MC.
- 400 cycle audio frequency modulation available separately for audio testing.
- Supplies either pure RF or modulated signal.
- Highly accurate calibration with calibration adjustment for exact frequency.
- Approximately 30% modulation.
- Uses 6SN7 as oscillator and audio frequency amplifier and 6X5 as transformer power supply rectifier.

$1950

Shipping Wt. 7 lbs. ● Convenient, portable—Dimensions 9"x 6" x 4¾" deep, weight 4½ lbs. Complete with detailed blueprints which enable the constructor to assemble an instrument he will be proud to own.

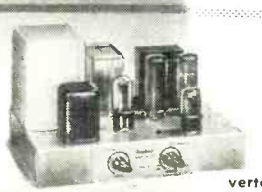
The NEW HEATHKIT VACUUM TUBE VOLTMETER KIT



The most essential tool a radio man can have, now within the reach of his pocketbook. The Heathkit VTVM is equal in quality to instruments selling for $75.00 or more. Features 500 microamp meter, transformer power supply, 1% glass enclosed divider resistors, ceramic selector switches, 11 megohms input resistance, linear AC and DC scale, electronic AC reading RMS. Circuit uses 6SN7 in balanced bridge circuit, a 6H6 as AC rectifier and 6X5 as transformer power supply rectifier. Included is means of calibrating without standards. Average assembly time less than four pleasant hours, and you have the most useful test instrument you will ever own. Ranges 0-3, 30, 100, 300, 1000 volts AC or DC. Ohmmeter has ranges of scale times 1, 100, 1000, 10M and 1 megohm, giving range .1 ohm to 1000 megohms. Complete with detailed instructions. Add postage for 8 lbs.

$2450

HEATHKIT HIGH FIDELITY AMPLIFIER KIT



Build this high fidelity amplifier and save two-thirds of the cost. Push pull output using 1619 tubes (military type 6L6's), two amplifier stages using a dual triode (6SN7), and a phase inverter give this amplifier a linear reproduction equal to amplifiers selling for ten times this price. Every part supplied; punched and formed chassis, transformers (including quality output to 3-8-15 ohm voice coil), tubes, controls, and complete instructions. Add postage for 20 lbs. 12" PM speakers for above $6.95

$1495

HEATH SELLS DIRECT TO THE BUILDER . . . .

Our engineers enjoy the friendly contacts with those who build Heathkit equipment, and can serve them better through direct relationships. Without the necessity for discounts to dealers, the equipment can be made available to you at the lowest possible cost. Send your order direct and we shall be glad to ship COD, or you may send cash in advance if desired.

No ORDERS UNDER $2.00

The HEATH COMPANY

BENTON HARBOR, MICHIGAN

BEST of SURPLUS

COMMAND SET ACCESSORIES

POWER TRANSFORMER *Specials*

A wonderful buy in a new production heavy duty power transformer. Primary 117V 60 cycle. Secondaries supply 746 V.CT at 220 MA, 6.3V. at 4.5 A., and 5V at 4 A. An ideal transformer for high quality amplifier modulator, small transmitter or quality radio. Will handle 13 tube radio receivers. Supply is limited, order early.

$3.95 . . . 3 FOR $9.95

FILTER CHOKE — 1.5 henries @ .100 amp. D.C. D.C. resistance, 50 ohms. No. 641.
3 FOR **$1.00**

FILTER CHOKE — 3 henries @ .060 amp. D.C. D.C. resistance 80 ohms max. No. 642
3 FOR **$1.00**

MODULATION AND OUTPUT TRANSFORMER — Couples 2 tubes 3000 ohms plate-to-plate 60 ma. D.C. balanced, to 1,250 ohms load at 80 ma. D.C. unbalanced and to 3.4 ohm speaker voice coil
No. 745 ..... **$1.00**

TRANSMITTER POWER SUPPLY KIT

For BC645, 223, 522, 274N's, etc. Ideal for powering militarv transmitters. Supplies 500 to 600 volts at 150 to 200 MA plate, 6.3 at 3.6A, also 9V and 12V A.C. Kit supplied complete with husky cased Acme 110V 60 cycle power transformer, 5U4 rectifier. Sprague oil filled condenser, cased choke, punched chassis, and all other parts, including detailed instructions.
Complete — nothing else to buy

$11.95

110V RECEIVER POWER SUPPLY KIT

With 24 volt filament, no wiring changes inside set, punched chassis and volume control **$5.95**

5" PM SPEAKER

With output transformer, matching headphone output **$2.80**

Dual receiver rack FT277A with connecting plugs **$1.00**

Shock mount for above rack **$1.00**

Single transmitter rack FT234A **$1.00**

MILITARY CONVERSION POWER TRANSFORMERS

Convert your military receivers without rewiring the filament. "A" type supplies 500 VCT at 50 MA, 5V at 2A and 24V at ½A. "B" type supplies 500 VCT at 50 MA, 5V at 2A and 12V at 1 amp.
State whether A or B type desired **$2.95**

MIDGET AMATEUR TRANSMITTER KIT

Uses Army Walkie-Talkie parts to easily assemble a 1 Watt 80 meter CW transmitter. Comes complete with 80 meter crystal, tube, chassis, tank coil, tuning condenser, all other small parts and complete instructions. The only other parts required are key and batteries listed below. Range up to 500 miles. Lowest cost ever offered. Add postage for 2 lbs.

ACCESSORIES
Key (add postage for 2 lbs.) $1.00
Kit of batteries (add postage for 4 lbs.) 3.25

$3.95

SOCKET SPECIALS

Single hole mounting octal, brown, low loss, bakelite, less locking rings,
25 FOR **$1.00**

2 hole flange mounting octal bakelite 1-5/16" mounting centers.
20 FOR **$1.00**

Ceramic 2 hole flange mounting octals, 1½" mounting
10 FOR **$1.00**

Ceramic acorn sockets
5 FOR **$1.00**

T32 TABLE MICROPHONE

One of the Army's best. Built by Kellogg, ideal for factory call system, public address, amateur use. Brand new in original cartons, add postage for 5 lbs. **$2.95**

HEARING AID HEADPHONES

The Army's best — eliminate flat ears and outside noise. Complete with transformer for conversion from low to high impedance. With cord and plug complete. Add postage for 1 lb.
$1.00

AN/APN1 RADIO ALTIMETERS

Brand new, complete with tubes, dynamotor, antennae, indicator, switch, plugs and instruction manual. Consists of 420 MC transmitter and receiver. Converts into excellent boat radar indicating in feet, or amateur 420 MC rig. In original crate.

$34.95

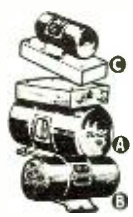
G. E. MODEL BC-375 TUNING UNITS

$2.49

These General Electric 150 Watt transmitter tuning units are the greatest surplus buy. Over $30.00 worth of new condensers, cails, switches. National Velvet vernier dial, etc. Supplied complete with cabinet and two reprints of conversion articles for transmitter and receiver reprinted from RADIO NEWS. Specify TU5B, TU10B or TU26B. Add postage for 20 lbs.

DYNAMOTORS

Consists of electric motor operating generator on same shaft. Many applications — operating radios from storage battery - using as motor.



Dynamotor C — Input 28 volts, output 220 volts at 60 MA. Shipping Weight 6 pounds. **$1.50**

Dynamotor A — Input 12 volts, output 1000 volts at 350 MA. Shipping Weight 72 pounds. **$5.95**

Dynamotor B — Input 6 or 12 volts, output 500 volts, 160 MA. Shipping Weight 30 pounds. **$5.95**

SOCKET KIT

20 beautiful octal, loctal and miniature sockets. **20 FOR $1**

TRIMMER CONDENSER KIT

10 brand new variables 12 MMF to 50 MMF ceramic insulated **$1.95**

MN26C BENDIX RADIO COMPASS

A brand new twelve tube Bendix radio compass complete with instruction manual, 12 six volt tubes, 24 volt dynamotor, power supply and shock mounting. Covers 150 KC to 1500 KC in three bands. Ideal for marine or aircraft use.

$24.95

BENDIX MN20E LOOP

Used with above receiver for direction finding, homing, establishing a fix, reception in snow and ice conditions, etc. 9" diameter.

$9.95

The HEATH COMPANY

BENTON HARBOR, MICHIGAN

Parts Lists

(FOR CIRCUIT DIAGRAMS APPEARING ON PAGES 90 AND 91)

WESTINGHOUSE MODELS H-164, H-166, H-167

Part No.	Code and Description
V-3305	R_1— 1 megohm tone control
V-3293	R_2, SW_1—2 megohm vol. control & sw.
RC20AE153J	R_3, R_4—15,000 ohm, ½ w. res.
RC20AE101M	R_5, R_6—100 ohm, ½ w. res.
RC20AE153K	R_7—15,000 ohm, ½ w. res.
RC20AE471K	R_8—470 ohm, ½ w. res.
RC20AE223K	R_9—22,000 ohm, ½ w. res.
RC20AE273K	R_{10}—27,000 ohm, ½ w. res.
RC20AE224M	R_{11}, R_{12}—220,000 ohm, ½ w. res.
RC30AE682K	R_{13}, R_{31}—6800 ohm, 1 w. res.
RC20AE680K	R_{14}, R_{21}—68 ohm, ½ w. res.
RC20AE333K	R_{15}, R_{16}—33,000 ohm, ½ w. res.
RC20AE474M	R_{17}, R_{18}, R_{19}, R_{20}, R_{48}—470,000 ohm, ½ w. res.
RC20AE274K	R_{22}, R_{23}—270,000 ohm, ½ w. res.
RC20AE105M	R_{24}—1 megohm, ½ w. res.
RC20AE156M	R_{25}—15 megohm, ½ w. res.
RC20AE332M	R_{26}, R_{27}, R_{28}—3300 ohm, ½ w. res.
RC20AE121K	R_{29}—120 ohm, ½ w. res.
RC30AE103M	R_{30}—10,000 ohm, 1 w. res.
RC20AE225M	R_{32}, R_{33}—2.2 megohm, ½ w. res.
RC20AE330M	R_{34}, R_{35}, R_{49}—33 ohm, ½ w. res.
RC20AE475M	R_{36}—4.7 megohm, ½ w. res.
RC20AE473M	R_{37}—47,000 ohm, ½ w. res.
RC20AE104K	R_{38}, R_{39}—100,000 ohm, ½ w. res.
RC20AE224K	R_{40}, R_{41}—220,000 ohm, ½ w. res.
RC20AE154M	R_{42}—150,000 ohm, ½ w. res.
RC20AE683M	R_{43}—68,000 ohm, ½ w. res.
RC41AE272K	R_{44}—2700 ohm, 2 w. res.
V-4758	R_{45}—110 ohm, 3 w. res.
V-4759	R_{46}—7500 ohm, 5 w. res.
V-5367	R_{47}, C_{62}, C_{63}, C_{64}, C_{65}, C_{66}, L_{10}, L_{11}, L_{12}, L_{13}—First i.f. trans.
V-5323	R_{50}—100 ohm, 10 w. res.
RCP10W4103A	C_1—.01 μfd. cond.
RCP10M4103A	C_2, C_3—.01 μfd. cond.
RCP10W6502A	C_4—.005 μfd. cond.
RCP10W4503A	C_5, C_6, C_7—.05 μfd. cond.
RCM30B512M	C_8, C_9, C_{10}, C_{11}, C_{12}, C_{13}—.005 μfd. cond.
RCM30C272G	C_{14}, C_{15}—2700 μμfd. cond.
RCP10W6202M	C_{16}—.002 μfd. cond.
RCM20B101M	C_{17}, C_{18}—100 μμfd. cond.
RCP10W6102K	C_{19}, C_{20}—.001 μfd. cond.
RCM30B103M	C_{21}, C_{22}, C_{23}, C_{24}, C_{25}—.01 μfd. cond.
RCM20B271J	C_{26}, C_{27}—270 μμfd. cond.
RCM20B221M	C_{28}, C_{29}—220 μμfd. cond.
R2CC21CH150J	C_{30}—15 μμfd. cond.
RCP10M6202M	C_{31}, C_{32}—.002 μfd. cond.
R2CC21CH050D	C_{33}—5 μμfd. cond.
R2CC36SL221M	C_{34}—220 μμfd. cond.
R2CC21PJ220K	C_{35}—22 μμfd. cond.
R2CC26PJ470K	C_{36}, C_{37}, C_{38}—47 μμfd. cond.
R5CC21ZY471M	C_{39}, C_{40}, C_{41}—470 μμfd. cond.
V-3241	C_{42}, C_{43}—.05 μfd. dual cond.
V-4880	C_{44}—2 μfd., 50 v. elec. cond.
V-3236	C_{45}—20 μfd., 25 v. elec. cond.
V-3302	C_{46}, C_{47}, C_{48}—40/40/16 μfd., 450/450/350 v. elec. cond.
V-4750	C_{49}, C_{50}, C_{51}, C_{52}, C_{53}, C_{54}—3-gang var. cond.
V-4746	C_{55}—Broadcast ant. trimmer
V-4747	C_{56}—Broadcast converter trimmer
V-4748	C_{57}, C_{58}, C_{59}—FM trimmer cond.
V-4749	C_{60}, C_{61}—2-gang trimmer cond.
V-5368	C_{67}, C_{68}, C_{69}, C_{70}, L_{14}, L_{15}, L_{16}, L_{17}—Second i.f. trans.
V-4623	C_{71}, C_{72}, L_{18}, L_{19}, L_{20}, L_{21}—Third i.f. trans.
V-4624	C_{73}, C_{74}, L_{22}, L_{23}, L_{24}—Dis. trans.
R2CC21UJ100F	C_{75}—10 μμfd. cond.
V-5442-1	C_{76}—.1 μfd. cond.
V-5040-15	C_{77}—.01 μfd. cond.
V-4887	L_1—FM ant. input choke
V-4886	L_2, L_3—Fil. choke
V-4751	L_4—Broadcast ant. coil
V-4752	L_5—Broadcast converter coil
V-4753	L_6—Broadcast osc. coil
V-5048	L_7—FM r.f. coil assembly
V-4755	L_8—FM converter coil assembly
V-4756	L_9—FM osc. coil assembly

GENERAL ELECTRIC MODELS 354, 355

Part No.	Code and Description
URD-089	R_3, R_{11}, R_{11}, R_{13}—47,000 ohm, ½ w. res.
URD-033	R_4—200 ohm, ½ w. res.
URD-133	R_5, R_{25}—2.2 megohm, ½ w. res.
URD-113	R_6, R_{21}—470,000 ohm, ½ w. res.
URD-017	R_7—47 ohm, ½ w. res.
URF-067	R_8, R_{13}—5600 ohm, 2 w. res.
URD-057	R_9, R_{24}—2200 ohm, ½ w. res.
URD-105	R_{10}, R_{20}—220,000 ohm, ½ w. res.
URD-1076	R_{10}—13,000 ohm, ½ w. res.
RRC-033	R_{17}, S_3—2 megohm vol. control & sw.
URD-053	R_{18}—1500 ohm, ½ w. res.
URD-141	R_{19}, R_{36}—6.8 megohm, ½ w. res.
URE-037	R_{22}—330 ohm, 1 w. res.
URF-051	R_{23}—1200 ohm, 2 w. res.
URD-077	R_{26}—15,000 ohm. ½ w. res.
URD-1045	R_{27}—680 ohm, ½ w. res.
URD-097	R_{28}, R_{31}, R_{32}, R_{37}, R_{40}—100,000 ohm, ½ w. res.
URD-049	R_{29}, R_{11}—1000 ohm, ½ w. res.
URF-077	R_{30}—15,000 ohm, 2 w. res.
RCY-018	C_1, C_5, C_6—3-30/30-60/79-129 μμfd. trimmer
UCU-004	C_2—10 μμfd. mica cond.
UCN-504	C_3—3.3 μμfd. ceramic cond.
RCW-017	C_4, C_{47}—1.5 μμfd. ceramic cond.
UCN-1506	C_7—6.8 μμfd. ceramic cond.
RCY-019	C_8, C_9—219-269/47-83 μμfd. trimmer
RCY-017	C_{10}—Air trimmer
RCW-001	C_{11}—Ceramic cond.
UCU-044	C_{12}—470 μμfd. mica cond.
UCC-020	C_{13}—.003 μfd., 400 v. cond.
UCC-040	C_{16}, C_{17}, C_{22}, C_{31}, C_{35}—.01 μfd., 600 v. cond.
UCC-028	C_{18}—.05 μfd., 400 v. cond.
UCC-045	C_{19}—.05 μfd., 600 v. cond.
UCU-020	C_{23}, C_{24}, C_{46}—100 μμfd. mica cond.
RCC-040	C_{29}—.01 μfd. oil cond.
UCU-1040	C_{30}, C_{31}—330 μμfd. mica cond.
RCE-038	C_{33}—8 μfd., 25 v. elec. cond.
UCC-036	C_{37}—.002 μfd.. 600 v. cond.
UCC-041	C_{38}—.02 μfd., 600 v. cond.
RCE-039	C_{39A}, C_{39B}, C_{39C}, C_{39D}—20/15/30/30 μfd., 25/300/350/350 v. elec. cond.
RCC-014	C_{40}—.005 μfd. paper cond.
UCC-011	C_{41}—.05 μfd.. 200 v. cond.
UCU-1032	C_{48}—150 μμfd. mica cond.
RCW-013	C_{49}—10 μμfd. ceramic cond.
UCW-1022	C_{50}—56 μμfd. ceramic cond.
UCU-060	C_{52}—2200 μμfd. mica cond.
RCY-020	C_{53}—86-146 μμfd. trimmer
UCC-024	C_{54}, C_{56}—.008 μfd., 400 v. cond.
RCW-1028	C_{55}—100 μμfd. ceramic cond.
RSW-024	S_1—Bandswitch
RSW-025	S_2—Tone control sw.
RTL-031	T_1—First i.f. trans.
RTL-032	T_2—Second i.f. trans.
RTD-004	T_3—Dis. trans.
RTP-028	T_5—Power trans. (60 cycles)
RTP-033	T_5—Power trans. (50 cycles)

BELMONT MODEL 4B115

Part No.	Code and Description
C-9B1-25	R_1—100,000 ohm, ½ w. res.
C-9B1-74	R_2—10,000 ohm, ½ w. res.
C-9B1-34	R_3, R_5, R_8—3.3 megohm, ½ w. res.
C-9B1-72	R_4—6800 ohm, ½ w. res.
A-10A-13640	R_6, S_1—1 megohm vol. control & sw.
C-9B1-37	R_7—10 megohm, ½ w. res.
C-9B1-30	R_9—680,000 ohm, ½ w. res.
C-9B1-33	R_{10}—2.2 megohm, ½ w. res.
C-9B1-57	R_{11}—390 ohm, ½ w. res.
A-2M-12618	C_1, C_5—Plate trimmer
C-8D-10787	C_2—.001 μfd., 600 v. cond.
C-8F3-8	C_3, C_9, C_{12}—100 μμfd. mica cond.
C-8F3-119	C_4—330 μμfd. mica cond.
C-8D-10770	C_6, C_7—.05 μfd., 200 v. cond.
C-8D-10775	C_8—.25 μfd., 200 v. cond.
C-8D-10778	C_{10}, C_{14}—.002 μfd., 600 v. cond
C-8D-10774	C_{11}—.02 μfd., 400 v. cond.
C-8D-10785	C_{13}—.006 μfd., 600 v. cond.
A-8C-11495	C_{15}—10 μfd.. 150 v. elec. cond.
A-13E-13648	T_1—Ant. coil
A-13D-13647	T_2—Osc. coil
B-13B-13643	T_3, T_4—I.f. trans.
B-12C-13641	T_5—Output trans. for speaker

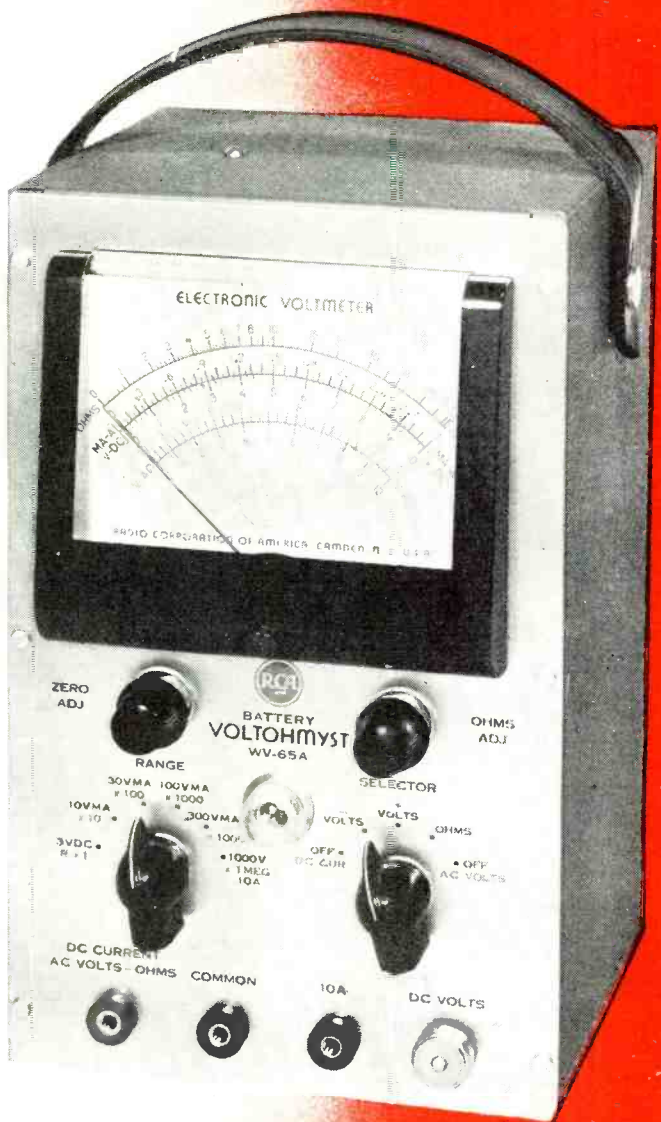
MECK FM CONVERTER

Part No.	Code and Description
RC-21000	R_1, R_9—100 ohm. 1/3 w. res.
RC-21503	R_2—150,000 ohm, 1/3 w. res.
RC-21003	R_3, R_{14}—100,000 ohm, 1/3 w. res.
RC-21501	R_4—1500 ohm. 1/3 w. res.
RC-22202	R_5, R_{10}—22,000 ohm, 1/3 w. res.
RC-22001	R_6—2000 ohm, 1/3 w. res.
RC-21001	R_7—1000 ohm, 1/3 w. res.
WP-10003	R_8—Line cord res.
RC-26802	R_{11}—68,000 ohm, 1/3 w. res.
RC-24703	R_{12}—470,000 ohm, 1/3 w. res.
RC-26801	R_{13}—6800 ohm, 1/3 w. res.
CC-1520	C_1, C_{14}—2 μμfd. ceramic cond.
CVP-10014	C_{2A}, C_{2B}—FM var. cond.
CC-15300	C_3, C_4—30 μμfd. ceramic cond.
CPP-12502	C_5—.005 μfd. paper cond.
CPP-12203	C_6—.02 μfd. paper cond.

Now...

New BATTERY OPERATED RCA VOLTOHMYST

you can use it anywhere!



Measures voltage resistance . . . and current

ABOUT THE HANDIEST METER in the service field! In one instrument, for one price, you get an electronic voltmeter, ohmmeter, and ammeter . . . *battery-operated* to make it completely independent of power-line sources.

Use it to test car radios, farm sets, railroad signal equipment, aircraft radio, industrial electronic devices . . . opens up hundreds of profitable new opportunities beyond the limits of power lines.

With it you can measure both a-c and d-c voltages to 1000 volts, resistance to 1000 megohms, and direct current to 10 amperes. A new low-cost, RCA crystal probe can be attached if you want to make v-h-f measurements.

Most important, this instrument is easy on batteries. They last up to 10 months in normal service. A neon pilot light flashes when the instrument is on . . . serves as a reminder to turn the instrument off when not in use.

Linearity and stability are excellent.

Here is one of the best buys in test equipment on the market today. We'll be glad to send you complete descriptive and price information on this time and money saver. See it at your RCA Test Equipment Distributor.

RADIO CORPORATION of AMERICA

TEST AND MEASURING EQUIPMENT **HARRISON, N. J.**

CPP-12103	C_7, C_8—.01 μfd. paper cond.
CPP-12102	C_9—.001 μfd. paper cond.
CLP-10007	C_{10A}, C_{10B}—30/50 μfd. elec. cond.
CPP-12522	C_{11}—.0025 μfd. paper cond.
CLP-10011	C_{12}—8 μfd. elec. cond.
CC-15501	C_{13}, C_{16}, C_{19}—500 μμfd. ceramic cond.
CC-15200	C_{15}—20 μμfd. ceramic cond.
CC-15500	C_{17}—50 μμfd. ceramic cond.
CC-15101	C_{18}—100 μμfd. ceramic cond.
CPP-12200	C_{20}—.2 μfd. paper cond.
TRFP-10009	L_1—FM ant. coil
TRCP-10010	L_2—FM osc. coil
TSP-10016	RF_1—Choke & T_1
LG-10002	RF_2—12 μh. choke
LF-10001	RF_3—Line cord inductor

CROSLEY MODELS 68TA, 68TW

Part No.	Code and Description
AW-137800	1—R.f. coil
AW-137724	2—Osc. coil
AC-137933	3—First i.f. trans.
AC-137934	4—Second i.f. trans.
AW-138546	5—Ant. loading coil
W-48858	6, 54—Type 47 dial bulb
C-132300-1	7—Cable and plug assembly
B-136597	9—Power trans.
B-136598	10—Output trans.
B-136595	11—1 megohm vol. control & sw.
C-138246	13—Speaker
39373-23	14—330 ohm, ½ w. res.
39373-60	15—22,000 ohm, ½ w. res.
39373-67	16—47,000 ohm, ½ w. res.
39373-84	17—330,000 ohm, ½ w. res.
39373-87	18—470,000 ohm, ½ w. res.
39373-92	19—1 megohm, ½ w. res.
39373-97	20—2.2 megohm, ½ w. res.
39373-107	21—10 megohm, ½ w. res.
39373-40	22—2200 ohm, ½ w. res.
39372-7	23—1500 ohm, 10 w. res.
39373-165	24—12,000 ohm, 1 w. res.
39373-62	25—27,000 ohm, ½ w. res.
39373-97	27, 28—2.2 megohm, ½ w. res.
39373-60	29—22,000 ohm, ½ w. res.
39001-11	32, 33—.005 μfd., 600 v. cond.
39001-13	34, 35—.01 μfd., 600 v. cond.
39001-17	36, 37, 39—.05 μfd., 600 v. cond.
39001-7	38, 41—.001 μfd., 600 v. cond.
39001-73	40—.00025 μfd., 600 v. cond.
39001-13	42—.01 μfd., 600 v. cond.
B-136596	44A, 44B—50/30 μfd., 300/300 v. elec. cond.
W-132267-1	45—Trimmer cond.
AB-138584	46—Terminal board
AC-138464	47—Loop ant. assembly
AC-138595-2	48A, 48B, 48C—Var. cond. assembly
C-137727-52	51—12 μμfd., 500 v. cond.
B-142857	52—2 megohm tone control
39373-67	53—47,000 ohm, ½ w. res.

ZENITH MODEL 8G005

Part No.	Code and Description
63-591	R_1—22,000 ohm, ¼ w. res.
63-271	R_2—1 megohm, ¼ w. res.
63-585	R_3—2200 ohm, ¼ w. res.
63-590	R_4—15,000 ohm, ¼ w. res.
63-600	R_5—2.2 megohm, ¼ w. res.
63-594	R_6—68,000 ohm, ¼ w. res.
63-654	R_7—180,000 ohm, ¼ w. res.
63-254	R_8—1500 ohm, ¼ w. res.
63-583	R_9—1000 ohm, ¼ w. res.
63-602	R_{10}—4.7 megohm, ¼ w. res.
63-1344	R_{11}—1 megohm vol. control
63-1093	R_{12}—15 megohm, ¼ w. res.
63-771	R_{13}—120,000 ohm, ¼ w. res.
63-1042	R_{14}—1 megohm, ¼ w. res.
63-238	R_{15}—1000 ohm, ¼ w. res.
63-592	R_{16}—33,000 ohm, ¼ w. res.
63-1226	R_{17}—1200 ohm, ½ w. res.
63-1361	R_{18}—88 ohm, 2 w. res.
63-1343 or 63-1359	R_{19}, R_{20}—970 ohm, 3 w. res.
22-1373	C_1—3-gang var. cond.
22-1425	C_2—Ant. wave trap trimmer
22-1329	C_3, C_4, C_5—31 meter and 25 meter short-wave ant. trimmer and wave booster
22-1415	C_6—7-70 μμfd. trimmer
22-1390	C_7—.0005 μfd., 600 v. cond.
22-1391	C_8—250 μμfd., 600 v. cond.
	C_9—Broadcast ant. trimmer (on C_1)
22-817	C_{10}—.05 μfd., 200 v. cond.
	C_{12}—Broadcast det. trimmer (on C_1)
22-1430	C_{13}—.05 μfd., 200 v. cond.
22-1392	C_{15}—25 μμfd., 500 v. cond.
22-1393	C_{16}—50 μμfd., 500 v. cond.
22-1394	C_{17}—56 μμfd., 500 v. cond.
	C_{19}—Broadcast osc. trimmer (on C_1)
22-813	C_{20}—.02 μfd., 200 v. cond.
22-820	C_{21}—.1 μfd., 200 v. cond.
22-147	C_{22}—.0005 μfd., 600 v. cond.
22-1063	C_{23}—.001 μfd., 600 v. cond.
22-811	C_{24}—.01 μfd., 600 v. cond.
22-953	C_{25}—.0002 μfd., 600 v. cond.
22-470	C_{26}—.00015 μfd.. 600 v. cond.
22-805	C_{27}—.004 μfd., 600 v. cond.
22-1437	C_{28}—.01 μfd., 200 v. cond.
22-818	C_{29}—.05 μfd., 400 v. cond.
22-1426	C_{30}, C_{31}, C_{32}—40/20/10 μfd., 150/150/150 v. elec. cond.
22-1234	C_{33}, C_{34}—200/40 μfd., 10/150 v. elec. cond.
85-225	S_1—Short-wave switch
85-335	S_2—Antenna switch
85-334	S_3—Band selector switch
85-332	S_4—Tone control switch
85-333	S_5—Changeover switch
95-912	T_1—First i.f. trans.
95-913	T_2—Second i.f. trans.
44-17	J_1—Phone jack
49-517	SP_1—5¼" dynamic speaker
S11212	L_1—18 mc. osc. coil
S11213	L_2—15 mc. osc. coil
S11214	L_3—12 mc. osc. coil
S11215	L_4—9 mc. osc. coil
S11216	L_5—6 mc. osc. coil
S11217	L_6—18 mc. det. coil
S11218	L_7—15 mc. det. coil
S11219	L_8—12 mc. det. coil
S11220	L_9—9 mc. det. coil
S11221	L_{10}—6 mc. det. coil
S11222	L_{11}—18 mc. ant. coil
S11223	L_{12}—15 mc. ant. coil
S11224	L_{13}—12 mc. ant. coil
S11225	L_{14}—9 mc. ant. coil
S11226	L_{15}—6 mc. ant. coil
S11246	L_{16}—Broadcast wavemagnet
S11821	L_{17}—Wave trap coil
S11562	L_{18}—Short-wave wavemagnet
S11591	L_{19}—Ant. loading coil
S11210	L_{20}—Detector coil
S11823	L_{21}—R.f. choke coil
S11822	L_{22}—R.f. choke coil
S11211	L_{23}—Broadcast osc. coil
	L_{24}—First i.f. trans. pri. trimmer (on T_1)
	L_{25}—First i.f. trans. sec. trimmer (on T_1)
	L_{26}—Second i.f. trans. pri. trimmer (on T_2)
	L_{27}—Second i.f. trans. sec. trimmer (on T_2)
S11952	L_{28}—R.f. choke
S11209	W_1—Battery cable

-30-

REFERRAL SERVICE

THE Associated Radio Service Men of N.Y., Inc. has recently instituted a new service for radio customers in the form of a referral service.

Persons seeking reliable and competent technicians for the servicing of AM, FM and television receivers may contact the central distribution office of the organization from which point calls are distributed to the nearest qualified member of the ARSNY.

This is the first time that New York City has had a central distribution agency of this type. The service is offerred to the public without charge and provides them with a guarantee of reliability and competence backed by the technical and ethical standards of the Associated Radio Service Men of New York.

Other cities might like to adopt such a setup for the benefit of the hundreds of persons who haven't already selected a regular radio service technician.

-30-

"No wonder it left scars on you Pa. The man says it isn't a heat pad a'tall!"

MONEY BACK GUARANTEE We believe units offered for sale by mail order should be sold only on a "Money-Back-If-Not-Satisfied" basis. We carefully check the design calibration and value of all items advertised by us and unhesitatingly offer all merchandise subject to a return for credit or refund. You, the customer, are the sole judge as to value of the item or items you have purchased.

The Model 88-A *COMBINATION*

SIGNAL GENERATOR AND SIGNAL TRACER

The ultimate in signal tracing procedure is achieved by the Model 88, for the use of this model, enables you to use either the broadcast signal itself or the signal injected by the Signal Generator. This is especially useful of course when servicing "dead" or "intermittent" receivers. The Model 88 you will find is the greatest time-saver ever provided for by combining a full range Signal Generator and Signal Tracer into one unit; the set up time for interconnecting, etc., is entirely eliminated.

Signal Generator Specifications:

- Frequency Range: 150 Kilocycles to 50 Megacycles.
- The R.F. Signal Frequency is kept completely constant at all output levels. This is accomplished by use of a special grid loaded circuit which provides a constant load on the oscillatory circuit. A grounded plate oscillator is used for additional frequency stability.
- Modulation is accomplished by Grid-blocking action which has proven to be equally effective for alignment of amplitude and frequency modulation as well as for television receivers.
- Positive action attenuator provides effective output control at all times.
- R.F. is obtainable separately or modulated by the Audio Frequency.

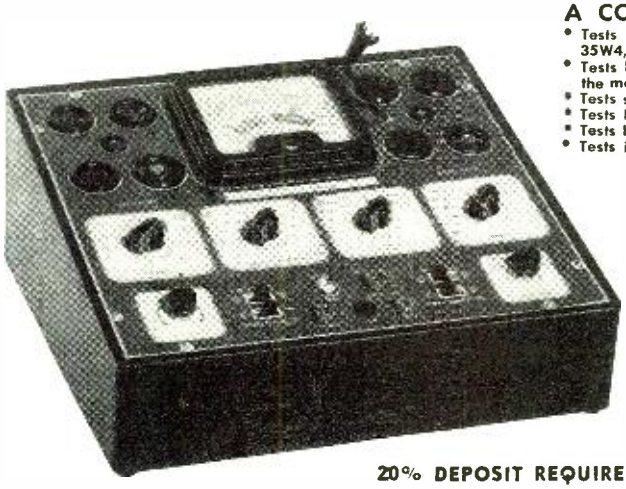
Signal Tracer Specifications:

- Uses the new Sylvania IN34 Germanium crystal Diode which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megacycles.
- Simple to operate—Clips directly on to receiver chassis, no tuning controls.
- Provision is made for insertion of phones of any impedance, a standard Volt-Ohm Milliammeter or Oscilloscope

The Model 88 comes complete with all test leads and operating instructions. Only.....

$28.85 NET

The New Model 60-T TUBE & SET TESTER



A COMPLETE TUBE TESTER

- Tests all tubes including the new post-war miniature loctals such as the 12AT6, 12AU6, 35W4, 50B5, 11723, etc.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests shorts and leakages up to 3 Megohms in all tubes.
- Tests leakages and shorts of any one element against all elements in all tubes.
- Tests both plates in rectifiers.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.

A COMPLETE MULTI-METER

- 6 D. C. Voltage Ranges: 0 to 7.5/15/75/150/750/1,500 Volts
- 6 A. C. Voltage Ranges: 0 to 15/30/150/300/1,500/3,000 Volts
- 4 D. C. Current Ranges: 0 to 1.5/15/150 Ma. 0 to 1.5 Amps.
- High Resistance Range: 0 to 20 Megohms
- 3 Decibel Ranges: —10 to +38 +10 o +38 +30 to + 58 D.B.
- 2 Medium Resistance Ranges: 0 to 20,000/200,000 Ohms
- Low Resistance Range: 0 to 2,000 Ohms (1st division is 1/10t. of an ohm)

Model 60-T operates on 90-120 Volts 60 Cycles A.C. Housed in sloping leatherette covered cabinet. Comes complete with test leads, tube charts and detailed operating nstructions.

$49.85 NET

Extra: We can now supply the Mode 60 housed in a beautiful hand-rubbed oak cabinet. Complete with portable cover making it suitable for either bench or outside use. Only $2.75 additional. Specify Model 60-C.

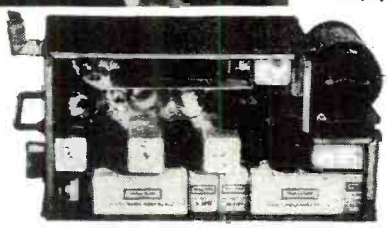
20% DEPOSIT REQUIRED ON ALL C. O. D. ORDERS

GENERAL ELECTRONIC DISTRIBUTING CO.

Dept. RN-4, 98 Park Place
New York 7, N. Y.

ESSE Specials!

Do not fail to closely examine this list of bargains. We believe that every item listed below is a sensational value. All equipment advertised herein is unconditionally guaranteed to the customer's satisfaction to this extent: Return any item advertised within five days after delivery for full refund except transportation charges (both ways).



BC-733D LOCALIZER RECEIVER

A part of aircraft blind landing equipment. Operates on any one of its 6 pre-determined crystal controlled frequencies in the range of 108-120 Mc. Contains 10 tubes—3 of which are W.E. 717-A's—and crystals. Ideal receiver for conversion to 144 Mc. ham band or mobile telephone bands. For 24 V. DC operation. Size, 14½x7x4⅝".

Price With Dynamotor **$5.95**

Price Without Dynamotor **$4.95**

ATTENTION, PROSPECTORS, MINERS, OIL COMPANIES, PLUMBERS, etc. Below is the finest metal detecting mine detector ever constructed . . .

SCR-625 MINE DETECTOR
Brand New

Metallic Objects Only

Used by the Army to detect buried metallic mines. Its private use suggests the location of underground or underwater pipes, cables and ore bearing rock, the location of metallic fragments in scrap materials, logs, etc. and the screening of personnel in plants for carrying of metallic objects.

The unit consists of a balanced inductance bridge, a two-tube amp. and a 1,000 cycle oscillator. The presence of metal disturbs the bridge balance, resulting in a volume change of the 1,000 cycle tone. The tubes used are low-battery drain types such as 1G6 and 1N5. The circuit may be modified for control of warning signals, stopping of machinery etc. when metal is detected. Operates from two flashlight batteries and 103 V. "B". However, a power supply operating from 110 V. may be used. Comes complete with spare tubes, spare resonator and instruction manual—in wooden chest 8¼"x 28¼"x16". Weight in operation is 15 lbs. New, complete in original overseas packing container. Originally sold by War Assets for $166.00.

The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

Price . . . . . **$79.50 ea.**

Batteries . . . . . $4.00 extra

AIRCRAFT RADIO RANGE FILTER FL-8-A

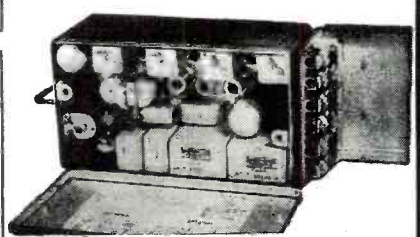
For helpful reduction of QRM on crowded CW bands. When attached to output of any communications receiver:

1—Will pass signal of 1020 CPS, eliminating others.

2—Will pass voice frequencies and eliminate 1020 CPS code signal.

Compact, light weight, with switch. Size 2¾"x2⅜"x3¾".

Price . . . . . **$2.25 ea.**



R-89/ARN 5A GLIDE PATH RECEIVER

Formerly used for blind landing but adaptable to many other uses such as receiver for new police or citizen's band. Band of operation 326-335 mc. on any of three predetermined crystal controlled frequencies. Contains eleven tubes, 6 relays and other valuable parts. For 24 V. DC operation. Size 13¾"x5¼"x6⅜".

Price, complete **$12.45**

SCR-274-N COMMAND SET
COMPONENTS - TRANSMITTERS and RECEIVERS FOR 10 METER RIG.

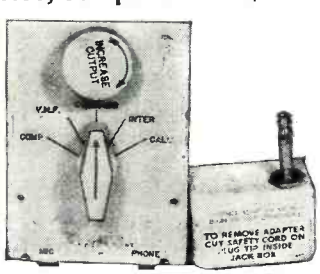
Refer to "CQ" magazine for May 1946 for conversion information of these units. This outfit can be made into a sensational amateur radio station. We are featuring and pricing the components separately so as that you may buy what you want instead of what you do not need.

TRANSMITTERS:

4-5.3 Mc.	$5.75
5.3-7 Mc.	$5.75
Modulator with Carbon Mike Input (with dynamotor)	$5.75
Tuning Control Box (gang of three)	$2.50
Antenna Unit with Relay 5000 V. 50 Mmfd. Condenser and Meter	$2.25
Remote Control Box with Switch and Volume Control	$1.50
Receiver Rack (set of three)	$1.50
Transmitter Rack (set of two)	$1.00

RECEIVERS:

3-6 Mc.	$5.75
6-9.1 Mc.	$5.75



JACK BOX BC-1366

Contains 2-pole 5-position switch, rheostat, two phone jacks, etc. In aluminum case 3¼"x4⅜"x2¼". Complete with headphone set adapter to match high to low impedance.

Price **$1.25**

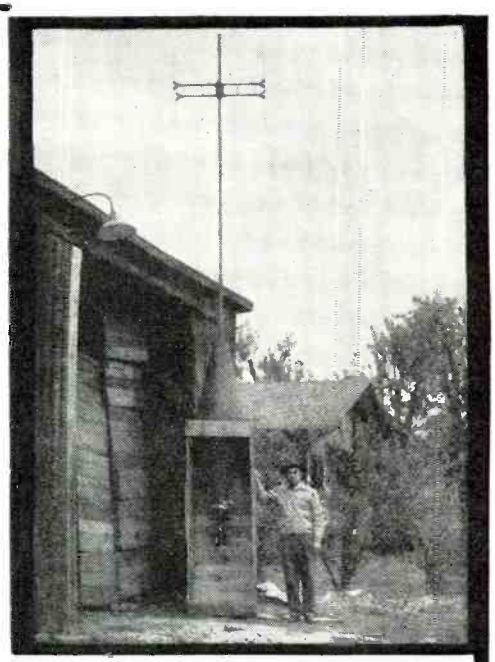
ANTENNA KIT 2A-264-126

Canvas bag containing 20 ceramic insulators each 3" long (1¼" dia. with screw-in type eyelets), covered wires each 5' long, 10' long, 35' long, 2 each 25' long, 5 each 20' long, 150' long, (all having ⅛" thimbles and 6" connecting leads at each end and all stranded copper covered with weather proof insulation.) Brand new. Original crates. Useful to any ham, serviceman, or experimenter. Each kit

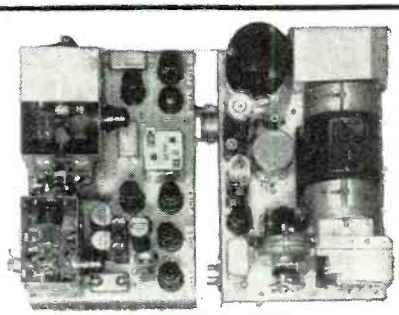
Special Price **$4.95**

2-METER BEAM ANTENNA

Portable or fixed, manually operated or can be used with beam motor, for use in 100-156 Mc. band. Easily adapted for ham or experimental use. Contains tuning unit which matches output of transmitter to antenna, 18' steel mast with brass tube containing co-ax cable and fittings inside steel mast (OD color), "H" frame for holding dipoles, 3 sets (4 per set) dipole rods, compensator or sense antenna for "H" frame, 2 steel truncated cones used as antenna support and feedthrough, 360 degrees bearing indicator, and handwheel for rotating. Brand new packed in six boxes, total weight approx. 600 lbs. Limited quantity and in much demand. Place order now

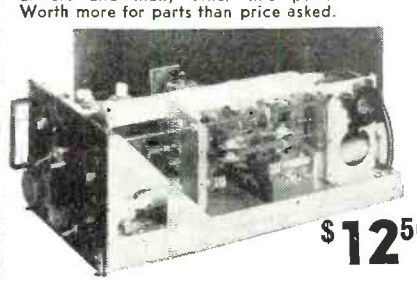


Special Price **$79.50**



BC-966-A IFF

Approximately 2 meter frequency operation. 14 tubes, 350 V DC dynamotor, 12 V. DC input. Contains voltage regulators and many other fine parts. Worth more for parts than price asked. **$4.75**



T-39/APQ-9 RADAR XMITTER

$12.50

Contains many excellent parts for the VHF experimenter such as a cavity oscillator using 2-RCA 8012 tubes rated at full output to 500 Mc. Tubes are forced air cooled by 24 V. DC motor, which is easily converted for 110 V. AC operation. Other valuable parts such as a pair of 807's, 2-6AC7, 1-931 and 1-6AG7 tubes; ceramic switch, potentiometers, gears, revolution counter, etc.

RADIO TUBES

We're overstocked—we're unloading

7C5	each—$.35
7F7	each— .35
7Y4	each— .35
CW-931	each— .35
30 (VT-67)	each— .35

(Hi-freq.-low-loss base)

6SN7	each— .35
VT127A	each—3.75
OZ4	each— .70
12A6	each— .35
1625	each— .35
1629	each— .35

All tubes checked before shipment.

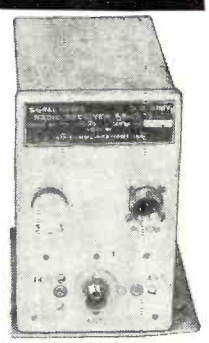
TURBO AMPLIFIER

Used for parts — shipped complete with the following tubes:

2 ..... 7C5's
1 ..... 7Y4
1 ..... 7F7

Price ..... $1.75 ea.

MARKER BEACON RECEIVER



Can be adapted to radio controlled devices. Was used by pilots to flash a signal lamp on aircraft instrument panel when in range of a beacon transmitter. Responds to modulated signals over a variable range of 62 to 80 Mc. Tube plates and filaments operate directly from 24 V. DC. Can be adapted for radio control of experimental apparatus, opening garage doors, etc. Circuit diagram and parts list included on either model shown below.

BC-357—Contains 12C8 and 12SQ7 tubes and sensitive relay (size 5⅜"x5¼"x3¼").

Price **$2.95**

BC-1033—Contains 6SH7, 6SL7 and 12SN7 tubes, sensitive relay (size 5⅜"x5¼"x3¼").

Price **$3.50**

CO-AXIAL CABLE VALUES THAT WE CAN ONLY OFFER TO CUSTOMERS WHO BUY A MINIMUM OF 100 FOOT PER TYPE.

RG-8/U Cable, 52 ohms impedance (unmarked) ..... $2.95 per 100 ft.
RG-8/U Cable, 52 ohms impedance (marked) ..... $3.95 per 100 ft.
RG-29/UCO-AXIAL, 53.5 ohms impedance (marked) ..... $3.95 per 100 ft.
RG-21/U Cable, 53 ohms impedance (unmarked) ..... $3.95 per 100 ft.

ESSE Radio Co

130 W. New York St.
Indianapolis 4, Ind.

Unless Otherwise Stated, All of This Equipment Is Sold As Used
CASH REQUIRED WITH ALL ORDERS
Orders Shipped F.O.B. Collect

Technical BOOKS

"RADIO RECEIVER TUBE PLACEMENT GUIDE" compiled and published by *Howard W. Sams & Co., Inc.*, Indianapolis. 192 pages. Price $1.25.

This newest member of the "Photo-Fact" family is designed to assist the radio serviceman by cutting servicing time usually required in replacing tubes.

The book shows exactly where to replace tubes in more than 4500 receivers covering models for the years 1938 to 1947. A handy index locates the set and then refers the the technician to the correct diagram covering that particular receiver. 1880 diagrams are included in this 192 page booklet which comes in handy tube manual size.

By using this manual the serviceman should be able to eliminate the time-consuming task of replacing tubes, as well as the hazards of burnouts if hit-and-miss methods of replacement are employed.

* * *

"MOST-OFTEN-NEEDED F. M. AND TELEVISION SERVICING INFORMATION" by M. N. Beitman. Published by *Supreme Publications*, Chicago. 192 pages. Price $2.00.

With the growing popularity of FM and television, many radiomen are faced with the problem of servicing these rather complex receivers without adquate preparation to handle this type of business.

This latest servicing book from *Supreme Publications* covers around forty of the popular 1947-1948 FM and television receivers of twenty-four different manufacturers.

The notes covering each set include a complete schematic diagram, dial stringing data, parts lists, special alignment data, information on any features of the receiver which might require specialized servicing techniques, and other pertinent data as it applies to the set in question.

Pictorial diagrams have been included on several of the sets. Diagrams accompanying text material are clear and complete.

This book should find a permanent place on many service benches in the coming months as new areas are opened to FM and television reception.

* * *

"ELEMENTS OF RADIO" by A. Marcus and William Markus. Published by *Prentice-Hall, Inc.*, New York. 738 pages. Price $4.25. Second Edition.

The second and revised edition of this popular home-study course in basic radio has been enlarged to include a new section on radar and television in addition to a special chapter covering modern radio receivers.

As was the case with the first edition, the new book is divided into two parts, the first section dealing with basic radio while the second section

covers the more advanced theory, antennas, transmitters, etc.

In planning this text the authors have not presupposed any previous knowledge of mathematics or physics. Three short chapters are devoted to a brief discussion of the history of communication, wave motion, and waves in ether. The student is then introduced to a simple radio receiving set. From the crystal unit the student then takes up the elements of tuning, detection, and reproduction. From this point he covers, in easy stages, the various refinements in equipment until the modern superheterodyne is discussed.

Each chapter includes a summary of the material presented, a glossary of the terms used in the text, and a series of questions and problems covering the subject matter. This type of pedagogy, plus many detailed drawings and experiments, makes this book ideally suited for the person interested in studying radio at home. The beginner should have no difficulty in grasping the subject as the book is clearly written and familiar analogies are used throughout.

* * *

"UNDERSTANDING VECTORS AND PHASE" by John F. Rider and Seymour D. Uslano. Published by *John F. Rider Publisher, Inc.*, New York. 160 pages. Price $0.99 paper cover.

This new book has been written as an aid to understanding new technical developments in the radio and electronic field. The text is prepared especially for the radioman without technical training, electronic engineering students, and servicemen. A minimum of mathematics has been used in presenting the material, thus any person with a simple knowledge of electronics should have no difficulty in grasping the subject.

Since more and more technical publications use vectorial representation in discussing radio and electronic circuits a working knowledge of this method of presentation is worthwhile for those in the industry.

The book is clearly written and diagrams have been used freely to illustrate the points under discussion. The book is recommended for home study.

* * *

"THE SELF ADVANCEMENT GUIDE FOR APPLIED PRACTICAL ELECTRICITY" by Coyne Staff. Published by *Coyne Electrical School,* Chicago. 47 pages.

In order to extend the benefits of technical training to those unable to study in residence, the *Coyne Staff* has prepared this first of a series of self-advancement guides which are designed to be used in conjunction with the school's courses.

This book is for use with the school's "Applied Practical Electricity" course and contains a series of twenty questions covering each section of approximately thirty pages in the corresponding volumes of the course. These "self-check" tests are divided into true and false and multiple choice questions.

Persons already owning the school's "Applied Practical Electricity" course should contact the school with regards to obtaining their copy of the guide, those buying courses in the future will be supplied copies of the guide along with the course.

* * *

"PRACTICAL AMPLIFIER DIAGRAMS" by Jack Robin and Chester E. Lipman. Published by *Os-tronic Publications.* Los Angeles. 55 pages. Price $2.00.

This book is a practical text containing forty-five circuits covering from one to eleven-tube amplifiers with phase inversion, inverse feedback, bass boost, treble boost, compression and expansion recording amplifiers, multichannel amplifiers, preamplifiers, portable p.a. amplifiers, etc.

Available outputs cover the range from 1 watt to 75 watt units with a.c.-d.c. models described, in addition to several a.c.-battery units.

One section of the book has been devoted to a discussion of servicing amplifiers and troubleshooting techniques.

The book is presented with a spiral binding which will prove a boon to those building the equipment from the schematics in the book.

—30—

NOW! BUILD 15 RADIOS $14.75

COMPLETE KIT ONLY...

ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY
YOU NEED NO ADDITIONAL PARTS

THE PROGRESSIVE RADIO KIT is the ONLY COMPLETE KIT. Operates on 110-120 volts AC/DC. Contains everything you need. Instruction Book, Metal Chassis, Tubes, Condensers, Resistors and all other necessary radio parts. The 36-page Instruction Book written by expert radio instructors and engineers teaches you to build radios in a professional manner. The first circuit built is a simple one-tube detector receiver. Each succeeding circuit incorporates new arrangements of detectors, RF and AF amplifiers. This kit is excellent for learning the principles of receiver, transmitter and amplifier design. It is used in many radio schools and colleges. All of the commonly used detectors are used, including diode, grid leak, plate and infinite-impedance. The transmitters are designed with Hartley and Armstrong oscillators, using screen-grid and control-grid modulation. Both vacuum tube and selenium rectification are employed in these circuits. The circuits are designed to provide excellent performance. Altogether, fifteen circuits are constructed, including 11 receivers, 1 audio amplifier, and 3 transmitters. The sets start with simple circuits of 1 tube plus rectifier, gradually grow more complex, and finish with several examples of radio sets using three tubes plus rectifier.

Progressive Radio Kit, only.... $14.75

SPECIAL FREE OFFER!

Electrical and Radio Tester sent absolutely FREE with each Progressive Radio Kit. PLUS FREE membership in Progressive Radio Club. Entitles you to free expert advice and consultation service with licensed radio technicians. Write for further information or ORDER your KIT NOW!

PROGRESSIVE SCOOPS!

4 TUBE TRF MIDGET RECEIVER

Regular Price $12.75

7½"x5¼"x4¼" Wt. only 2¾ lbs. Beautiful Suede finish Cabinet (assorted colors). Uses miniature tubes 12 BA6, 12 AT6, 50 B5, 35 W4. 4" Alnico V Speaker.

Price, only..... $11.75

ESPEY CUSTOM-BUILT AM-FM HIGH FIDELITY RECEIVERS
Model No. 7-B

11 Tube AC Superheterodyne AM-FM Receiver. Folded dipole antenna for FM supplied. Wired for phonograph operation. Requires nothing but a cabinet. Ideal for custom builders.

(LIST PRICE $140.00)

Your Price..... $82.50
$25.00 dep. required with c.o.d. orders.

FM COIL & CONDENSER KIT

Designed for operation on 88-108 MC (new band) contain 2 IF transformers, 1 Limiter Transformer, 1 Discriminator Transformer, 1 RF coil, 1 Variable condenser, Schematic and wiring instructions. Excellent for Schools, Experimenters and Radio Hobbyists.

Price, only..... $4.95

40-40 MFD. 150 W.V. DC ELECTROLYTIC CONDENSERS..... 45c

ANTENNA and RF COIL SET..... 59c
(Broadcast Band)

25000 OHM Wire Wound Pot ¼" Shaft 35c

Long Nose Pliers and Cutters $1.45

75 Watt Soldering Iron..... $2.40
(UL approved)

6" Alnico Slug Speaker..... $1.69

10-10 MFD. 450 W.V. DC Electrolytic Condensers..... 65c

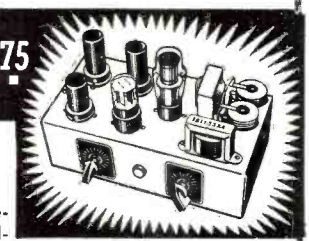
20-20 MFD. 150 W.V. DC Electrolytic Condensers..... 30c

12" Alnico Slug Speaker..... $5.60

Selenium Rectifiers..... 79c

55 Watt Soldering Iron..... $1.90
(UL approved)

PROGRESSIVE AMPLIFIER KIT $15.75



HIGH FIDELITY, HUMLESS AMPLIFIER
SEVEN TUBE PERFORMANCE

This newest Progressive Kit will enable you to build a newly designed, high fidelity, humless amplifier.

Beautiful aluminum custom-punched chassis, etched tone and volume control plates.

Designed by former Western Electric engineer.

Ideal amplifier for television kit or set, FM tuner, AM tuner, microphone, phonograph, wire and instantaneous recorders.

Electrify your musical instruments by connecting them to the Progressive Amplifier by means of a contact mike.

Amplifier can be readily modified to match the GE reluctance pick-up.

Separate mike and phono input. Regulated power supply maintains constant voltage supply. DC heater supply, whether amplifier is used on AC or DC, provides humless operation by eliminating cathode-heater leakage hum. Contains degenerative feedback for improved frequency response, balanced phase inversion and push-pull beam power output. Every stage thoroughly decoupled to improve low-frequency response and to prevent motor boating. Tone and volume controls completely variable.

Seven-tube performance. Uses 2 selenium rectifiers, 2-beam power amplifiers, 1 high-mu pentode mike amplifier, 1 twin-triode phase inverter, and 1 voltage regulator tube.

PROGRESSIVE AMPLIFIER KIT (less Tubes and Speaker) **Only.... $15.75**

TUBES for Progressive Amplifier Kit
1-12SL7, 1-12SJ7, 1-VR75, 2-12A6's Complete Set, Only..... **$3.00**

BUILD A 5 TUBE AMPLIFIER *Only*....$9.75

Ideal for phonograph, FM tuner or microphone. Has 5 tubes including rectifier. Kit is complete with tubes, chassis, volume control, tone control, radio parts, hook-up wire, solder and instructions. We can provide a 4-inch PM Speaker with mounted output transformer to fit on chassis, priced at $1.95. Or use this kit with your own Speaker. It has 5 watts output, more than enough to drive a 12-inch Speaker. **ONLY..... $9.75**

CONDENSER KIT
50 PAPER TUBULAR CONDENSERS
Values from .002 mfd. to .1 mfd. 400 V. DC to 600 V. DC, Only..... **$1.95**

RESISTOR KIT
100 CARBON RESISTORS
½ Watt, RMA color-coded. Values from 120 ohms to 2.2 megohms..... **$1.50**

PROGRESSIVE RADIO TOOL KIT
Contains 75 Watt 110/120 Volt Soldering Iron, long nose pliers and cutters, screwdriver, insulated alignment tool..... **$3.25**

MIDGET SOLDERING IRON
35 WATTS
110/120 Volts, UL approved..... **69c**

WRITE FOR PROGRESSIVE QUANTITY PRICES

PROGRESSIVE ELECTRONICS CO.

DEPT. RN-8 497 UNION AVENUE
BROOKLYN 11, NEW YORK

RADIOMEN'S HEADQUARTERS ✱✱ WORLD WIDE MAIL ORDER SERVICE!!!

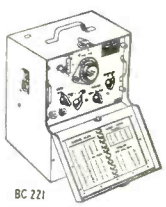
DUE TO POPULAR DEMAND WE REPEAT THESE TERRIFIC BARGAINS

Three assorted new **MICROPHONES**, including push-to-talk type $1.49
Ten assorted **R. F. Chokes** including high frequency types ..... $ .35
Five assorted **AUDIO or FILTER CHOKES** ..... $ .99
One hundred assorted **RESISTORS** $1.95
Ten assorted **JAN CABLE CONNECTORS**, including SCR2T4, 522 and BC 375 types ..... $ .99
Six assorted **OIL FILLED CAN TYPE CONDENSERS**, all with mounting brackets $1.49
Ten assorted **METAL & BAKELITE KNOBS**—(no wooden knobs) ..... $ 39
Six assorted **VARIABLE CONDENSERS**, including butterfly types $1.49
Six assorted **POWER and AUDIO TRANSFORMERS**, all new $1.98
Six assorted isolantite and bakelite **R. F. COILS**, shielded and unshielded ..... $ .99

The above ten assortments totaling over $12.00 at the unbelievable bargain prices listed can be purchased together as one lot at a super-special total price of only $10.00. All merchandise guaranteed to be as advertised

Aluminum gear box 18x8x7 that contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from ½ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar usage **$3.00**

BRAND NEW 110 V AC INPUT POWER SUPPLY, in grey enameled shock-mounted case 9" x 10" x 16". Several heavy duty resistors, 3 chokes, 4-1000 V and 600 V oil-filled condensers, 1 relay, 2-5U4's, 3 voltage regulator tubes, safety interlock, and several fuses are included in this regulated power supply at the bargain price of **$9.95**



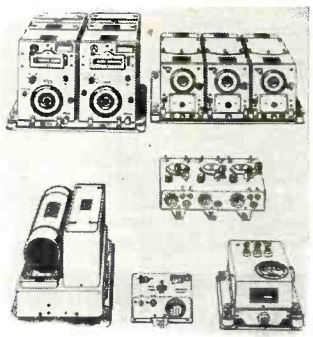
BC-221 FREQUENCY METERS with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only **$36.95.**

100 KC crystal calibrator kit containing everything that is necessary to construct a 100 KC osc. that will supply 100 KC marker points to your receiver so that it may be used for frequency determination. The 100 KC crystal is worth far more than the price that we are asking for the complete kit.

Kit 100K Plate and fil voltage supplied by receiver **$9.95**

Kit 100KA Same as above, including 110 VAC or DC self-contained power supply... **$12.95**

RT1463 7 tube amplifiers containing 3—7F7, 1—7Y4, 3—7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing stepless control proportional to correction required for ailerons, rudder and elevator, in the original application. A control amplifier of the ordinary type would deflect the rudder by some arbitrary amount when the ship was blown off the course to port or starboard. The result would either be that the correction was insufficient and the plane continued off course, or the correction would be too great, starting a series of tackings and would greatly increase fuel consumption and elapsed time in reaching the objective. This phenomenal unit, with its 3 amplifiers and six 5000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9"x7"x8" black crackle aluminum case. Brand new in original carton. **$9.95.**



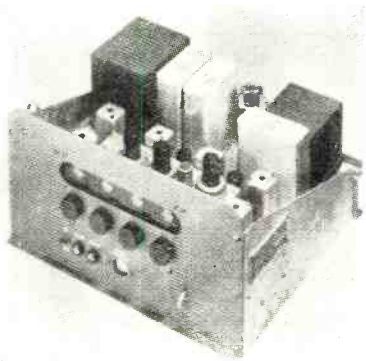
SCR-274N COMMAND SET

The greatest radio equipment value in history

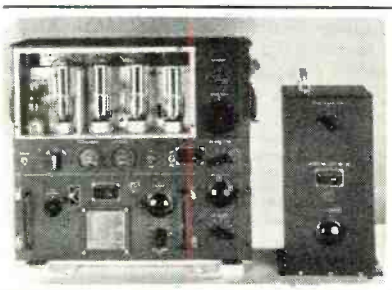
A mountain of valuable equipment that includes 3 receivers covering 190 to 550 KC; 3 to 6 MC; and 6 to 9.1 MC. These receivers use plug-in coils, and consequently can be changed to any frequencies desired without conversion. Also included are two Tuning Control Boxes; 1 Antenna Coupling Box; four 28 V. Dynamotors (easily converted to 110 V operation); two 40-Watt Transmitters including crystals, and Preamplifier and Modulator. 29 tubes supplied in all. Only a limited quantity available, so get your order in fast. Removed from unused aircraft and in guaranteed electrical condition. A super value at **$29.95,** including crank type tuning knobs for receivers. Without these knobs the receivers can't be tuned, and are only useful for parts. Don't buy without knobs!

RECORDING AMPLIFIER. 3 stage, 110 V, 25 or 60 cycle high gain amplifier built by recently bankrupt manufacturer specifically for recording use. Transformer for low impedance wire recorder head or magnetic cutter included on chassis. Tone and volume controls and switches on chassis for playback, recording or use as public address amplifier. Complete with tubes—**$9.95.**

14-Tube UHF Superhet Receiver — $39.95



This beautifully constructed receiver was designed especially for Signal Corps communication service, and is one of the finest and most sensitive sets ever manufactured. Operating from 110V 60 cycles, this set has two tuned RF stages, tuned converter and oscillator, five I.F. stages, using iron-core IF's, a diode detector, tuning eye, and a two stage amplifier that will drive a speaker or phones. The frequency range is 158-210 Mcs. It is a simple matter to operate on other bands by making a slight alteration in the tuning coils. A complete set of tubes is included with each receiver, along with a circuit diagram and parts list. The high-voltage power supply delivers 150 milliamperes, and is well filtered by a heavy-duty choke and three 7 Mfd. oil-filled condensers. This buy of a lifetime cost the government about $700. Amateurs and experimenters will never again be able to purchase fine equipment at such a tremendous saving! **See January Radio Craft, Page 57, for complete conversion to television receiver.**



GENERAL ELECTRIC 150 WATT TRANSMITTER

Cost the Government $1800.00
Cost to you $44.50!!!!

This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-in tuning units which are included. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: FREQUENCY RANGE: 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter band with slight modification.) OSCILLATOR: Self-excited, thermo compensated, and hand calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with dynamotor which furnishes 1000V at 350 MA. Complete instructions are furnished to operate set from 110V AC. SIZE: 21½x23x9¼ inches. Total shipping weight 200 lbs., complete with all tubes, dynamotor power supply, five tuning units, antenna tuning unit and the essential plugs. These units have been removed from unused aircraft but are guaranteed to be in perfect condition.

BRAND NEW INVERTERS AND DYNAMOTORS

PE 6A: A 24 to 32 V DC input, to 80 V AC regulated output converter—**$12.95.**
PE 19A: A 24 to 28 V DC input, to 80 V AC at 800 cps output—**$9.95.**
(We include a stepup transformer with each of the above so that 110 VAC is available from either.)
27 V DC input 285 V DC @ 75 MA output—**98c.**
27 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp—**$5.95.**
12 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp—**$12.00.**
13 or 26 V DC input. Output 800 V DC, 400 V DC @ 135 MA, and 9 V AC—**$15.00.**
(By running on 6 V AC, 60 cycle input, with a small amount of DC for field excitation, the above dynamotor will provide a good source of 12, 24, 400 or 800 V DC.)

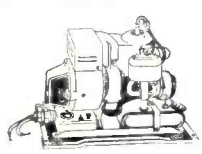
GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as IF's, with 4 slug-tuned 40 Mc. IF transformers, plus a 7H7, 7E6's and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice in AM or FM transmission or reception, for use as a mobile public address system, as on 80 to 110 Mc. FM broadcast receiver, as a Facsimile transmitter or receiver, as an amateur television transmitter or receiver, for remote control relay hookups, for Geiger-Mueller counter applications. It sells for only **$29.95** or two for **$53.90.** If desired for marine or mobile use, the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only $15.00 additional.

SCR-284 TRANSMITTER-RECEIVER—This medium power transmitter and the accompanying 7-tube very sensitive receiver are naturals for 80 or 40 meter operation (phone or CW), on either fixed stations or mobile applications. These units are brand new and come complete with 17 tubes, key, microphone, 200 KC calibrating crystal and instructions and diagrams for use with up to 100 watts input to the final stage on 40 or 80 meters for either phone or CW, using vehicle or 110 Volt power supply. Your cost..... $39.95

PE-109 32-VOLT DIRECT CURRENT POWER PLANT

This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32V DC for operation. **The price of this power plant is only $58.95.** We can also supply a converter that will supply 110V AC from the above unit or from any 16-32V DC source for **$12.95.**



Minimum order $3.00—All prices subject to change—25% deposit with COD orders.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 4-N BUFFALO 3, N. Y.

RADIOMEN'S HEADQUARTERS ✻✻ WORLD WIDE MAIL ORDER SERVICE!!!

BUFRAD CAR RADIO ANTENNAS

All of our car radio antennas are made of triple plated Admiralty Brass Tubing, complete with low loss shielded antenna leads and high quality fittings.

SIDE COWL—BR-1, 3 sections extend to 66". Your price—single units—**$1.50**; in lots of 12—**$1.35** ea.

SKYSCRAPER—BR-2 has 4 heavy duty sections that extend to 98". Your price—single units—**$2.45**; in lots of 12—**$2.25** ea.

TILT ANGLE—BR-3, may be adjusted to all body contours. 3 sections extend to 66". Single unit price—**$1.50**; 12 lot price—**$1.25** ea.

VERSATILE—BR-4, single hole fender or top cowl mounting may be adjusted to conform with all body contours. 4 sections extend to 56" Single unit price—**$2.90**; 12 lot price—**$2.75** ea.

THE MONARCH—BR-5, single hole top cowl mounting, 3 sections extend to 56". Single unit price—**$1.90**; 12 lot price—**$1.75** ea.

BR1 BR2 BR3 BR4 BR5

BENDIX SCR 522—Very High Frequency Voice Transmitter-Receiver—100 to 156 MC. This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each set cost the Gov't $2500.00. Crystal Controlled and Amplitude Modulated—HIGH TRANSMITTER OUTPUT and 3 Microvolt Receiver Sensitivity gave good communication up to 180 miles at high altitudes. Receiver has ten tubes and transmitter has seven tubes, including two 832's. Furnished complete with 17 tubes, remote control unit, 4 crystals and the special wide band VHF antenna that was designed for this set. These sets have been removed from unused aircraft and are guaranteed to be in perfect condition. We include free parts and diagrams for the conversion to "continuously variable frequency coverage" in the receiver.

The SCR 522 complete with 24 volt dynamotor sells for only $37.95. The SCR 522 is also available with a brand new 12 volt dynamotor for only $42.95.

SPEAKERS—These PM speakers are the finest that are available. All have heavy oversize Alnico V magnets.

3½"	$1.15	6 for	$ 6.60
4"	$1.15	6 for	$ 6.60
5"	$1.10	10 for	$ 9.50
6"	$1.50	6 for	$ 8.70
7" (Car Radio Size)	$4.50	6 for	$21.50
8" 10 oz.	$3.95	6 for	$20.50
8" 21 oz.	$4.95	6 for	$26.50
10" 21 oz.	$5.50	6 for	$30.00
12" 21 oz.	$7.95	6 for	$42.00

AUTO RADIO DEALERS! ATTENTION!

Nationally advertised brand of 1948 car radio which will fit practically any car and every pocketbook. Six tube super with three gang condenser and 6½" speaker. **$32.20 for sample, or Dealer price $29.97 each, in lots of two or more.**

Here is an item that no serviceman who repairs auto radios should be without. Nationally advertised ATR battery eliminator that supplies perfectly filtered 12 VDC or 6 VDC at 14 amps. from 110 AC.....**$36.00**

CLOSING OUT

THE FOLLOWING DESIRABLE ITEMS AT SACRIFICE PRICES TO MAKE ROOM IN OUR WAREHOUSE FOR INCOMING STOCK

LORAN INDICATOR OSCILLOSCOPE complete with 26 tubes in a five inch Cathode Ray Tube. Greatly superior to other scopes because the multivibrator circuit Inc. can be used to present two traces simultaneously on screen. This input and output of and amplifier stage can be viewed at same time on screen distortion is indicated conclusively by difference between input and output traces while fidelity is made evident by identical traces. Government instruction manual included. $39.95.

947A ONE KILOWATT HIGH FREQUENCY TRANSMITTER. This relay-controlled transmitter includes a 115 V, 60 cycle power supply protected by 3 magnetic circuit breakers, that alone is worth more than the price we are asking for the whole rig, even on today's surplus market. On the front panel are six 3½" GE or Weston meters, including 250 MA. 50 MA. 1000 MA, 150 V AC and 1500 V DC at 1000 ohms per volt for screens and plate. The rack-type 21" x 15" x 36" unit contains six amplifier and rectifier tubes aggregating over $60.00 at WAA current wholesale prices. Western Electric's price to the government was $1500.00. Shipping weight 400 lbs. Your **cost at closeout price as is. Formerly $69.95, now only.....$39.95**

RADIO SERVICEMEN!! Buffalo Radio Supply's lower prices mean increased profits for you. Order all of your needs from us and receive in return courteous service and first class merchandise at the lowest prices in the country.

TUBES: all types in stock, 60% off on all tube if ordered in lots of 10 or more.

TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS**; Steps up 110v to 220v, or steps down 220v to 110v—$1.95. **FIL. TRANS.**; 6.3v, 8 Amps.—**$1.98**; 5v, 10 Amps.—**$1.98**; Universal Output Trans. 8 Watt—**89c**; 18 Watt—**$1.29**; 30 Watt **$1.69. AUDIO TRANSFORMERS**: S. Plate to S. Grid. 3:1—**79c**; S. Plate to P.P. Grids—79c; Heavy Duty Class AB or B. P.P. inputs—$1.49; Midget Output for AC-DC sets—69c; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC ouncer type—**$2.00**. Stancor SB or DB mike to line or grid—**$1.95.**

POWER TRANSFORMERS—Half-shell type. 110V, 60 cy. Centertapped HV winding. Specify either 2.5 or 6.3V filament when ordering.

For 4-5 tube sets—650V, 40MA, 5V & 2.5 or 6.3V	$1.49
For 5-6 tube sets—650V, 45MA, 5V & 2.5 or 6.3V	1.75
For 6-7 tube sets—675V, 50MA, 5V & 2.5 or 6.3V	1.90
For 7-8 tube sets—700V, 70MA, 5V & 6.3 or two 2.5V	2.35
For 8-9 tube sets—700V-90MA, 5V-3A, 2.5V-3.5A, 2.5V-10.5A	2.85
For 9-11 tube sets—700V, 100MA, 5V & 6.3V-4A	2.85
For 9-15 tube sets—600V, 150MA, 5V & 6.3V	2.95

CONDENSERS—PAPER TUBULAR 600 WV—.001, .002, .005—8c; .01, .05—9c; .1—10c; .25—23c; .5—36c; **ELECTROLYTICS**: 8mfd 200v—20c; 10mfd 35v—20c; 30mfd 150v—23c; 20/20mfd 150v—35c; 30/20 150v—46c; 50mfd 150v—43c; 8mfd 475v—34c; 16mfd 350v—65c; **OIL CONDENSERS**: 4mfd 600v—49c; 2mfd. 600v—29c; 3X 1mfd. 600v—29c.

FILTER CHOKES: 200, 300, 400, 500 ohm light duty—59c; 200 or 300 ohm heavy duty—99c; 250 ma 35 ohm, made for U.S. Navy, fully shielded—$1.95; 75 ohm 125 ma—25c or 25 for $4.25; "Meisner type" tapped filter chokes—25c; 8 amp. iron core A filter—25c; Choke-condenser combination, ideal to replace any size speaker field when installing PM speakers—79c.

110 V. CIRCUIT BREAKERS of Magnetic type: Following Current Ratings in Stock; 1.25, 3, 4, 8 Amps. Please specify. **$1.95 each.**

Seven Assorted I.F. Transformers—**$1.98**; Five Asstd. Oscillator Coils—69c.

SELENIUM RECTIFIERS—Dry disc type 1½" by 1" 1.2 Amp. maximum, suitable for converting DC relays to AC. for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—90c.

METER RECTIFIERS—Full wave, may be used for replacement, or in construction of all types of test equipment—**$1.25.** Half Wave—**90c.**

MICROPHONES — All nationally known brands. Bullet Crystal—$5.45; Bullet Dynamic—$7.45; Mike Jr.—60c; Handy Mike—90c; Lapel Mike—93c; SHURE T-17 MIKES, with push to talk switch—99c.

20 ASST'D COIL FORMS, including 11 ceramic, 3 polystyrene, and 6 fiber, all useful sizes—50c.

VARIABLE CONDENSERS: 350 MMFD, 5 gang—$1.95; 4 gang—$1.49; 3 gang—83c; 7.5 to 20 MMFD. 1750v spacing, extra long shaft Hammarlund—69c; miniature variables 25 MMFD—39c; 50 MMFD—49c; 75 MMFD—59c; 100 MMFD—69c; 140 MMFD—79c.

INTERRUPTION FREQUENCY COILS for super-regenerative receivers or the tremendously popular FM adapters for standard broadcast sets. Iron core with a resonant frequency of 50 KC—39c; Air Core, 100 KC—29c.

30 MC IF TRANSFORMERS, double slug tuned—25c.

30 MC (VIDEO) AMPLIFIER PLATE COILS—Slug tuned—25c.

REMOTE CONTROL UNIT: Aluminum case 4x3x2" containing 2 potentiometers, triple pole switch, 4 knobs, gear mechanism, counter and phone jacks—59c.

MODULATION TRANSFORMERS—30-watt, open-type, $1.95; 40 watt, cast aluminum case, $2.95; Class "B" input transformers, cast aluminum case, $1.95; Transceiver audio transformers, 65c; Transceiver modulation transformers, 65c. Miniature pliers set contains one of each of the following: Needle nose, flat nose, parrot nose, standard nose. All contained in a leatherette case. Your cost—$1.98.

SOCKET WRENCH SET consisting of 5 sockets ranging in size from 5/16 to ½" and a handle—79c.

RT-1579 consists of a three stage (cascade 6SJ7s and 6F6 output stage) high gain, high fidelity amplifier with 60 cycle. 110V power supply on the same 13½x14½ chassis, which is protected by a substantial steel cover over tubes and parts. Made by Western Electric with typical quality components such as a husky power transformer and oil condensers, this unit is obviously intended to give years of trouble-free service with no more need for repairs than a telephone. Disconnecting one wire each, from the special input and output filters, will result in as high a fidelity amplifier as can be obtained. Your cost with tubes, diagram and parts list included—$14.95.

We also offer the **RT-1579** with a Raytheon Magnetic Voltage Regulator already installed beneath the cover. Imagine an amplifier complete with tubes, built to Western Electric quality standards, and immune to line voltage variations besides, making it perfectly suited for the most difficult industrial, circus, carnival, or commercial installations, offered for a total price of only **$19.95**, our price for both units.

AT LAST YOU CAN AFFORD A LABORATORY STANDARD MICRO VOLTER

The famous Measurements Corp. Model 78B, 5 Tube Laboratory Standard Signal Generator (that sold new, FOB Boonton, N. J., for $310.00 net), is available in perfect condition for 25 to 60 cycle, 115 V AC operation. Until now this is the sort of top-flight lab equipment that discriminating buyers have only vainly hoped would be released at a bargain price. Worth every cent the manufacturer asks but available FOB Buffalo while our limited supply lasts for only **$79.95.**

Such companies as Admiral Corp. and John Meck, Inc., have ordered from us and repeated many times on these 78 generators for use in their labs and production line testing.

"REMEMBER THAT A STANDARD IS ONLY AS RELIABLE AS ITS MAKER."

$9.95 TAKES ALL THREE BIG BARGAINS

1. AUDIO AMPLIFIER Undreamed of value. Uses 6V6's. Has 4 microphone inputs brought to jacks at rear panel. Various output impedances available at rear panel connections. Steel case with chrome handles. 9" long x 9" high x 6" deep. Tubes included. New in original carton. Shipping weight 20 lbs. **SUPER SPECIAL—$4.95** while supply lasts.

2. RADIO HEADSETS Latest supersensitive type with rubber earpieces. Every pair guaranteed perfect. **$.59 per pair OR 3 PAIRS FOR $1.00.**

3. HOME WORKSHOP AT BARGAIN PRICE

Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service, supplied with 56" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

NO C. O. D.'s—ORDER NOW—DON'T DELAY

Cable Address: BUFRAD

Minimum order $3.00—All prices subject to change—25% deposit with C.O.D. orders

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 4N, BUFFALO 3, N. Y.
CABLE ADDRESS BUFRAD

522 Transmitter

(*Continued from page* 50)

the control shafts, plug in a crystal, and push home the appropriate slider. For ten meters the crystal frequency should be between 7.0 and 7.425 megacycles, or 14.0 and 14.85 megacycles (either works well). Set the oscillator tuning condenser to approximately 130 megacycles on the scale. Turn the meter switch to position five (amplifier grid current). Apply power, and tune the 12A6 tuning condenser for maximum meter deflection. Remove power and turn meter switch to position three (power amplifier plate current), apply power again and tune the final amplifier condenser for a sharp dip in the plate current. Connect the antenna and adjust the link to draw 60 to 70 milliamperes. (Full scale of the meter in this position is 100 milliamperes.) Next return the meter switch to position five and peak the exciter stages for maximum grid current.

Other crystal frequencies may be used. For ten meters 9.333 mc. to 9.9 mc. crystals will have harmonics that fall in the 28 mc. band. For six meter application 10 mc. to 10.8 mc. crystals can be used with the fifth harmonics falling in the 50 to 54 mc. band.

After tuning the transmitter on the various channels, carefully hold the controls immovable and tighten the wing nuts. After this is done it is only necessary to push in the proper slider to change frequency.

Tuning is the same on 50-54 megacycles, except that 8.3333 to 9.0 megacycle crystals are used, and the oscillator is tuned to about 150 megacycles. It is possible to pick off the wrong harmonic in the 12A6 stage, unless care is used. If three turns are removed from the coil, the peak near the 150 megacycle mark on the scale is the correct one.

28 megacycles	
Amplifier coil: 14 t. #16 wire, $1\frac{1}{16}$" diam. Turns spaced wire diameter with $\frac{3}{8}$" gap in center to accommodate antenna coil	
Antenna coil: 3 t. #16 wire, $1\frac{1}{16}$" diam., closewound	
50 megacycles	
Amplifier coil: 10 t. #14 wire, $\frac{3}{4}$" diam. Turns spaced slightly more than wire diameter with a $\frac{3}{8}$" gap in center to accommodate antenna coil	
Antenna coil: 3 t. #14 wire, $\frac{3}{4}$" diam., closewound	

Table I. Coil winding specifications.

Power output of 12 to 14 watts is obtainable on both bands at an input of 20 watts to the final amplifier.

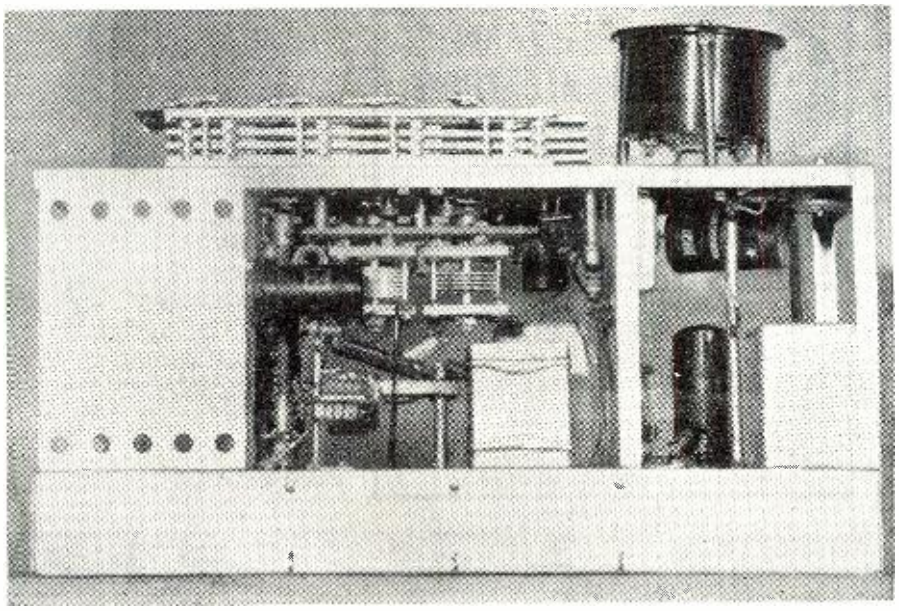
The unused parts were not removed from the transmitter so it might be returned to two-meter operation if desired. Furthermore, no effort was made to install switches, etc., to switch bands, because it is more satisfactory to have separate transmitters for each band. However, by converting the transmitter for 50-megacycle operation, it is possible to add enough capacity to the 12A6 stage to permit it to tune to 28 megacycles. In this case small banana plugs and jacks will permit changing the amplifier inductance.

No easy solution for including the 144-megacycle band in a rapid-change arrangement is immediately apparent, but with a soldering iron, either transmitter may be put back on 144 megacycles in five minutes.

(EDITOR'S NOTE: *Regarding the meter switch, position one is plate current to the 12A6 frequency multiplier, with a full-scale range of 50 milliamperes, two is plate current to the 832A tripler, with a range of 100 milliamperes. On some transmitters position four is the carrier level indicator, while on others this position is blank, as is position six on all models.*)

—30—

Top view. Coupling condensers to 832A tripler can be seen (center of photo) unsoldered and bent away from the 12A6's tuning condenser. The #12 wires connected to the tuning condenser carry excitation voltages to final amplifier. Coil which is modified for 6-meter operation can be seen, partly hidden, by the horizontally positioned tube.



War Surplus Bargains Sold As Used Unless Otherwise Specified!

RADIO ALTIMETER APN/1

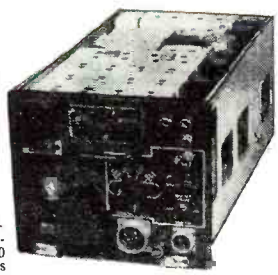
A complete 460 mc. radio receiver and transmitter which can be converted for ham or commercial use. Tubes used and included: 4—12SH7, 3—12SJ7, 2—6H6, 1—VR150, 2—955, 2—9004. Other components such as relays, 24 V dynamotor, transformers, pots, condensers, etc., make this a buy on which you can not go wrong. Complete as shown in aluminum case 18"x7"x7¼.

$8.95

NAVY CRV-46151 AIRCRAFT RADIO RECEIVER

INCLUDING CASE

$19.50



Four bands, including broadcast (195-9,050 KC). Circuit is six-tube superheterodyne with mechanical band change or remote operated electrical band change. Remote band change and tuning controls included, making this set readily adaptable to mobile ham use. Powered from self-contained 24 V. DC dynamotor.

The sets are complete with tubes, mounting rack and remote controls. No cables or plugs.

AIRCRAFT TRANSMITTER BC-475A or BC458A

Ideal to make over for master oscillator. Priced complete with tubes. Has built-in crystal for dial calibration. Used but in good condition. 5.3-7 MC or 4-5.3 MC FREE Mounting Rack with order of two or more.

$3.95

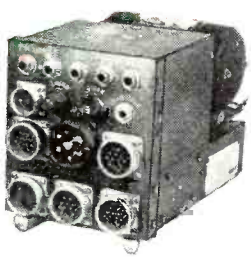
3-4 MC $5.75

INTERPHONE AMPLIFIER RL-7

Convert to high fidelity phone Amp. or speech Amp. Complete with tubes and dynamotor, for 24 V. DC operation. Used but in good condition.

SPECIAL PRICE

$1.95

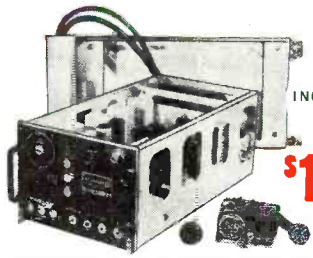


TERMS: CASH WITH ORDER

AMERICAN SURPLUS PRODUCTS CO.

537 N. CAPITOL AVE.
INDIANAPOLIS, IND.

ARC-4 TRANSMITTER & REC.

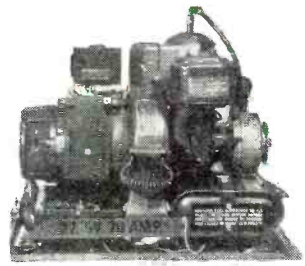


INCLUDING CASE

$17.95

Operates on any of its 4 predetermined crystal controlled frequencies in the range of 140 MC. Complete with tubes, remote control, junction box, shock mounting base and connecting plugs. This unit is ideal for amateur UHF or mobile telephone. Operates from self-contained 24 V DC dynamotor.

(HRU) DC POWER SUPPLY



24-28 V. at 70 amp. 2000 watts gasoline engine generator with electric starter. Power supply which can be used to operate 24-28 V. equipment, start airplane engines, charge batteries, as a welding machine, lighting system, or for amateur radio station. 21½". 17½" x 24⅝". Wgt., 115 lbs. Includes 20 ft. plug-in. cable.

$72.50

BRAND NEW SCR-625 MINE DETECTORS

ATTENTION, PROSPECTORS, MINERS, OIL COMPANIES, PLUMBERS, ETC.

Used by the Army to detect buried metallic mines. Its private use suggests the location of underground or underwater pipes, cables and ore-bearing rock, the location of metallic fragments in scrap materials, logs, etc., and the screening of personnel in plants for carrying of metallic objects.

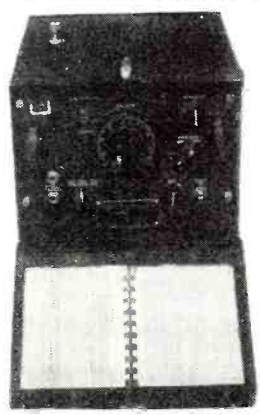
New, complete in original overseas packing container. Originally sold by War Assets for $166.00. The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

$79.50

SCR-274N COMMAND SET

SCR-274N Transmitter and Receiver Assembly consists of 13 pieces which are: 4 dynamotors, 1 modulator, 1 remote control box, 2 transmitters, 3 receivers and one antenna relay unit and it has its own individual dynamotor. Each receiver employs 12 V. tubes. Each transmitter contains four 12 V. tubes and has a variable frequency and crystal calibrated master oscillator, driving two 1625 final amplifier tubes, 55-watt output, with built-in silver plated variable inductance antenna matching device. Oscillator and final stage have simultaneous tuning and the dial is directly calibrated in MC. Transmitters have slugged and capacity tuning, built-in high voltage and antenna switches. Modulator furnishes plate supply for transmitters and is equipped with a dynamotor for high voltage. Also supplied is one antenna relay with built-in antenna meter. Transmitters make ideal VFO driver unit. Easily converted to 110 V. 60 cycle operation. Wt. approximately 100 lbs.

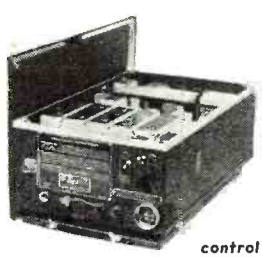
PRICE **$19.95**



BC-221 FREQUENCY METER

Covers 125-20,000 Kc. Battery operated. Beautiful equipment.

$49.95



R5/ARN-7 RECEIVER

ONLY

$19.95

control heads available

$2.50 Each

Three bands 200 to 1750 KC. Complete with 17 tubes required. This set is ideal for conversion to home broadcast Receiver addition to ham shack, etc. Reported sold for many times the price when brand new. A Receiver that would be hard to pick up at this price.

PRICES F.O.B. INDIANAPOLIS

OXYGEN TANKS

These oxygen tanks, removed from surplus aircraft, have a capacity of 500 lbs. pressure. Type D2, with complete regulator assembly. Size of tank 22"x5". Weight 7 lbs.

$5.95

TERMS: CASH WITH ORDER

AMERICAN SURPLUS PRODUCTS CO.

537 N. CAPITOL AVE.
INDIANAPOLIS, IND.

Mac's Service Shop

(*Continued from page* 63)

bench with a metal hood arrangement that came down to within about eighteen inches of the top of the bench.

"Here is where you clean up the chassis and speaker of each set after you have taken them out of the cabinet," Mac explained. He snapped a switch, and there was the whir of a powerful fan accompanied by the throbbing of a small paint-spray compressor underneath the bench.

"You put the chassis on this bench and turn on that exhaust fan," Mac yelled above the noise. "Then you use these brushes to brush off all the dust and lint you can. The fan will carry it off. The compressed-air jet here will help a lot, too. Be sure and blow the dust out of the tuning condenser plates. If there is any gummy dirt on the chassis—and there usually is around the transformer—use the carbon-tet to loosen it and wipe it off. Clean the speaker, too. The main point is that I want all the dirt off. I want every chassis and every speaker to be shining clean before you set them on the service bench."

Mac turned off the switch and closed the door. From a cabinet he took out a little hand-type vacuum cleaner.

"This," he explained, "is the gadget you use to clean out the cabinets, helping things along a bit in the corners with a little brush. After the cabinet is all cleaned inside, you wipe off the outside with a damp cloth and then go over it with furniture polish."

He stopped talking to find Barney grinning broadly.

"What's so funny?" Mac asked.

"I was just thinking that Mom was a little worried at first about my working in a radio shop. She was afraid I might get electrocuted. When I go home tonight I am going to tell her that the worst she has to worry about is that I'll be getting dishpan hands or housemaid's knee."

"I suppose it does sound a little that way now," Mac said, "but radio servicing is a lot more things than watching a pattern on a scope. Good preparation is half of any job. All this asking questions and this cleaning may not sound very glamorous, but they are part of the preparation. The questions tell you what to look for and where to look. You will find, too, that there is something about a bright, clean radio that makes you do your workmanlike best on it."

"I didn't mean that the way it sounded, Mr. McGregor," Barney said in quick seriousness. "I was just making a little joke for Mom."

"I realize that, Barney; and what say we drop the 'Mr. McGregor' business. I'll settle for 'Mac.'"

In a twinkling Barney's face was wreathed in its usual grin. "Okay, Mac," he said softly, "and you may as well quit fighting it and start calling me 'Red.' You know you want to!" -30-

DAVEGA COMMUNICATIONS DIVISION

Presenting the NEW MODEL S-53

...to give amateurs:

MORE VALUE
Never before all these features at this price

GREATER PERFORMANCE

LOWER PRICE
$79.50

MODEL S-53

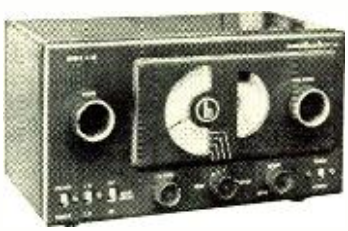
The latest addition to the Hallicrafters Communication Receiver line exhibits performance complimentary to the most recent engineering developments. Tuning Range: 540 KC to 31 MC, 48 MC to 54.5 in five bands. No image on amateur bands. Seven tubes plus rectifier.

ONLY $79.50

MODEL S-51

FOR LAND . . . SEA . . . AIR COMMUNICATIONS. Tuning Range: 132 KC to 13 MC. AC-DC power, three fixed frequency channels for aircraft, ships and telephone communications. Ideal for yacht owner and landlubber. Another Hallicrafter achievement.

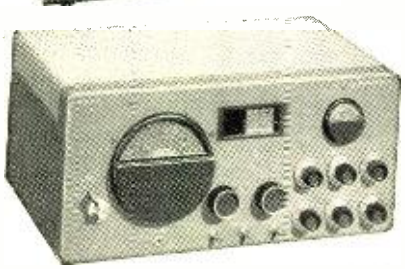
ONLY $129.50



MODEL S-38

Overall frequency range from 540 KC to 32 MC in four bands. Compact and rugged. AC-DC. Built-in speaker. Tens of thousands sold. 5 Tubes plus rectifier.

ONLY $47.50



MODEL SX-43

The SX-43 offers continuous coverage from 540 KC to 55 MC and has an additional band from 88 to 108 MC. AM reception all bands. CW on four lower bands and unbelievable pure tone on the FM frequencies above 44 MC.

ONLY $169.50

Speaker additional $19.50

DAVEGA

MAIL COUPON FOR DESCRIPTIVE LITERATURE

DAVEGA COMMUNICATIONS DIVISION
63 Cortlandt Street, New York 7, N.Y.
Please send full information on Communications Receivers without obligation.

NAME.....

ADDRESS.....

CITY.....

RN-11

(*Continued from page* 73)

ing material, is to make possible the inclusion of an abrasive which is added to the compound for purposes of sharpening a steel playback stylus.

The conventional sharply pointed steel reproducing needle (Fig. 5B) is familiar. When initially employed on a record, considerable hiss is present due to the sharp needle point of the stylus engaging the bottom of the groove of the record. Due to the speed and grinding action of the revolving record there will be a gradual wearing of the needle point. While initial surface noise reduces somewhat during playing, distortion will result as the reproducing stylus becomes worn. The abrasive material in the record will grind off the sharp point of the needle and the stylus will assume a rounded and somewhat distorted point. If permitted to run for any length of time, the walls of the groove will be torn and worn from improper seating, hence the necessity for changing needles, as is done with the conventional phonograph.

With the advent of *permanent* point types (sapphire, diamond, etc.) of stylus tips, this condition has been somewhat alleviated. The stylus tip is not worn due to its ability to maintain its initial shape for many thousands of playings. Such styli are less hazardous to the life of the record. Normally, looking directly from the end cross-section of a groove, we find

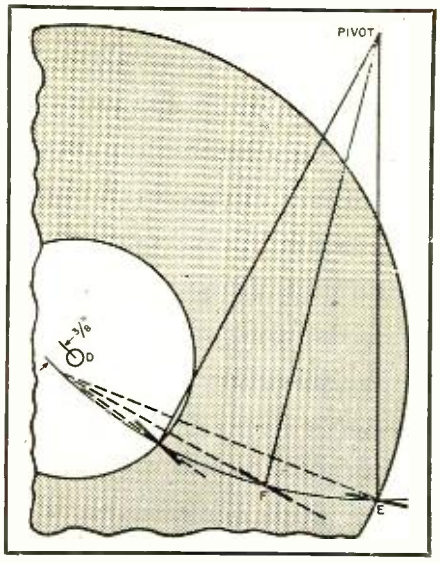


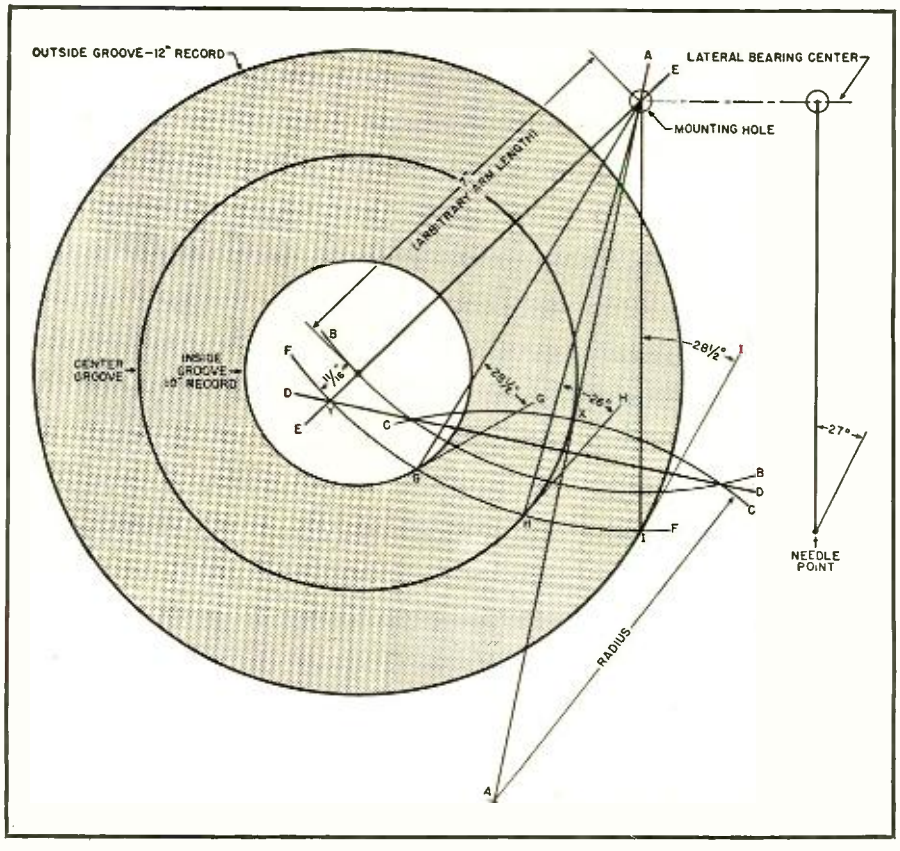
Fig. 3. Reproducing needle swings in arc below hub line.

that it is V-shaped. Obviously a sharp pointed needle, when used on a new record, engages only the bottom of this groove. Inasmuch as modulation is on the *walls* of the groove, there is no proper seating or contact with the walls of the groove for many revolutions of the disc.

Pinching Effect

A flat tool-like chisel point is used, as explained in Part 13, which cuts the groove in a revolving recording blank. The face of the *cutting stylus* cuts a groove of even width providing no sound is impressed on the cutter.

Fig. 4. Method for determining correct tone arm length and included angle of offset.



THE BEST BUY IN WIRE

GENERAL PURPOSE HOOK-UP WIRE

EVERY FOOT GUARANTEED! For all uses where a low loss dialectric is required. Every foot guaranteed to give you the best buy in wire. Buy it in hundred or hundred thousand lots.

DESCRIPTION	Per 100 Feet	Per 1000 Feet
#12 Stranded	$1.15	$9.00
#16 Stranded	.95	7.50
#18 Choice of Sol. or Str.	.75	6.50
#20 Choice of Sol. or Str.	.65	5.50
#22 Choice of Sol. or Str.	.55	3.75
#24 Solid	.45	3.50

#22 Magnet wire, cotton covered, per lb. ..... $ .75

#22 Magnet wire, plain enameled, per lb. ..... .60

"Limp" test prod wire, per 100 feet 1.75

Please specify first and second choice of colors.

LOW PRICE AND EXELLENT QUALITY NEED NO LENGTHY BUILD-UP

TUBES

All parts included to build this unit . . . tubes: 2—35L6; 1—12SL7; 1—35Z5; Punched chassis, 6" P.M. Speaker, diagram, pictorials, output transformer, etc.

$7.75 Kit Complete as Shown

HI-FI PHONO AMPLIFIER KIT

HAS 7 IMPORTANT FEATURES:

1. 4 W. Audio Output.
2. Gain, enough for Phonograph, Radio, F.M. Tuner, Carbon Mike.
3. H-Fi response, 50-20,000 C.P.S.
4. Variable Tone Control.
5. 3 section filter assures extremely low hum level.
6. Push-Pull balanced output.
7. Heavy Duty Universal Output Transformer.

SAVE ON THESE ASSORTMENTS

Resistor Assortments
100 assorted ½, 1, 2, 5 and 10 watt resistors. All standard coded. Wide range of values. 100 assorted **$1.95**

Paper Condenser Assortments
100 tubular by-poss condensers. All guaranteed, fresh stock. Wide range of useful sizes including many 600 W.V. condensers. 100 asst'd **$3.85**

Mica Condenser Assortment
50 mica condensers. All brand new —standard color coded. 50 assorted **$1.95**

Ceramic Condensers
100 assorted **$1.95**

25 POUNDS OF RADIO PARTS AND ASSEMBLIES

We still have plenty of good usable odds and ends and samples in our warehouse. Take advantage of the overloaded condition of our warehouse. Each kit contains 25 pounds of good and usable parts. Yours at the terrifically low price of 25 pounds for Only **$3.00**

ROTARY BAND SWITCHES
Furnished with Pointer Knob and Mounting Hardware.

Single pole ..... 5 position
Single pole ..... 12 position
Double pole ..... 6 position
Four pole ..... 2 position

35¢

Any 10 for $3.15

ALL NEW - FIRST GRADE MERCHANDISE.

GUARANTEED. CONTROLS

less Switch — ⅜" Shaft or longer

5,000 Ohm	
10,000 Ohm	
75,000 Ohm	
500,000 Ohm	
1,000,000 Ohm	
2,000,000 Ohm	
4,000,000 Ohm	
5,000,000 Ohm	

19c

with Switch — 1¼" Shaft or longer

25,000 Ohm	
250,000 Ohm	
500,000 Ohm	
1,000,000 Ohm	
2,000,000 Ohm	

39c

Deduct 10% from all orders of 20 or more controls.

MONEY BACK GUARANTEE

EVERY TUBE GUARANTEED

No "off" brands, seconds or used tubes. Money back with no questions asked if not completely satisfied.

1A5	$ .50	6S8	.50	12SH7	.60
1LC5	1.10	6SA7	.50	12SK7	.60
1LC6	1.10	6SD7	.50	12SN7	.50
1LH4	1.10	6SF7	.60	12SQ7	.60
1LN5	1.10	6SG7	.50	14A7	.95
1N5	.60	6SH7	.50	14B6	.75
1R5	.75	6SJ7	.50	14R7	.75
1S5	.75	6SK7	.50	25Z6	.60
1T4	.75	6SL7	.75	26	.50
2A5	.50	6SN7	.50	26A7	.50
2C26	.50	6SQ7	.50	27	.50
2C40	1.00	6SR7	.50	35W4	.50
2X2	1.00	6V6	.50	35Y4	.75
3B24	1.00	6X5	.60	35Z5	.60
5U4	.50	7B6	.60	39/44	.50
5Y3	.50	7C5	.60	50B5	.60
5Y4	.50	7F7	.75	50L6	.60
6AC7	.95	7F8	.60	50X6	.75
6AG5	.75	7G7	.95	56	.50
6AK5	.75	7H7	.95	75	.50
6AT6	.50	7N7	.60	76	.50
6B4	.95	7Q7	.60	77	.50
6B8	.95	7Y4	.60	78	.50
6C4	.50	12A6	.50	80	.50
6C8	.75	12AH7	.75	84/6Z4	.50
6F7	.75	12AT6	.50	884	1.00
6H6	.50	12BA6	.60	954	.50
6J5	.50	12BE6	.60	955	.50
6J6	.50	12J5	.50	956	.50
6J7	.60	12SA7	.60	9001	.50
6K6	.50	12SF7	.60	9002	.50
6K7	.60	12SG7	.60	9006	.50

DEDUCT 10% from all tube orders $20.00 or more.

Minimum order $2.00. All orders shipped f.o.b. Chicago. 25% deposit on all c.o.d. shipments.

IRVING JOSEPH

220 S. Halsted St., Chicago 6, Ill.

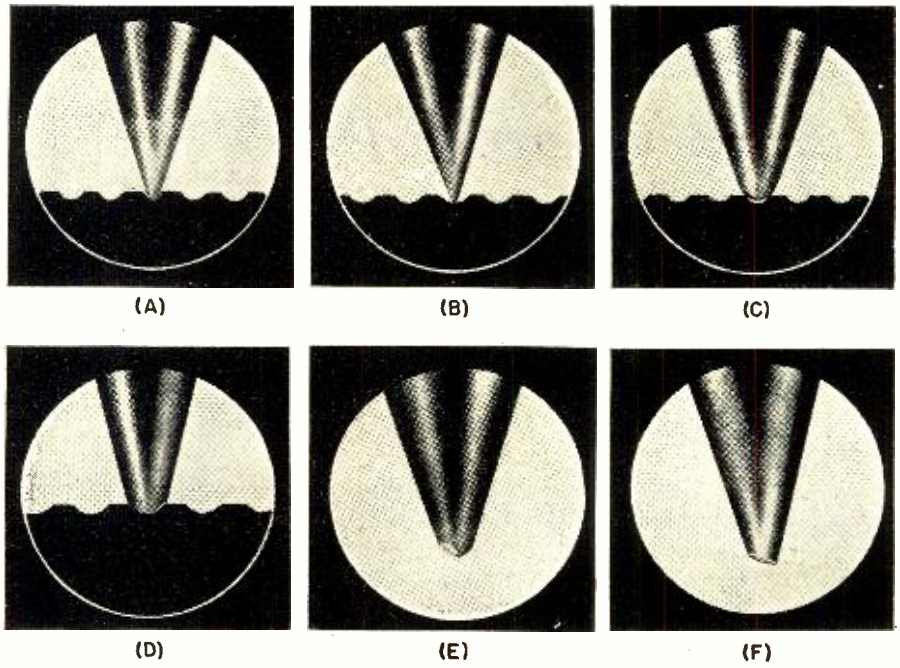


Fig. 5. Microphotographs of reproducing styli showing several conditions as met in everyday practice by the professional studio and by the home recordist. (A) a correctly seated stylus in a properly cut groove. (B) How a sharp point on the stylus can cut into the soft surface material. (C) Indicates the condition when a too rounded stylus rests on the walls of the groove. (D) A worn stylus ground to fit into the groove. (E) A chipped or defective stylus point. (F) Indicates a worn out or damaged needle point.

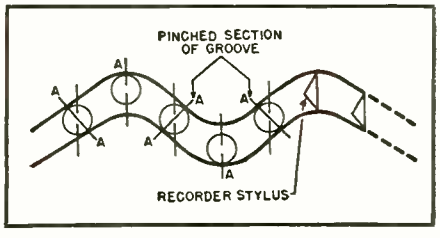
However, when modulation takes place the actual width of the groove varies with frequency, disc diameter, etc., as illustrated in Fig. 6.

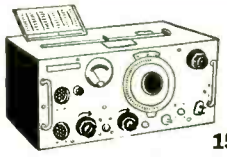
A *reproducing stylus* has a rounded point, therefore, it is almost impossible for this point to seat properly in the modulated groove. The illustration, Fig. 6, serves to show the effect. Note, for example, that the width of the recording stylus at the maximum swing results in a certain dimension in the groove. Comparing this to the point of a reproducing stylus, we find that the tendency is for the point to ride out on the crest, or maximum modulation point, of that particular crest. Hence, sound vibrations are impressed on the needle at the farthest point of inertia. Actually, the point skids from side to side in the wider portions of the groove. Another possible cause of distortion, when the recording has been made with a chisel-shaped cutter and reproduced with a round point, occurs when the needle rounds a curve, as illustrated in Fig. 6.

There is no "cure-all" for the elimination of record wear and distortion. Suffice to say that the chief remedies are as follows: A perfectly level turntable free from mechanical vibration, a pickup having a tone arm with an offset head which permits a minimum degree of tracking error, and properly designed reproducing styli. By paying particular attention to these requirements, the recordists and music lovers may be assured that they have taken the necessary steps for the ultimate in reproduction.

One other important factor having an effect upon fidelity and its relation to record wear and distortion is in improved design of the pickup cartridge and reproducing stylus. By employing a "knee action" as illustrated in Fig. 7 we can eliminate somewhat the pinching effect. A widening and narrowing of a groove results from a spade-like cutting point. The driving force of the record causes the stylus to move in a vertical direction and occurs at a frequency which is double that of the lateral motion of the groove. If this vertical movement of the stylus produces an electrical output (as it does in many common crystal pickups now on the market), the result is an appreciable amount of second harmonic distortion in the reproduced sound. At the same time, the pinch effect produces a mechanical reaction on the record and stylus, as previously explained. The magnitude of the pinch effect is inversely proportional to the distance from the center of the record. It may be seen by inspecting worn records that the greatest wear occurs near the center of the record. The pinch effect is undoubtedly responsible for greatly accelerating this record wear. In most of the newer pickups now used the mass of the moving parts is small enough so that the vertical inertia re-

Fig. 6. How rounded-point needle (A-A) skids like a toboggan in modulated groove.





Test Set 159TPX

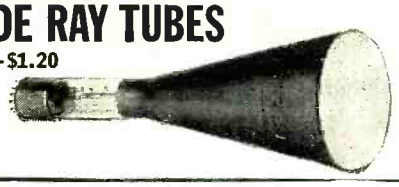
Measures frequency between 150 & 200 Mc. by heterodyne method. Pwr. Output of XMTR can be measured directly. Measures DC voltages up to 500 V. Operates on 110 V. 400 cy. Complete with tubes crystal, calibration chart. Conversion kit for 60 cy. $29.95

BEST BUYS "Communications" LOWEST PRICES

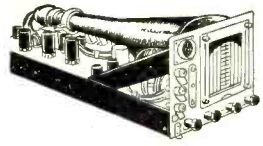
CATHODE RAY TUBES

5BPI's—$1.20

5FP7 - $1.75
5JP2 - $4.00



3BPI - $1.25
3FP7 - $1.20



Radar Set SCR-521

Makes an excellent foundation unit for a high gain scope. Has following tubes: 4-6AC7, 3-6H6, and 1-5BPI CR tube. Comes enclosed in metal shield. New, with all tubes, less power supply. With wooden carrying case. $17.50

Ceramicon Capacitors

(Erie, Centralab) $7.50 per 100

3 mmf	±5%	67 mmf	±20%
5 mmf	±5%	100 mmf	±5%
4 mmf	±.5 mmf	115 mmf	±2%
8.5 mmf	±.5 mmf	120 mmf	±5%
11 mmf	±5%	240 mmf	±3%
15 mmf	±2.5 mmf	250 mmf	
48 mmf	±2%	500 mmf	+15 −30%
50 mmf	±20%	1000 mmf	±5%
60 mmf	±3%		

Silver-Mica Button Capacitors

(Erie, Centralab) $9.50 per 100

185 mmf ..... ±2.5 mmf
175 mmf ..... ±2.5 mmf
500 mmf ..... ±10%

Transformers

(All Primaries 117 V, 60 Cycles)

No. 5102: 1080 VCT @ 55 Ma, 6.3 V. @ 1.2 Amp, 6.3 V. @ 1.2 Amp. ..$2.35
No. 5110: 1100 V. @ 70 Ma, tapped @ 550 V. (for use with H. W. rect.) .$2.75

Filament Transformers

No. 5123: 6.3 VCT @ 5 Amp, 6.3 VCT @ 1 Amp. $2.15
No. 5109: 27 Volts @ 8.8 Amp, 6.3 V. @ 2.5 Amp. $2.75
No. 19163: 2.5 V. @ 1.75 Amp, 5 V. @ 3 Amp, 6.5 V. @ .6 Amp, 6.5 V. @ 8 Amp. $5.35
Doughnut Fil. Xfmr. Two 5.1 V. Windings @ 5 Amp. each, 15,000 volt test $7.50
No. 5058: 6.3 VCT @ 2A, 6.3 VCT @ 2A, 6.3 VCT, @ 2A. $2.25
No. 5126: 5 VCT @ 3A, 5 VCT @ 3A, 5 VCT @ 6A. $2.25
No. 5100: 6.3 VCT @ 1.2 A, 5000 V test. $1.35
No. 5085: 6.3 V NCT @ 6A, 6.3 V NCT @ 1.5 A. $1.40
No. 5056: 6.3 VCT @ 9 A, 6.3 VCT @ 2.2 A, 6.3 VCT @ 2.2 A. $2.50
No. 5057: 6.3 VCT @ 1A, 5 VCT @ 3 A, 5 VCT @ 3 A. $2.50
UX 6899: 5 V @ 5.5 A, 5 V @ 5.5 A, 29,000 Volts Test. $24.50

Power Chokes

6 Hy @ 150 Ma. $1.50
6 Hy @ 300 Ma. $3.25
1 Hy @ 800 Ma, 7.5 Ohms. $8.95
Dual Choke: 2-2 Hy @ 100 Ma. ..... $ .90
Dual Choke: 7 Hy @ 75 Ma, 11 Hy @ 60 Ma. $1.50
8.5 h @ 125 Ma. $1.50
2.5 h @ 65 Ma. $1.10

ARC-5 ACCESSORIES

Conversion Coils for ARC-5 Xmtrs

M.O. Coils	P.A. Coils	Loading Coils	Freq. Range
$1.00 Ea.	$1.00 Ea.	5.85 Ea.	
No. 6029	No. 7247 (W.E.)	No. 6033	3-4 mc.
No. 6030	No. 9293	No. 6034	4-5.3 mc.
No. 6032	No. 9295	No. 6035	7-9.1 mc.

Kit, consisting of 1-MO and 1-PA coil in any one particular frequency range $1.50
Kit, consisting of 1-MO, 1-PA COIL, and 1-loading coil in any one particular frequency range $2.00
ARC No. 6558 variable receiving capacitor. 62 mmf/section. 3 sections. .03" spacing, 8 rotors. Worm drive ratio 33:1 $1.75
ARC No. 4490, variable xmtg. capacitor, 22.4-145 mmf, .05" spacing, 11 rotors. Each $1.00
ARC 5032, Var. Xmtg. capacitor, 29.2-117 mmf, .06" spacing, 16 rotors, worm drive; 9G1 ..... $1.00
Single revr. mtg. racks $1.00
Dual mtg. racks (revr.) $1.50
BC band coil plug-in RF coils $1.00
Shock mounts for rack ..... $ .50
DUAL CONTROL BOXES FOR RCVRS $1.00

Sonar Sound Detection Unit

Ideal for detecting under water sounds, such as fish swimming in schools, within a 15 mile area. Using a Rochelle salt crystal, which is about 1000 times more sensitive than quartz. It is completely enclosed in a solid rubber sheath. This sound detector was originally used in harbor defense. Coupled to an audio amplifier, this can be found to have many valuable applications. It's the Model JR which contains 7 microphone units. $12.50

Coax Cable and Plugs

RG9/U 51 ohm silver coated. Min 50 ft. length. ..... per ft. .07½
RG8/U 52 ohm. Min 40 ft. length ..... per ft. .04½

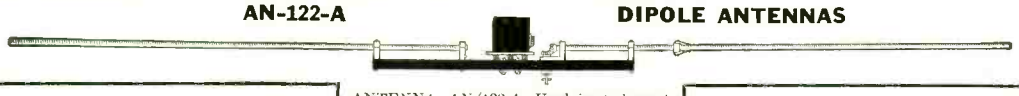
Amphenol Low-Loss Series Connectors

83-1 R. Female 27c
83-1 AP. Rt. angle 27c

250 Watt Output Transformer

W. E. #KS 9496, H1-FI output. 9.000 ohm push-pull plates to 9 ohm voice coil. Freq. Response: -3 db @ 50 cps, -1.25 db @ 100 cps. 0 db @ 1.000 cps, .3 db @ 10.000 cps, 3db @ 50,000 cps $3.95

AN-122-A DIPOLE ANTENNAS



ANTENNA, AN/122-A. Used in 4-element adcock arrays for high gain and directivity; each dipole element is 12' long, made of ⅜" tubing. Excellent for that new 6 or 2-meter beam. Don't miss this great value. $5.65 each or 4 for $20.00

ANTENNA AN/104-A. The famous ax-handle antenna, used with the SCR 522. Ideal for mobile quarter wave, because of its streamline construction; or 2 units can be used to form a dipole for 2 meters or for TV and FM reception. Consists of copper sheath 21" long moulded about a wooden support, with 83-1R coax connector. $.75 ea., or 2 for $1.35.

ANTENNA, ARN/1. Originally designed as radio altimeter antenna, these antennas make excellent dipoles for use on the 420 mc band. Consists of center-fed dipole, 11½" long, going to 83-1R connector on mounting plate. Use four of them in array for increased directivity and signal strength. Ea. $1.25 or four for $4.50.

MICROWAVE TUBES

(Magnetrons)

Tube	Freq. Range	Pk. Pwr. Out	Price
2J31	2820-2860 mc	285 Kw	$10.00
2J21-A (725-A)	9345-9405 mc	50 Kw	$25.00
2J22	3267-3333 mc	265 Kw	$15.00
2J26	2992-3019 mc	275 Kw	$15.00
2J27	2965-2992 mc	275 Kw	$15.00
2J31	2820-2860 mc	285 Kw	$15.00
2J32	2780-2820 mc	285 Kw	$15.00
2J38	PKG. 3249-3263 mc	5 Kw	$25.00
2J55	PKG. 9345-9405 mc	50 Kw	$25.00
3J31	24.000 mc	35 Kw	$17.50
W.E. 700-A	680-710 mc	100 Kw	$30.00
W.E. 720-BY	2800 mc	1000 Kw	$25.00

MAGNETS for 2J21-A (725-A), 2J22, 2J26, 2J27, 2J31, 2J31, 2J32 and 3J31, each $8.00

Field Strength (Gauss)	Distance Between Pole Faces	Pole Face Diameter	Price
4850	⅝"	¾"	$8.00
1500	1½"	1⅝"	$8.00
1000	Adjustable		
(Electromagnet)	2⅜" to 3"	2½"	$12.00
2100	1⅛"	¾"	$4.00

Relays

Leach contactor—SPST—24 VDC. Contacts: 400 amps. Completely enclosed $1.20
#CR 2790-E109A1—115 V, 60 cycles. Contacts: 230 VAC @ 10 amps. $1.65
3 PDT, 24-28 VDC. #CR 2791B100J3. Contacts: 8 amps. Bakelite insulation $1.35
#1067-490 antenna relay. DPDT with SPST receiver section. Silver contacts. Ceramic and Micalex insulation $1.15

Headsets

Dynamic mike and headset combination. A high quality, efficient unit, used in B-19 tank Xmtrs. Mike & phones complete, new. $2.75

R-15 headsets: 8000 ohms impedance, rubber cushions. Comes with 8' cord & plug PL 55. New $1.95. Used, in good condition . $ .60

HS 30 headset. Inert type headset cuts out background noise, and low impedance (500 ohms) assures efficiency and high fidelity. A MUST for every ham at this price. . $ .85

Xfmr to match 8000 ohms output. . . $ .35

R-2A headsets, 10.000 ohms impedance, with headband. 8' cord, and P1 55 Plug. Slightly used, in excellent condition $2.25

PE 73 CM Power supply for BC 375. Input: 28 VDC. Output: 1000 VDC @ 350 Ma. Starting relay, filter, etc. Mfrs.: Write for quantity, prices & discounts on above item.

BD 77, Power supply for BC 191. Input: 14 VDC. Output: 1000 VDC @ 350 Ma. With spare fuse links, etc. . . $5.95

PE 101C, Input: 13/26 VDC @ 12.6/6.3 A. Output: 400 VDC @ 135 Ma., 800 VDC @ 20 Ma. (9VAC @ 1.12 A.) $3.49

PE 86 N. Input: 28 VDC, Output: 250 VDC @ 60 Ma. Westinghouse w/Filter $1.95
Without Filter $1.60

DM 33A. Input: 28 VDC @ 7 A. Output: 540 VDC @ 250 Ma. Power supply for modulator of SCR 274 N. . . $3.95

DM 28-R. Input: 28 VDC @ 1.25 Amp. Output: 270 VDC @ 70 Ma. New, with enclosed terminal box $3.25

ZA/USA .0515. Input: 12/24 VDC @ 4/2 Amp. Output: 500 VDC @ 50 Ma. Compact rectangle shape, size: 7¼ x 4¼" x 3" $3.95

ZA/USA .0516. Input: 12/24 VDC @ 8/4 Amp. Output: 275 VDC @ 110 Ma, 12 VDC @ 3 Amp. Compact square, size 7½" x 4¾" x 3" $4.25

35X055, Input: 19 VDC @ 3.8 Amp. Output: 390 VDC @ 95 Ma $2.20

PE 55. Input: 12 VDC @ 25 Amp. Output: 500 VDC @ 400 Ma. (slightly used) $4.95

MP 10 G Power supply, using 2 dynamotors. Input: 24-28 VDC. Output 1000 VDC @ 400 Ma. 230 VDC @ 100 Ma. New, complete with relays, filters, etc. BENDIX $40.00

B-19 power pack (dynamotor). Input: 12 VDC @ 9.4 Amp. Output: 275 VDC @ 110 Ma, 500 VDC @ 50 Ma. New, complete in metal case with 2 plugs, filters, etc. $4.75

Inverters

PE 206-A. Input: 28 VDC @ 38 Amp. Output: 80 Volts 500 volt-amp, 800 cy. Leland Electric. New, complete with instruction book, relays, filters, etc. $12.50

PE 218—Input: 25-28 VDC @ 92 Amp. Output: 115 volts, 1500 volt-amps, 380/500 cy. Leland Electric, New. . $15.00

12 and 24 Volt Filament Transformers

(All primaries 110 v. 60 cycles). No. 517: Output: 12 v @ 10 amp or 24 volts @ 5 amps. . . . $2.75

No. 2Z17: Output: 24 volts @ 3 amp. Size: 3" x 3⅛" x 3" (as shown) $1.50

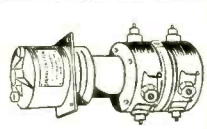
A rack for complete rig, $45.00

46" high, 24" wide, 22" deep, black crackle finish, with special receiver mounting panel. Has 3 decks and hundreds of useful parts. Listed below are just some of the components:

11—1" Jewels
4—AC Outlets
2—0-3 Amp RF meters
1—40-0-40 ammeter
2—Ceramic switches
1—Ohmite potentiometer
5—AC relays
3—Fuse blocks

2—115 VAC contactors
1—6" AC gong.
7—panel-controlled circuit breakers (4—15 Amp, 2—35 Amp, 1—50 Amp)
3 Large push-button switches
3—Wall-type switches
1—Reset push-button switch
1—Microphone jack
3—Meters on 5-hole meter panel
5—Large Jones strips
1—4" DPDT heavy-duty knife switch
1—Control amplifier

The parts alone are worth many times this special price for quick sale. . $45.00



Motor Driven Switch

Switch operates at 1800 rpm, using internal 24 VDC motor. Switch is DPDT, and was originally designed for automatic switching of YAGI radar-antennae. $2.00

All merchandise guaranteed. Mail orders promptly filled. All prices, F.O.B. New York City.
Send Money Order or Check. Shipping charges sent C.O.D.

COMMUNICATIONS EQUIPMENT CO.

131 N. Liberty St., New York City 7, N. Y. **Digby 9-4124**

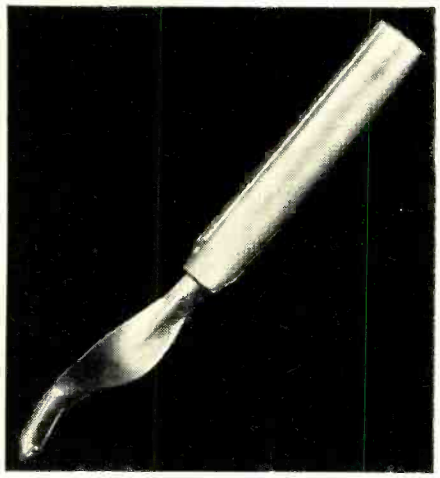


Fig. 7. Playback needle with "knee-action" feature.

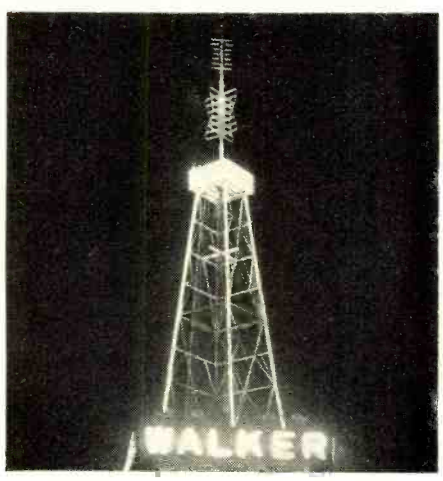
action on the stylus and record due to the pinch effect is of negligible magnitude and does not contribute appreciably to record wear.

The "needle talk" is greatly reduced by employing such design. This is particularly true at the lower frequencies because of the reduced vertical reaction on the record. In relieving this reaction, the stylus and armature move vertically as a unit up to a frequency of between 500 and 800 c.p.s. rotating about a horizontal transverse axis. As the frequency increases, this axis moves closer to the armature until, at very high frequencies, the axis of rotation passes through the armature.

Record life has thus been increased considerably by careful design of pick-ups and their associated reproducing styli.

(To be continued)

Night view of station KDYL's super turnstile or "bat wing" antenna used for both experimental television and FM transmission. The antenna is mounted on top of Salt Lake City's highest office structure, a 20-story bank building in the business district, and towers 330 feet in the air giving coverage of the Greater Salt Lake Valley. KDYL's experimental telecasts from St. Louis to the Pacific Coast over station W6XIS, were started last month. The station which operates on channel 2 is powered at 400 watts visual and 200 watts aural. Commercial operation is expected before the end of 1948 on this circuit.



SENSATIONAL VALUES

THE NEW MODEL 247

TUBE TESTER

Incorporates a newly designed element selector switch which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap."

The new free-point system described above permits the Model 247 to overcome the difficulties encountered with other emission type tube testers when checking Diode, Triode and Pentode sections of multi-purpose tubes, because sections can be tested individually when using the new Model 247. The special isolating circuit allows each section to be tested as if it were in a separate envelope.

The Model 247 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R. M. A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Model 247 comes complete with new speed-read chart. Comes housed in handsome, hand-rubbed oak cabinet sloped for bench use. A slip-on portable hinged cover is included for outside use. Size: 10¾" x 8¾" x 5¾".

ONLY $29.90 NET

The New Model 650

SIGNAL GENERATOR

RANGE:

100 Kilocycles
to
105 Megacycles

R. F. obtainable separately or modulated by the Audio Frequency.

★ Audio Modulating Frequency—400 cycles pure sine wave—less than 2% distortion.
★ Attenuation—3-step ladder type of attenuator (T pad).
★ Uses a Hartley Exciter Oscillator with a Buffer Amplifier.
★ Tubes: 6J5 as R. F. Oscillator; 6AS7 as Modulated Buffer and Mixer; 6SL7 as audio oscillator and rectifier.
Complete with coaxial cable, leads and instructions.....

REDUCED FROM $48.75 To $39.95

SEE and HEAR the Signal with the new CA-12

SIGNAL TRACER

FEATURES:

* Comparative intensity of the signal is read directly on the meter —Quality of the signal is heard in the speaker.
* Simple to operate — Only one connecting cable—No tuning controls.
*Highly sensitive—Uses an improved vacuum-tube voltmeter circuit. * Tube and resistor capacity network are built into the detector probe. * Built-in high gain amplifier—Alnico V speaker. * Completely portable—Weighs 8 pounds—measures 5½" x 6½" x 9".

Complete with self-contained batteries and instructions....

Reduced from $34.85 to **$29.95**

The New Model 670 SUPER METER

A Combination VOLT-OHM-MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS.

D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/7500.—A.C. VOLTS 0 to 15/30/150/300/1500/3000 Volts.—OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000.—D.C. CURRENT: 0 to 1.5/15/150 Ma.; 0 to 1.5 Amps.—RESISTANCE: 0 to 500/100,000 ohms, 0 to 10 Megohms.—CAPACITY: .001 to .2 Mfd., 1 to 4 Mfd. (Quality test for electrolytics).—REACTANCE: 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.—INDUCTANCE: 1.75 to 70 Henries; 35 to 8,000 Henries. DECIBELS: −10 to +18, +10 to +38, +30 to +58.

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

$28.40 NET

AVAILABLE FOR IMMEDIATE SHIPMENT FROM STOCK—20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

MOSS ELECTRONIC DISTRIBUTING CO.

DEPT. RN-4, 229 FULTON STREET NEW YORK 7, N.Y.

Singing Doorbell

(*Continued from page 47*)

with perfect pitch! However, relative pitch is definitely important, i.e., one note must bear the right relation to all the others or the tune won't "sound right." To tune to any particular song, first consider the beginning note. Is it lower or higher than the following notes, or is it about in the middle? In any case, select one of the *RC* circuits which tunes to approximately the same range. For example, to set up the well-known phrase "I'll come down and let you in," the lowest *RC* combination should be selected for the first note, since this note is lower than all the rest. Similar reasoning will hold for each note in turn.

Tune the chosen *RC* circuit to some convenient pitch, which now becomes the reference pitch to which all other notes will be compared. Now hum or whistle the first two or three notes of the tune, starting with the reference pitch as the first note, then tune the next *RC* circuit to the second note. By continually repeating the tune, both by humming and by running through the notes already tuned, you will find it very simple to tune all the *RC* circuits to produce the required tones. To play the tones in this manner, a piece of paper should be slipped under all tone brushes and a short piece of wire used to short the various tone brushes to the collector brush. Remember that repeated notes required only one *RC* circuit, e.g., the "down" and "let" in the cited example are played on the same *RC* combination. To be perfectly frank, the notes for "and" and "in" must also be tuned to the same pitch if only five tones are available. This leaves "and" a half-step too low, but I dare say nobody will complain!

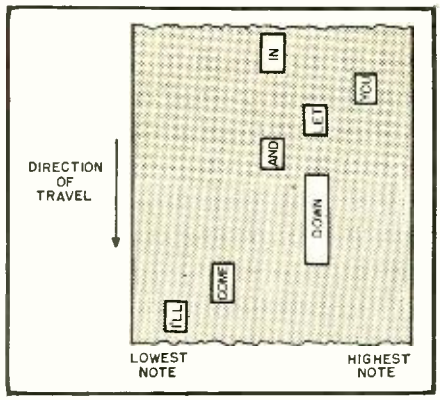
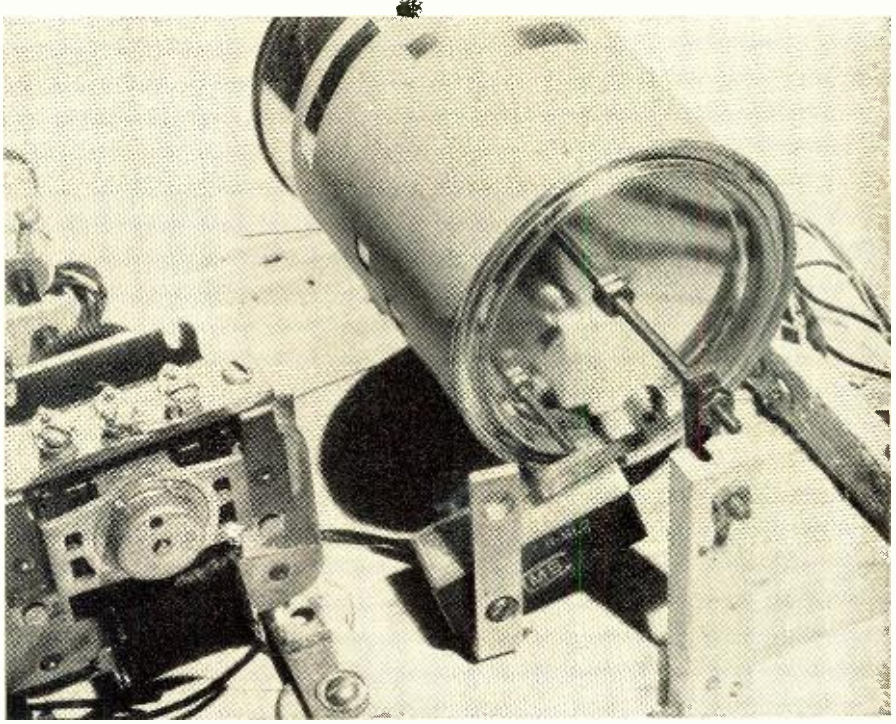


Fig. 4. Drawing shows method of cutting out paper "record" to obtain tune, "I'll come down and let you in."

The next step is to make the "record." Cut a piece of graph paper (or other lined paper) to fit around the drum. Mark the line of travel of each brush. The openings will be cut along these lines. Using a pencil, draw on the paper the outlines of the slots required. The position of the slot determines the note it plays and the length of the slot determines the time duration of the note. The slot position is determined from the previous *RC* circuit tuning. The slot length must be determined experimentally the first time. The actual length will, of course, depend on the speed of the drum and the desired note length. Once the slot length has been determined for say a quarter note, the rest will be simple. After all the slots are marked, cut them out with a sharp knife or razor blade.

Fig. 5. Closeup view shows detail of drum assembly.



BUY *from America's* STOREHOUSE *of* QUALITY PARTS

RADIO SUPPLY & ENGINEERING CO., Inc.

LOWEST PRICES

129 SELDEN AVE. DETROIT 1, MICH.

VOLUME CONTROLS

1000 ohm wire wound midgets – manufacturers close out – ¼" shaft ⅝" long – list $1.25 – over 90% off.

EACH **12c**

SEALED Box of 252 **24.95**

.5 mfd — 300 Volt

That's right – genuine Sprague condensers—manufacturers close out – new fresh stock – size ¾" x 2½" – tinned leads.– all guaranteed.

NET EACH **6c** 10 FOR **49c**

OUTPUT TRANSFORMERS

Clean stocks – long leads – mounting feet – made to fit where you need them.

For 6F6-6K6 – to 4 ohm voice coil – size 2" x 1⅝" x 1⅜".
50L6-35L6-25L6 to 4 ohm voice coil 1⅜" x 1⅝" x 1⅜".
Specify quantity of each type you need at..... **49c**

MULTI-USE WIRE

An old favorite – back again!

Stranded No. 22 tinned wire – glass "ROCKBESTOS" 1000 volt insulation—fireproof aircraft wire – a wartime development – at this low price you can use the best.

100 feet..... **45c** 1000 feet..... **3.89**

MODEL 451A AC-DC Volt-Ohm –Meter

A dependable instrument of wide utility – sensitivity 1000 ohms per volt.
Ranges: Volts AC, DC, and Output Ranges: 0-10/50/100/500/1000.
Ohms full scale, 500,000.
Ohms center scale, 7200.

NET complete with batteries..... **14.90**

MODEL 312 Volt-Ohm – Milliammeter

An economy pocket meter featuring a 2" moving vane meter.
Reads: AC-DC volts, 0-25/50/125/250; Mills AC-DC, 0-50; Ohms, 100,000; mfd. .05-15.
Jacks provide range selection.

NET Complete with cord and plug.... **6.75**

JEWELLED PILOT LIGHT ASSEMBLIES

- Miniature bayonet socket
- Mount in 1" hole
- Lamps removable from front of panel
- Available in red, green, or amber – quantities limited – order now.

List Price $1.30
At RSE'S 85% off – you pay **19c**
Back again – by popular demand!

Pep-Up PHILCO CHANGERS

At last! All the parts you need to restore brilliant tone and volume to "sick" changers! You'll need all three items – sell your customer a 100% reconditioning job –

Selenium cell only, no holder **$1.80**
Sapphire needle only, no mirror..... **$1.20**
Special original equipment lamp..... **27c**
RECONDITIONING KIT—all three above items – postpaid – special at ... **3.21**

RADIO RULE

Here is a clear 6" plastic rule – a necessity for radio students, draftsmen, hams, all who desire cleaner, more precise work.
Nationally advertised at $2.00.
Order yours today postpaid only.. **35c**

VOLUME CONTROLS

Our own private brand – made by a nationally known manufacturer – you have this same control on your shelf now – the same kind that net for $1.09! Standard noise-free carbon construction — ⅜" bushing — ¼" shaft, 2" long – complete with switch. Ideal all purpose replacement control – individually boxed in our colorful carton carrying the RSE quality seal of approval.

Full range of sizes – with attached switches!

10 M ohms, 15 M ohms, 25 M ohms, 50 M ohms, 100 M ohms, 250 M ohms, 1 Meg. ohms, 2 Meg. ohms — **59c each**

55.00 per 100 assorted

500 M ohms – less switch 39c ea. 100 for $35.00

10 MEG. ½ WATT.

type 10 Meg. ½ Watt resistors – manufacturers close-out – clean stock – how can you pass them up at **1c ea.**

PANEL METERS

Panel meters by Top quality instruments – new – boxed – five popular types – priced right – your chance to get those meters you've always wanted.

– 0-150 A.C. volts – 3" round flush mounting black brass case.

– 0-150 A.C. volts – 2" round flush mounting bakelite case.

– 0-150 A.C. volts – 2" round metal case – less mounting clamp.

– 0-30 D.C. volts – 2" round flush mounting bakelite case.

– 0-400 D.C. volts – 3" round projection mounting – bakelite case.

– 0-30 A.C. amps. – 3" round flush mounting bakelite case.

0-150 D.C. volts – 3" round flush mounting black brass case.

Supply limited – order now – **2.95 EACH**

SEND FOR *FREE* CATALOG

DEMAND THIS SEAL OF QUALITY

ORDER INSTRUCTIONS

Include full remittance with orders of $3.00 or less. Include 25% deposit with all C.O.D. orders of $3.00 or more. All shipments sent express collect if postage is not included. Prices subject to change without notice. BE SURE TO INCLUDE SUFFICIENT POSTAGE. EXCESS WILL BE REFUNDED.

PHONO PICKUP CRYSTALS

Standard types – Set Manufacturers close-out – all Guaranteed

Nationally adv.—newest and finest—osmium tipped permanent needle—1.8 volts output—fits standard mounting holes. List Price $7.50. You pay us **2.69**

Nationally adv.—pintype terminals—¾ oz. pressure, 1.6 volt output—5000 cycle cutoff. List price $5.55—our Special.. **1.98**

—new postwar design—solder terminals—1¼ oz. pressure—1 volt output—4000 cycle cutoff. List price $5.55—we quote you..... **1.98**

—another new type—1¼ oz. pressure—.75 volt output—6000 cycle cutoff. List price $5.55—64% off... **1.98**

The prewar favorite—used in millions of phonographs—solder terminals—1¼ oz. pressure—.6 volt output—4500 cycle cutoff. List price $4.45—your cost..... **1.98**

RESISTANCE LINE CORDS

Standard 3 terminal 135 ohm AC-DC cords – sturdy construction, flexible – 5 ½' long complete with plug – for sets having approximately 69-75.2 volts drop in the filaments. Regular list price 1.17

***Only* 33c**

8/8/8 – 450

Genuine triple 8 mfd. – 450 volts – inverted screw mounting – insulated aluminum can 1½" x 4"-6" insulated leads – List price $4.25 – one time only at **89c**

OZ4 TUBES

New, guaranteed, made by the only maker of OZ4's. Buy now! Hit that car radio business hard – $2.20 List – 60% or more off – limited quantity.

Egg crate of 100 **79.00**

In colorful RSE box at 88c ea.

PAPER TUBULARS

Genuine name brand paper bypasses! New, fresh, full capacity standard merchandise – not surplus – all guaranteed! Check the list prices – our low nets – no need to figure the discount – buy 'em now, they've hit bottom!

Mfd.	Volts	List Price	Net Each	Per 100
.01	600	30c	10c	$ 9.15
.02	600	30c	11c	$ 9.95
.05	600	40c	14c	$12.95
.1	600	45c	16c	$14.95

Quantity Prices not assorted.

Wrap the paper around the drum, fasten it with *Scotch* tape, and play the record several times. Any errors in cutting will be very apparent and can be corrected by cutting a new record and changing spacing as indicated by the first trial. A finished record is shown in Fig. 4.

The laudatory comments of your visitors and the amusement of constantly surprising your friends with new tunes will repay in short order what little work goes into building this musical "doorbell." After that, all the fun will be clear profit, and I'll give you my personal guarantee that few, if any, will cross your threshold without a *SMILE!* —30—

A WEATHERPROOF HOUSING FOR SMALL SELSYN MOTORS

By C. F. DONBAR, W8PA

WHEN small indicating type selsyn motors appeared on the surplus market, the writer acquired a pair with the idea of placing them in service to give remote indication of the rotary antenna position.

These motors may be classed as delicate instruments, and probably would have a very short life if left in the weather, unprotected, for any length of time. Since one of the motors had to be mounted with the antenna rotating mechanism, a method of weatherproofing was devised which has been very satisfactory. The motor was recently inspected, and found in perfect condition after eight months of Michigan winter and spring weather.

A wide mouth, quart size glass jar, with a sturdy screw cover, forms the basis of the weatherproof housing for the motor. A can of similar size could be substituted, but the writer felt that it would be more convenient to use the glass jar, since the presence of moisture could be seen without opening.

A simple right angle metal bracket supports the motor and jar; this bracket is made from a strip of one sixteenth inch thick scrap metal which is approximately the same width as the diameter of the jar lid. At W8PA, a piece of heavy gauge scrap radio chassis was used for the mounting bracket.

Small sized flexible shaft is used for the mechanical connection between the selsyn motor and the antenna mechanism. This flexible shaft is of the same type as used to drive speedometers, and was used on the tuning heads of the older car radios. If an appreciable length of drive cable is needed, a used speedometer cable might be secured from a junk yard, and this could be cleaned up, relubricated, and used as is, providing the armored housing, and core are in sound condition. If a short length is required, the flexible shaft core may be secured as a radio part, and a length of soft drawn one-quarter inch copper tubing used for the housing. A word of advice concerning the method of cutting the flexible shafting: The core is made of a number of fine spring steel wires wound together under tension, and these wires have a tendency to unwind when cut; therefore it is best to clean and solder the core at the spot where the cut is to be made, and it will then saw easily without unwinding.

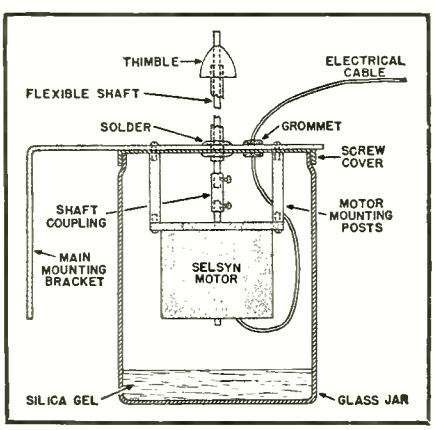
The motor is centrally located, and mounted about one and one-half inches below the under side of the jar lid in order to provide clearance for a brass set screw coupling which connects the flexible shaft to the motor shaft. The mounting of the motor will depend on the type of mounting flange on the motor, however most of the motors readily adapt to the use of brass mounting posts, or thin metal strips may be bent to form the supports. Keep in mind that the finished assembly must slip easily into the jar.

Lay out the motor mounting holes on the top of the jar lid, and include a center hole which will clear the flexible shaft housing. One other hole is needed for the entrance of the electrical cable, and the size of this hole will depend on the cable and grommet used. The lid and the main supporting bracket may be clamped together and both drilled at the same time, as all holes must match identically on each piece, since the two pieces are held together with the same screws that fasten the motor mounting posts.

The jar lid, main mounting bracket, and motor supports are assembled, and the flexible shaft housing is soldered to the assembly, and the flexible core is coated with graphite grease and pushed into place, the motor, with its shaft coupling, is then mounted and the assembly is complete. Note: If the motor does not have a protruding mounting flange, the mounting posts must be fastened to the motor face with studs, before final assembly.

In cases where the motor has leads brought out instead of terminals, a small terminal strip can be mounted alongside of the motor to eliminate splicing. If the flexible shaft ends in an upright position, a thimble should be drilled and soldered to the shaft end, to prevent the entrance of water; a jar rubber is added as an extra precaution, and sealing wax is recommended around the electrical cable entrance, unless rubber covered cable is used, and a tight fit secured with the grommet. A coat of asphaltum on the exterior metal parts will prevent rust, while a half inch layer of silica gel (obtainable from refrigeration supply houses or servicemen) will take care of all internal moisture. If the entire unit is to be mounted inverted, the silica gel may be placed in a cheesecloth sack, to prevent spilling. —30—

Weatherproofing the selsyn motor.



ARMY SURPLUS HEADPHONES HS23A

HS23A—Used but in A-1 electrical condition, 8000 ohms impedance. Complete with leather headband and rubber cushions. Shpg. Wt. 3 lbs.

ONLY **98¢**

SAVE NOW!

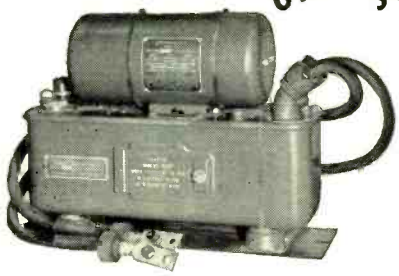
WITH A SURPRISE TRADE-IN ALLOWANCE ON YOUR USED TEST EQUIPMENT

SURPLUS KEY

Type J-37 Ruggedly built. ¼" silver contacts. Bakelite base. Shpg. Wt. 2 lbs.

ONLY **98c**

ON THESE SURPLUS SPECIALS



Brand New PE-103 DYNAMOTOR

Will deliver 500 VDC at 160 MA with either 6 or 12 VDC input. Complete with overload circuits, filter and connecting cable. In original overseas shipping crate. Shpg. Wt. 81 lbs.

ONLY..... **$9.95**

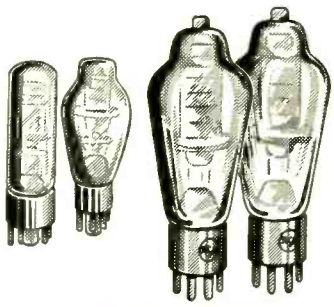
Output plug for above: Cannon P8-CG-12S. Shpg. Wt. ½ lb..... ONLY **95c**

For sensational trade-in values on your used Test Instruments and factory-built communication equipment, contact Walter Ashe right away. Simply tell us what you have to trade. We'll respond with an extra-liberal offer that's sure to please you. Write, wire or phone today!

ONLY **69c**

SURPLUS T-17 HANDMIKES

S. B. Carbon Mike with push-to-talk switch on handle. Complete with cord and plug. Brand New—in Original Cartons. Shpg. Wt. 3 lbs.



SURPLUS SPARE TUBE KIT

Complete set of spare tubes for BC-459-A or similar unit. Consists of 1—1626, 2—1625 and 1—1629. Brand new in original boxes. Shpg. Wt. 2 lbs.

ONLY **98c**

SURPLUS SENSITIVE RELAY

6500 ohm, 2 MA coil. SPST contacts. Shpg. Wt. ½ lb.

ONLY **98c**

EACH **5c**

SURPLUS OCTAL SOCKETS

Similar or equal to the MIP-8. Molded in plate 8 prong socket.
Shpg. Wt. 1 lb. **12 for 50c**

REMEMBER . . .

your Trade-In's worth more at the Walter Ashe Store. For real money-saving get Walter Ashe's offer before you make that trade.

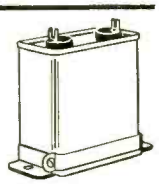
CHOKES

No. 5269—4.5 HY x 150 MA. 79 ohms DC Res. Shpg. Wt. 6 lbs.
Two for 79c ea.
One only....99c

No. 2785—Dual 12 HY x 250 MA. 150 ohms DC Res. per section. Shpg. Wt. 17 lbs.
ONLY.... **$4.95**

No. 6317—4 HY x 300 MA. 40 ohms DC RES. Shpg. Wt. 13 lbs.
ONLY... **$4.95**

FILTER CONDENSER



3 MFD. x 400 VAC. Good for about 1500 VDC. Metal can. Shpg. Wt. 3 lbs.
ONLY..... **98c**

TRANSFORMER

No.4891—1200/1400 VCT x 200 MA. PRI. 115 VAC 60 cy. Shpg. Wt. 18 lbs.
ONLY.... **$7.45**

Limited Quantity SURPLUS TUBES While They Last

Brand New . . . Original Cartons

3C24/24 G	$1.10
811	1.95
813	5.95
872 A	3.00
VT-127 A	2.95

ALL THE BIG NAME BRANDS of Test Instruments, Receivers and Transmitters in stock . . . ready for immediate delivery.

ATTENTION

RADIO SERVICEMEN . . . DEALERS, AMATEURS

For amazing bargains in top condition, slightly used Test Instruments and Communication Equipment, apply to Walter Ashe. A wide selection of good-as-new merchandise available.

TIME PAYMENTS AVAILABLE

ALL PRICES F. O. B. ST. LOUIS

IT'S HERE

IT'S HERE! . . . The new 1948 Walter Ashe Catalog—greatest in Walter Ashe history. Nearly 150 pages. Order your free copy today!

PHONE CHestnut 1125

WOULH WOJWD W9NRF WOWTM WOQDF WOPGI WOIYD

Use this coupon to get Walter Ashe's "Surprise" Trade-in Allowance on your used factory-built test equipment. RN4

WALTER ASHE RADIO CO.
1125 Pine St., St. Louis 1, Missouri

- ☐ Am interested in the following top condition, slightly used Test Equipment_____ (list preference)
- ☐ I want to trade_____ (describe used equipment) for_____ (show make, model of new Receiver desired or other equipment)
- ☐ Rush my FREE COPY of the big, New 1948 Walter Ashe Catalog.

NAME_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

Walter Ashe RADIO CO.

1125 PINE ST. • ST. LOUIS 1, MO.

MAIL COUPON TODAY

LETTERS from our readers

TRUE TO LIFE

"THERE is more truth than horror in the cartoon on page 181 of the January issue, only I do it one better. I have a midget radio that I rigged for headphones when the speaker went dead. Since I found I was the best available antenna I took another phone cord and ran it from the antenna lead of the set's loop antenna to a clip on my glasses. This saves me the trouble of holding the wire when I read while listening to the radio."

Paul C. Gunn
Kewanee, Illinois

That is OK providing you don't forget you are "connected" when the telephone or doorbell rings!

* * *

THE EDITORIAL

"THIS letter is prompted by your editorial in the February RADIO NEWS dealing with conditions in radio servicing. As a radio serviceman with some ten years' experience, I should like to make a suggestion.

"What I suggest is an investigation sponsored by some responsible organization, and carried out by properly qualified personnel. Let each man go into a reliable shop and work with the repairman, posing as a would-be helper or apprentice, for a period of at least a month. Let him observe every detail and get as clear a picture as he can of every angle. At the end of that time, each investigator would meet with the others and compare notes, collaborating in the publishing of their findings.

"Admittedly there are certain obstacles to such a project, but I think something along this line is badly needed both for the benefit of the public as well as the serviceman. What do you think?"

Donald Kiff
Elmira, New York

"NOW I am in complete agreement with you—there are too many chiselers in the radio business, also other types of business such as auto repairing, etc. But the reason for this letter is to pick some holes in your editorial.

"First you say a reliable serviceman probably would repair this set for free! Why? You cannot pay your bills working for free. Most good radio service stores have a minimum charge of approximately $1.00 for even so simple a job as replacing a dial light. No serviceman in his right mind will do any work for free—it might build goodwill but you cannot eat goodwill.

"Next, how can a serviceman cause a short in the volume control? That is a new one on me. Next, whoever heard of five condensers going out at once? Let's change the wording of that statement a little—change the words "going out" to the word "bad." My answer to this is, I have and you have too if you were ever in the radio service business.

"A leaky paper condenser is a bad condenser. I have found some of the sets have had to have all paper bypass condensers replaced. The customer has said the set worked better than when new!

"Now don't get me wrong, I am all for you, but I just didn't like some of the statements made in the article. RADIO NEWS is my favorite magazine."

Paul W. Curtis
Richland, Washington

* * *

"SPEAKING of a racketeer—how about the radio set that is put on the market that is no good or has extremely poor design or material incorporated in it. For example during the war I saw several $20 to $40 auto radios put in console cabinets and sold for the sum of $200 to $250. I see no reason for such practice now. We have had some nationally advertised radios in our shop that cost the customer $200 to $300 and from a performance standpoint they were no better than $25 set. I say this because a $200 radio should have more than a $20 cabinet, 5 or 6 tubes, a 7½" speaker, and an $18 list price record changer.

"It would be nice if we could eliminate all the racketeers not only in radio service but also in the well-known automobile field and few others as well. I haven't figured that out yet.

"I am looking forward to the time when radio and electronic servicing can be a licensed profession as I believe that education is the key to better service for electronic equipment.

"I don't believe any good radio serviceman that has spent from $12,000 to $15,000 and 10 to 15 years of his life to learn a few things about radio would care to check and repair any radio set for fifty cents, especially a portable. With prices at their present level, this would very soon lead to certain bankruptcy. Prices for professional services in other fields are somewhat above the level you mention for the professional radio serviceman."

Wendell W. Greiner
Central Electronics Co.
Salina, Kansas

It seems like the surest way to get an immediate reaction from readers is to get 'em angry enough about something so they'll get out pencil and paper and say so. Well—our gimmick (Feb. '48 editorial) worked and as a result, we've received a host of letters and phone calls from near and far in defense of the many thousands of honest, reliable servicemen who have been embittered by the stupid decoy radio set gag still being tossed around in the public spotlight as damning evidence that radio servicemen are all a bunch of racketeers.

We based our column on one of these "surveys," conducted by "Radio Daily" *and station WOR in N.Y.C. We reported their findings almost verbatim. Purpose—to reach the many thousands of radio technicians who neither heard the air blast from WOR nor read* "Radio Daily," "Time," *or other publications that ran the same story.*

We knew that many readers would have exactly the same reaction as we did. The most violent objection, of course, was that a qualified service technician was not on hand to carefully re-check the set after each call and to record any tampering (if any) that would put the next victim on the spot.

The public wasn't told that only one *"racketeer" could have done the dirty work and he could have been stop number one on the tour.*

Such surveys are usually run by those who seek the sensational. *And why is it that the target is always something technical or mechanical—like radio, watches, autos, etc. We think it's because people, generally, are not technically minded and feel that they are always being taken for suckers on things mechanical or electronic.*

* * *

BRITISH TV

"HAVING seen in the recent editions of RADIO NEWS the great strides made by the television industry in the USA, I thought perhaps your readers might be interested in my humble efforts at television construction in this land of "much austerity."

"As you are probably aware, the only TV transmissions at present are being radiated from Alexandra Palace, London, by the BBC on a frequency of 45 mc. for vision and 41.5 mc. for sound. The vision signal has a bandwidth of 4 mc. and the sound, which is AM, of 100 kc.

"The maximum service area for this transmitter is considered to be not more than fifty miles radius from Alexandra Palace. My home is 150 miles away so it is rather surprising that I receive anything at all. I am 3 miles below line-of-sight.

"The complete receiver, which is of home construction, has been made from ex-government radar parts purchased on the surplus market at the over-all cost, including the antenna, of less than 15 pounds ($60.00).

"The vision receiver itself is a converted naval "responder" unit which was designed to function between 200 and 250 mc. It was a superhet with 12 mc. i.f.'s that already had a 4 mc. bandwidth so only the front end had to be altered.

"The cathode-ray tube and time base

ANTENNA RELAY UNIT

0-10 Meter Weston Thermo-couple unit with 50 MMF, 5000v Vacuum condenser, and heavy duty relay...

$1.98

R·H·S

SPECIALS OF THE MONTH

RELAYS

Sigma No. 4RJ 2000 ohms SPDT. Can adjust to less than 1 ma..... **69¢**

ATR INVERTER
Model RSA

Input 12 v DC—output 110 v 60 c. 125 w Int. 100 w Cont.
Special **$18.95**

SELENIUM RECTIFIERS
Full Wave Bridge Type

INPUT	OUTPUT		
up to 18v A.C.	up to 12v D.C.	1 Amp.	$1.95
up to 18v A.C.	up to 12v D.C.	5 Amp.	4.45
up to 18v A.C.	up to 12v D.C.	10 Amp.	7.45
up to 18v A.C.	up to 12v D.C.	15 Amp.	9.95
up to 18v A.C.	up to 12v D.C.	30 Amp.	14.95
up to 36v A.C.	up to 28v D.C.	1 Amp.	3.45
up to 36v A.C.	up to 28v D.C.	5 Amp.	7.45
up to 36v A.C.	up to 28v D.C.	10 Amp.	12.45
up to 36v A.C.	up to 28v D.C.	15 Amp.	18.95
up to 54v A.C.	up to 36v D.C.	.25 Amp.	.98
up to 115v A.C.	up to 100v D.C.	.25 Amp.	2.95
up to 115v A.C.	up to 100v D.C.	.6 Amp.	6.95
up to 115v A.C.	up to 100v D.C.	5 Amp.	19.95

OIL CONDENSERS
NATIONALLY FAMOUS MAKES
All Ratings, D.C.

1mfd.	600v	$0.35	2mfd.	2000v	$1.75
2mfd.	600v	.35	3mfd.	2000v	2.75
4mfd.	600v	.60	4mfd.	2000v	3.75
8mfd.	600v	1.10	15mfd.	2000v	4.95
10mfd.	600 v	1.15	.1mfd.	2500 v	1.25
1mfd.	1000v	.60	.25mfd.	2500v	1.45
2mfd.	1000v	.70	.5mfd.	2500v	1.75
4mfd.	1000v	.95	.05mfd.	3000v	1.95
8mfd.	1000v	1.95	.1mfd.	3000v	2.25
10mfd.	1000v	2.10	.25mfd.	3000v	2.65
15mfd.	1000v	2.25	.5mfd.	3000v	2.85
20mfd.	1000v	2.95	1mfd.	3000v	3.50
24mfd.	1500v	6.95	12mfd.	3000v	6.95
.25mfd.	2000v	1.05	2mfd.	4000v	5.95
.5mfd.	2000v	1.15	1mfd.	5000v	4.95
1mfd.	2000v	.95	.1mfd.	7000v	2.95
SPECIAL 2 mfd. 3000v					$4.45

HIGH CAPACITY CONDENSERS

2x3500 mfd.—25WVDC..... $3.45
4000 mfd.—30WVDC..... 2.95
1000 mfd.—15WVDC..... .99
2000 mfd.—50WVDC..... 1.95

GIBSON GIRL TRANSMITTER
(SCR-578B)

Emergency life transmitter. 100% complete; includes balloon, hydrogen generator, kite, signal lamp, antenna and instruction manual. Self-powered merely by turning crank. Automatically transmits S.O.S. on 500 cycles.
FULLY GUARANTEED..... **$29.95**

PORTABLE F M TRANSMITTER
(SONOBUOY)

Operates on standard 67½v Minimac and 1½v Flashlight cells. Frequency 72 mc (easily doubled to 144 mc). Complete with 5 tubes and diagram. (Less batteries.)
EXCEPTIONAL BUY at..... **$12.95**

BC-375-E TRANSMITTER

Operates from 200 kc—12.5 mc complete with all tubes, dynamotor, seven tuning units and one antenna tuning unit.
Like New..... **$39.50**

CONSTANT VOLTAGE TRANSFORMER
NATIONALLY FAMOUS MAKE

Pri.: 190 to 260v 60 cyc.
Sec.: 115 volts @ 1.74 amps.
Rated 250 V. A.
Brand New..... **$29.95**

PERMALLOY SHIELDS
for CATHODE RAY TUBES

3" Shield..... $1.49
5" Shield..... 1.98

TUBES (*Brand New*)
Army-Navy Inspected

1N21	$0.39	371B	$5.95
2AP1	2.25	450TH	39.95
2C40	1.19	703A	7.95
2D21	.89	715B	7.95
2V3G	1.25	721A	4.35
2X2	.84	726/AC	7.50
3AP1	3.00	801	1.49
3BP1	2.95	802	1.98
3E29	2.95	803	8.95
3GP1	3.95	804	9.95
5BP4	4.95	805	4.95
5CP1	3.95	806	14.95
5JP1	11.95	807	.95
5LP1	8.95	808	2.95
5R4GY	.98	809	1.50
5Y3	.41	810	5.95
6AB7	.99	811	1.95
6AC7	.99	812	3.15
6AG5	.99	813	8.95
6AG7	.99	814	4.45
6AJ5	.99	815	3.95
6AK5	.90	829-A-B	3.00
6AL5	.99	832	2.25
6AQ6	1.09	833A	39.50
6AR6	1.29	836	1.75
6B4G	1.29	837	2.50
6C4	.69	838	3.95
6C5	.49	861	69.50
6D4	.99	866	.75
6F6	.89	872A	2.50
6F6G	.59	884	.98
6J4	1.50	885	.98
6J5	.55	902	3.00
6J6	.89	954	.75
6L6	1.23	955	.75
6L7	.98	956	.75
6N7	1.02	957	.75
6SH7	.59	958	.75
6SL7	.89	959	.75
6SN7	.69	1005	.69
6SR7	.89	1616	2.95
7A4	.81	1619	.75
7F7	1.25	1620	1.98
7L7	1.59	1622	1.98
10Y	.98	1624	.90
15E	1.50	1625	.75
HK24G	1.75	1626	.75
28D7	.98	8001	6.49
30	.75	8003	9.95
35T/TG	3.50	8005	4.95
VR90	.75	8011	3.75
VR105	.75	8016	1.65
VR150	.75	8025A	4.95
100TH	7.95	1654	1.98
100TS	3.00	9001	1.15
211	1.25	9002	.98
75T	2.95	9003	.98
250TH	14.95	9004	.98
257B	6.49	9005	.98
304TH	9.95	9006	.98
F-127A	22.50	F-128A	75.00

GLIDE PATH RECEIVER R-89/ARN-5

Glide Path Receiver used in the Instrument Landing System covering the frequency range 332 to 335 mc; complete with the following tubes: 7—6AJ5, 1—12SR7, 2—12SN7, 1—23D7, and including three crystals 6497KC, 6522K.
Brand New..... **$12.95**

TRANSFORMERS—115 V 60 CYC.
HI-VOLTAGE INSULATION

3710v @ 10 ma.; 2x2½v @ 3A..... $9.95
2500v @ 15 ma..... 6.50
2500v @ 4 ma.; 2½v @ 2A. 6.3v @ 1 amp.. 9.95
2150v @ 15 ma..... 6.50
1750v @ 4 ma.; 6.3v @ 3A..... 7.50
1700v @ 4 ma.; 6.3v @ 6A; 2½v @ 1.75A.. 8.50
1600v @ 4 ma.; 700v CT @ 150 ma.; 6.3v @ 9A..... 8.50
1600v @ 2 ma.; 6.3v @ 6A; 2½v @ 1.75A.. 8.50
1200v CT @ 400 ma.; 10v CT @ 10A..... 9.95
550-0-550 @ 150 ma.; 5v @ 3A; 2x6.3v @ 5A CT..... 7.95
525-0-525v @ 60 ma.; 925v @ 10 ma.; 2x5v @ 3A; 6.3v @ 3.6A; 6.3v @ 2A; 6.3v @ 1A. 8.95
525v @ 35 ma.; 5v @ 35 ma.; 2½v @ 1.75A.. 1.98
520-0-520v @ 120 ma; 5v @ 2A; 6.3v CT @ 5A..... 5.95
500-0-500v @ 25 ma.; 262-0-262v @ 55 ma.; 6.3v @ 1A; 2x5v @ 2A..... 4.49
500-0-500v @ 100 ma.; 5v CT @ 3A..... 4.95
400-230-0-230-400v @ 250 ma.; 3x5v @ 3A; 6.3v @ 5A; 6.3v @ 3A; 6.3v @ 1A..... 7.95
400-315-0-100-315v @ 200 ma., 2.5v @ 2A., 5v @ 3A., 6.3v @ 9A., 6.3v @ 9A..... 7.50
400-0-400v @ 200 ma.; 5v @ 3A..... 4.95
385-0-385-550v @ 200 ma., 2½v @ 2A., 5v @ 3A., 3x6.3v @ 6A. Pri-110/220v..... 9.95
375-0-375v @ 400 ma..... 4.95
350-0-350v @ 150 ma.; 5v @ 3A; 6.3v @ 6A; 78v @ 1A..... 4.95
350-0-350v @ 45 ma.; 675v @ 5 ma.; 2½v @ 2A; 2x6.3v @ 1A; 6.3v @ 2½A..... 4.95
350-0-350v @ 80 ma.; 6.3v @ .6A; 6.3v @ 3.75A; 2x5v @ 3A..... 3.98
350-0-350v @ 150 ma.; 5v @ 3A; 6.3v @ 7.5A; 6.3v @ 3A..... 5.95
350-0-350v @ 35 ma..... 1.49
340-0-340v @ 300 ma.; 1540v @ 5 ma..... 7.50
335-0-335v @ 60 ma., 5v @ 3A., 6.3v @ 2A., 0-13-17-21-23v @ 70 ma. Pri-110/220v..... 5.49
325-0-325v @ 120 ma.; 10v @ 5A; 5v @ 7A.. 3.49
300-0-300v @ 65 ma.; 2x5v @ 2A; 6.3v @ 2½A; 6.3v @ 1A..... 3.49
250-0-250v @ 100 ma.; 2x6.3v @ 4A; 6.3v @ 5A; 6.3v @ 1A..... 4.95
200-0-200v @ 140 ma.; 6.3v @ 4A; 5v @ 2A.. 1.98
120-0-120v @ 50 ma..... .98
24v @ 6A..... 3.50
3X10.3v @ 7A..... 9.95
6.3v @ 10A; 6.3v @ 1A..... 3.50
6.3v @ 1A; 2½v @ 2A..... 3.95
6.3v @ 21½A; 6.3v @ 2A; 2½v @ 2A..... 6.95
6.3v @ .25A; 6.3v @ 3A; 5v @ 12A; 6.3v CT @ 9A..... 4.95
5v CT @ 16A..... $3.49 5v—115A..... 14.95
5v—190A..... 17.50 6.3v @ 6.6A..... 2.95
6.3v CT @ 1A..... .98 8v CT 1A..... .98
220v to 110v @ .75 kv..... 2.98
6.3v CT @ 3A; 5v CT @ 4A..... 4.25

FILTER CHOKES
HI-VOLTAGE INSULATION

10 hy @ 400ma	$4.95	10 hy @ 250ma	$2.49
8 hy @ 300ma	3.95	10 hy @ 200ma	1.98
25 hy @ 160ma	3.49	10/20 @ 85ma	1.59
12 hy @ 150ma	2.25	15 hy @ 125ma	1.49
12 hy @ 100ma	1.39	15 hy @ 100ma	1.39
30 hy @ 70ma	1.39	3 hy @ 50ma	.29
120 hy Dual @ 17ma	1.39	30 hy Dual @ 20ma	1.49
.1 hy @ 5 amps	6.95	10/20 hy @ 85 ma	1.49
4 hy @ 600ma	5.95	10 hy @ 100ma	1.29

ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

All merchandise guaranteed. Mail orders promptly filled.
All prices F.O.B. New York City. Send money order or check.
Shipping charges sent C.O.D. Minimum order $5.00.
20% Deposit required with all orders.

ATTENTION!

INDUSTRIALS—LABS—SCHOOLS—AMATEURS

Let us quote on components and equipment that you require. We have too many items to be listed on this page. Place your name on our mailing list now for new catalog.

RADIO HAM SHACK Inc.

63 DEY STREET • NEW YORK 7, N. Y.

unit is a converted RAF indicator (similar to the U.S. indicator unit type BC704A). The CR tube itself is 6" in diameter and is electrostatically deflected. The time base generators are EF50 pentodes operating on the combined Miller-Transitron principle. They are synchronized by applying a negative going pulse to the suppressor grid and are extremely stable in operation.

"My sound receiver is an ex-RAF beacon receiver, Type 1125d, modified to the 41.5 mc. frequency. It is used as a converter to 7 mc., the latter frequency being fed into a modified USAAF *Bendix* radio compass receiver which serves me as a communications receiver.

"In closing I must say how much I enjoy reading RADIO NEWS and only hope that the British Treasury will allow me to invest in a further year's subscription."

Thornton N. J. Archard
Taunton, Somerset
England

Nice hearing from you, Mr. Archard. We know our readers will be interested in your comments.

* * *

SUGGESTION

"A GROUP discussion at one Detroit radio school brought out several suggestions requiring long time preparation.

"Between $.35 for high school students and $10.00 for engineers there is a demand for a tube manual selling for a $1.00 that will show graphs on every page, show oscillograph patterns at every stage for AM and FM, and give diagrams for FM alone and television alone.

"With more trucks and buses using two-way radio, new tube manuals should have another column showing operating readings for a storage battery power supply. Manufacturers of portables should attach a cellophane covered statistics sheet."

Steve Clamage
East Dearborn, Michigan

That is a lot of suggestions to digest at one time!

* * *

CIRCUIT DIAGRAMS

"FOR many years I have been a rather consistent reader of RADIO NEWS and am now subscribing to the RADIO ELECTRONIC ENGINEERING edition.

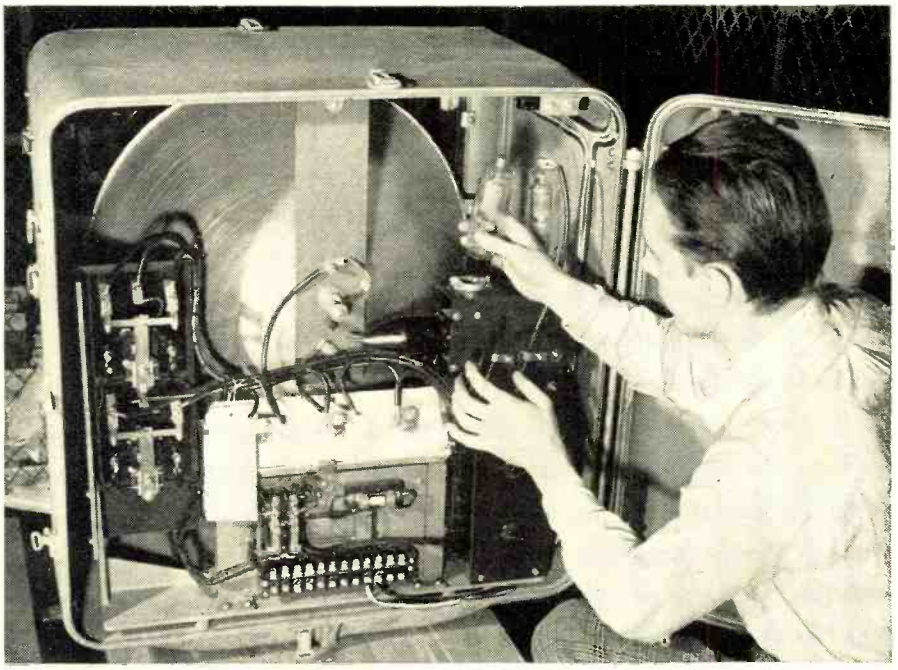
"In reading all electronic diagrams, parts are, unless listed otherwise usually referred to as C_1, C_2, C_3, etc. with separate listings of ratings and values as C_1, C_4, C_{12}—.01 μfd., 600 v., etc. This leads to many exasperating minutes looking through a long list trying to find the value of C_{12} or R_{50} which may be placed at random with other parts of similar value in the column.

"Why not simplify the problem by listing and indicating all like parts as $R_{1\text{-}1}$, $R_{1\text{-}2}$, $R_{1\text{-}3}$, etc. in the diagrams and listings? Avoid our confusion and hair pulling when values are not given on the diagram itself. May I suggest a poll of other readers?"

Robert J. Cartwright
Boston, Massachusetts

We'll check into this idea—but offhand don't think it too practical.—Ed.

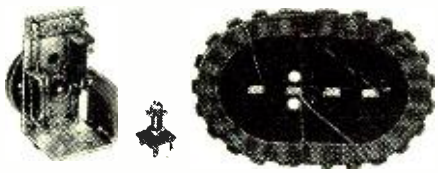
The 3.3 billion candlepower Krypton light used in the approach line of the Westinghouse all-weather approach light system for airports is flashed alternately "on" and "off" in a predetermined sequence by means of the electronic timing system shown here installed in the rear of the weatherproof case that houses the lamp, reflector, and flasher. The electronic sequencing element is built and tested by the Control Division in Buffalo, then shipped to the Lighting Division in Cleveland where it is assembled. These early units are for the first full system that is to be installed at New York City's "Idlewild Airport."



Your dollar buys more at MID-AMERICA!

VALUES! VALUES! VALUES!

PERMEABILITY TUNER



MA-2167

$1.24

Build a really HOT 5 or 6 tube AC-DC superhet receiver with this compact permeability tuner. Takes the place of old-style gang condenser, rf and antenna coils; regular 455 KC intermediate frequency. Wiring diagrams supplied for making receivers with all standard parts and conventional tube line-up. Complete with permeability tuned oscillator coil. 4"x2½"x2¼" diameter dial drum. Order MA-2169 Loop Antenna for use with tuner . . . **15c** and MA-2914 drilled and punched chassis . . . **39c**

T-17 MIKE

Famous T-17 carbon microphone with built-in hiss filter. Push-to-talk button in handle. Has 5-foot rubber-covered cable with PL-68 plug. Slightly used, but reconditioned and in perfect shape. A great buy!

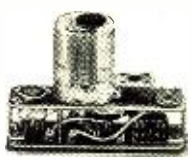
MA-17

49¢

DACO TUBE TESTER

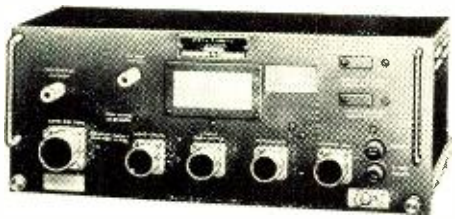
Tests performance, leakage and shorts in ALL receiving tubes, even sub-miniature and acorn. Durable construction, fully shielded. Dust-proof case. Tests every tube element. MA-2193....**$29.50** Portable model, MA-2194....**$32.50**

BANTAM 1-WATTER



BCR-746-A tuning unit used as foundation for Bantam 1-Watter described in Jan. 1948 QST. Makes tiny, crystal-controlled CW xmitter. 3⅜" long, 2½" high, 1⅛" wide. Requires 1½ volts "A", 30 to 90 volts "B"; draws 8 to 15 ma under load. Supplied less crystal, 1S4 tube and plug-in coil. MA-907.....

24¢

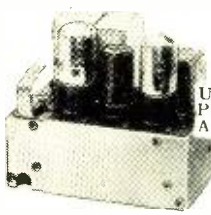


FM TRANSMITTER (APN-1)

MA-2198

$34.50

Used as indicator for altitudes up to 4000 ft.—but readily adapted for signaling, control circuits, etc. Contains dynamotor for operation from 27.5 volts. Complete with all 14 tubes. Two antennas, altitude indicator, limit switch, connectors, instruction manual.



Crystal Oscillator Unit

Used as frequency standard. Part of famous Collins AN/ART-13 transmitter. Unique sub-assembly utilizes one 12SL7GT twin triode as a combination 200 KC calibration oscillator and a frequency tripler, one 12SA7 as a converter, and one 12SL7GT as a signal detector and MCW audio oscillator supplying a 1000 cycle note. Regenerative frequency divider and multiplier circuit provides a 50 KC fundamental and harmonics to 18 megacycles. Shipped with tubes and schematic diagram, less 200 KC crystal. MA-OSC-3T... .....

$2.95

CRESCENT RECORD PLAYER

Inexpensive phono amplifier (base only) and record changer with big-set features. Changer handles 10" and 12" records without jamming. Finger-tip reject button. Lightweight pick-up with Shure crystal; 78 RPM constant-speed motor; less speaker, line cord, amplifier. MA-2192.....

$14.95

FM-AM HAM ANTENNA

AN-104-B ¼ wave at 100-156 MC. Formerly used with SCR-522, 274-N, ARC-5. A pair make an excellent broad-band dipole for FM reception. Coaxial connector in base. MA-2153.....

39¢

Miniature Tube-Pin Straightener

Steel die for straightening pins on fragile miniature tubes (1S5, 6AK5, 9002, etc). Quickly aligns pins. Simply plug tube in die. Only 1¼" high; 1⅝" mounting centers for bench installation. MA-2139. .

27¢

ORDER FROM THIS AD!

Hurry! Get your order in quick for the big bargains listed in this ad. Minimum order we will ship is $2.50! Send 25% deposit with order; balance COD. Mail coupon for BIG BARGAIN BULLETINS that offer latest, greatest buys that save you money! Send orders to store address.

MID•AMERICA CO. Inc.

STORE
2412 S. Michigan Ave.
Chicago 16, Ill.

WAREHOUSE
2307 S. Archer Ave.
Chicago 16, Ill.

MID-AMERICA CO, Inc.
2412 S. Michigan Ave., Dept. E-48
Chicago 16, Illinois

Please put my name on your mailing list to receive BIG BARGAIN BULLETINS that list latest, money-saving buys in radio parts, electronic equipment.

Name.....

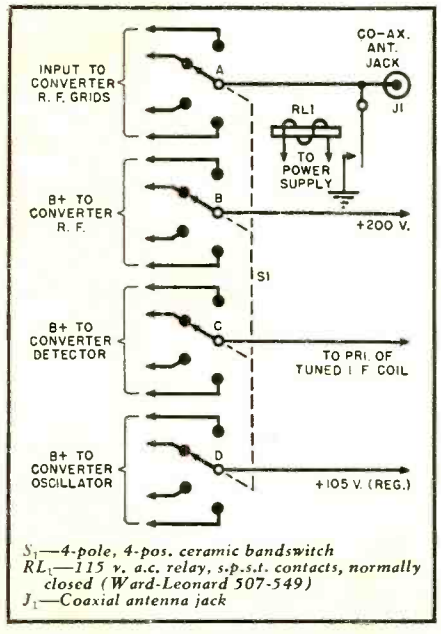
Address.....

City.....State.....

Deluxe Receiver

(*Continued from page 78*)

is obtained or 1900 kc., for the tunable i.f. to use. This means, therefore, that you tune the unit (Fig. 5) to 1900 kc., in its range of 1500-3500 kc. in order to receive signals on 14,400 kc. Since the three-gang condenser tuning the tunable i.f. section is of the straight-line-frequency type, and the dial calibration is linear, tunable i.f. section must be adjusted in order that 1500 kc. falls at 100 and 3500 kc. falls at 500, thus giving exactly 400 divisions, a quarter-inch apart, with each division representing exactly 5 kc. By this means, frequency can be determined at a glance, since the bottom edge of *all* bands hits at 100 on the dial. All that is necessary (for instance on 20 meters) is to multiply by 5 the dial reading in excess of 100, and add this figure to 14,000 kc. in order to determine the frequency.



S_1—*4-pole, 4-pos. ceramic bandswitch*
RL_1—*115 v. a.c. relay, s.p.s.t. contacts, normally closed (Ward-Leonard 507-549)*
J_1—*Coaxial antenna jack*

Fig. 10. Bandswitch wiring diagram.

—30—

"He's used to repairing radios under fire!"

EVERYTHING IN RADIO and ELECTRONICS IN ONE BOOK

The Radio Data Book

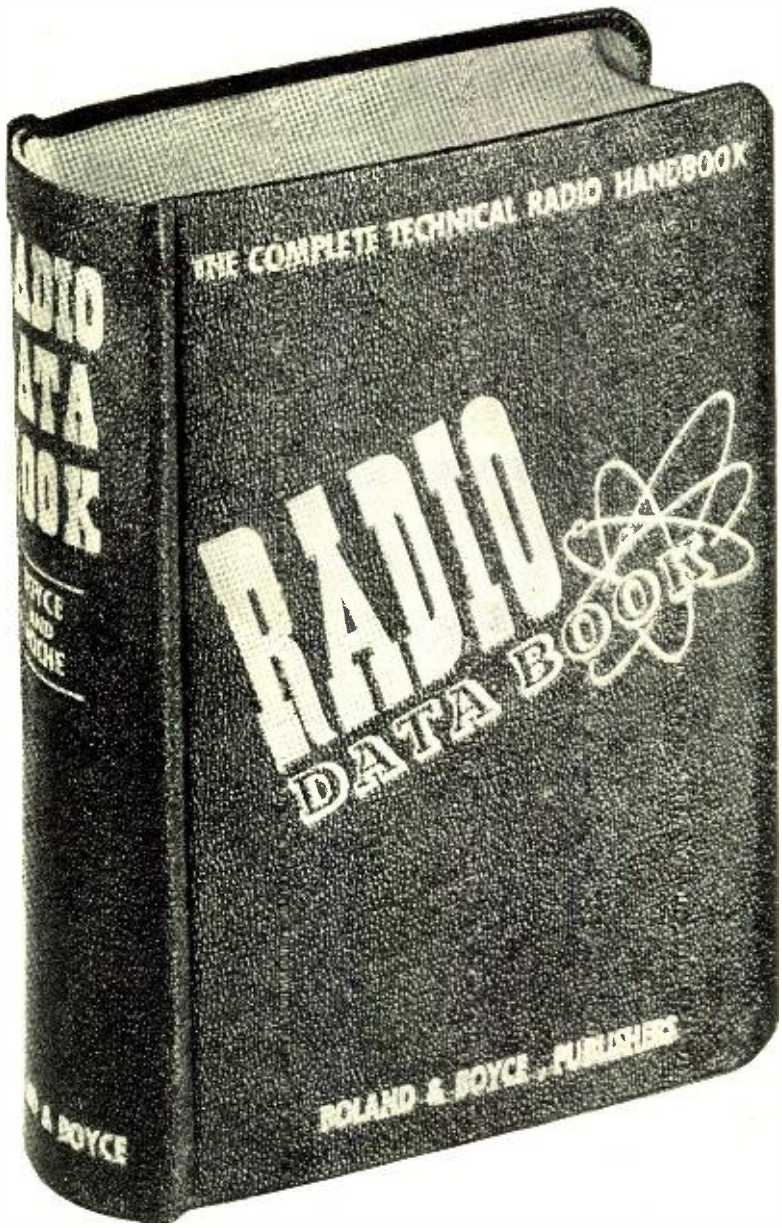
More Than 1000 Pages

●

All data and basic knowledge in radio and electronics digested into 12 sections . . . in a complete, quick to find, easy to read, handbook form.

●

HANDSOMELY BOUND IN RED AND GOLD



Plan every operation in radio and electronics with the *Radio Data Book.* This new radio bible will be your lifelong tool . . . you will use it every day, on the board, at the bench, in the field! Use it for engineering, construction, troubleshooting and testing. The RADIO DATA BOOK will be your invaluable aid in design, experiment and in layout. It will help make your production better, faster and easier. In any and every operation in radio and electronics, you will use the RADIO DATA BOOK!

The RADIO DATA BOOK is a work of complete authority, prepared by engineers with many years of practical experience. They have been assisted by the Boland & Boyce staff of editors skilled in preparing electronics manuals for the U.S. Signal Corps for many years. These men have worked for several years gathering material for this book . . . all the knowledge of radio principles and operation . . . all the statistics . . . all the newest developments in electronics . . . every possible angle and detail. Eighteen months were spent digesting this material into the most concise, the clearest, and the most readable form. The result is this invaluable manual . . . The RADIO DATA BOOK. Whether you use this book for general reference, for scientific instruction, or for education, one thing is certain—the practical help, the daily usefulness you will derive from it will prove to be worth many, many times its astonishingly low price!

Advance Sale . . . first printing. Only 10,000 available . . . To make sure to get your RADIO DATA BOOK, mail your order *NOW!*

12 complete books in one only $5.00! Less then 42c per book!

CONTENTS

Each section is a COMPLETE coverage of its subject . . . 12 sections . . . 12 books in ONE. 1000 pages . . . Schematics . . . Accurate photographs . . . Specially prepared drawings . . . White on black charts . . . Diagrams . . . Isometric projections and exploded views.

Section 1. THE 150 BASIC CIRCUITS IN RADIO.
Every circuit is analyzed and explained in a Johnny-on-the-spot reference for any occasion.

Section 2. COMPLETE TEST EQUIPMENT DATA.
Know more about the test instruments you now have . . . Find the new ones you want to buy . . . They're *All* in here—impartially described!

Section 3. RECORDING.

Section 4. ALL ABOUT ANTENNAS.
AM-FM-Television . . . design, installation, characteristics, construction and feed.

Section 5. SOUND SYSTEMS.
Planning, installing and servicing a PA System. A complete chapter on every component . . . How to select and combine components . . . estimating costs . . . even acoustic requirements!

Section 6. ELECTRICAL AND PHYSICAL CHARACTERISTICS OF RADIO COMPONENTS.
Know the size, the power, the shape! A quick reference on the construction and design of any circuit or equipment.

Section 7. COMPLETE TUBE MANUAL: Receiving, transmitting and commercial.
A flick of the pages brings to you all the data and ratings of any tube made.

Section 8. CHARTS, GRAPHS AND CURVES.
Quick calculation devices . . . Plotting curves, nomographs, rules and tables for speedy solutions to radio problems.

Section 9. CODES, SYMBOLS AND STANDARDS.
Handy reference to all radio symbols and abbreviations; code symbols, phrase and characters . . . Where you want them . . When you want them!

Section 10. 50 TESTED CIRCUITS DESIGNED FOR OPTIMUM PERFORMANCE.
Find any circuit you want with complete parts lists and specifications . . . One tube receivers to complete AM, FM and Television receiver circuits . . . Amplifiers . . . Transmitters . . . Test Equipment and Control Circuits . . . All with the latest engineering refinements.

Section 11. DICTIONARY OF RADIO AND ELECTRONIC TERMS.

Section 12. RADIO BOOK BIBLIOGRAPHY.

Mail this Coupon to Your Jobber or Direct to: RN-4

BOLAND & BOYCE INC., Publishers
460 Bloomfield Ave., Montclair, N. J.

Please send me a copy of
THE RADIO DATA BOOK Enclosed is $5.00. ($5.50 Foreign)

NAME.....
ADDRESS.....
CITY.....ZONE.....
STATE.....

BOLAND & BOYCE INC., PUBLISHERS

What's New in Radio

(*Continued from page* 86)

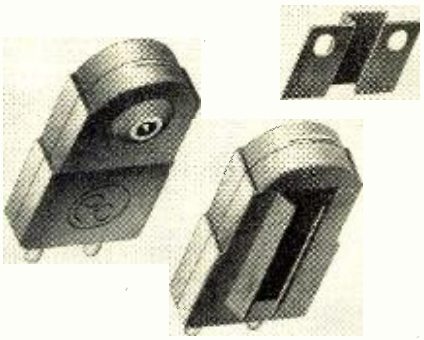
formance, good wear characteristics, reduced hum pickup, and controlled groove contour.

Complete information is available to firms interested in the manufacture of wire recording equipment. All requests for information must be made on company letterhead direct to *Shure Brothers, Inc.,* 225 West Huron Street, Chicago, Illinois.

DIAMOND CARTRIDGE

The *Pickering* Diamond Cartridge, the Model D-120M, is currently being placed with jobbers throughout the country.

Electrically identical with the *Pickering* Cartridge, the new unit provides



practically unlimited life, outwearing at least ten sapphire equipped cartridges, according to the company. This feature is especially advantageous when playing shellac records.

The diamond is finished to a high polish and since it does not change its shape with continued playing, it causes little wear on the records.

A new technical bulletin describing both models of the *Pickering* Cartridge and the Model 125H Equalizer-Amplifier is now available from *Pickering & Company, Inc.,* 29 W. 57th Street, New York 19, New York.

CABINET RACK ASSEMBLIES

Newcomb Audio Products Co. of Hollywood, California has announced the availability of basic elements for custom, cabinet-type rack systems suitable for various sound applications in industry, schools, churches, fairs, stadia, etc.

These new rack assemblies enable the engineer to install public address equipment designed to meet the customer's requirements. Included in this new line are the Model 595 cabinet, the Model K-60P-900 sixty watt power amplifier, the Model KX-6-900 preamplifier, Model PR-2-450 dual channel preamplifier, Model MP-450 and Model MP-900 monitor speaker panel, Model TB1-450 talk back amplifier, the Model WC-900 phonograph changer panel, and various sized blank panels.

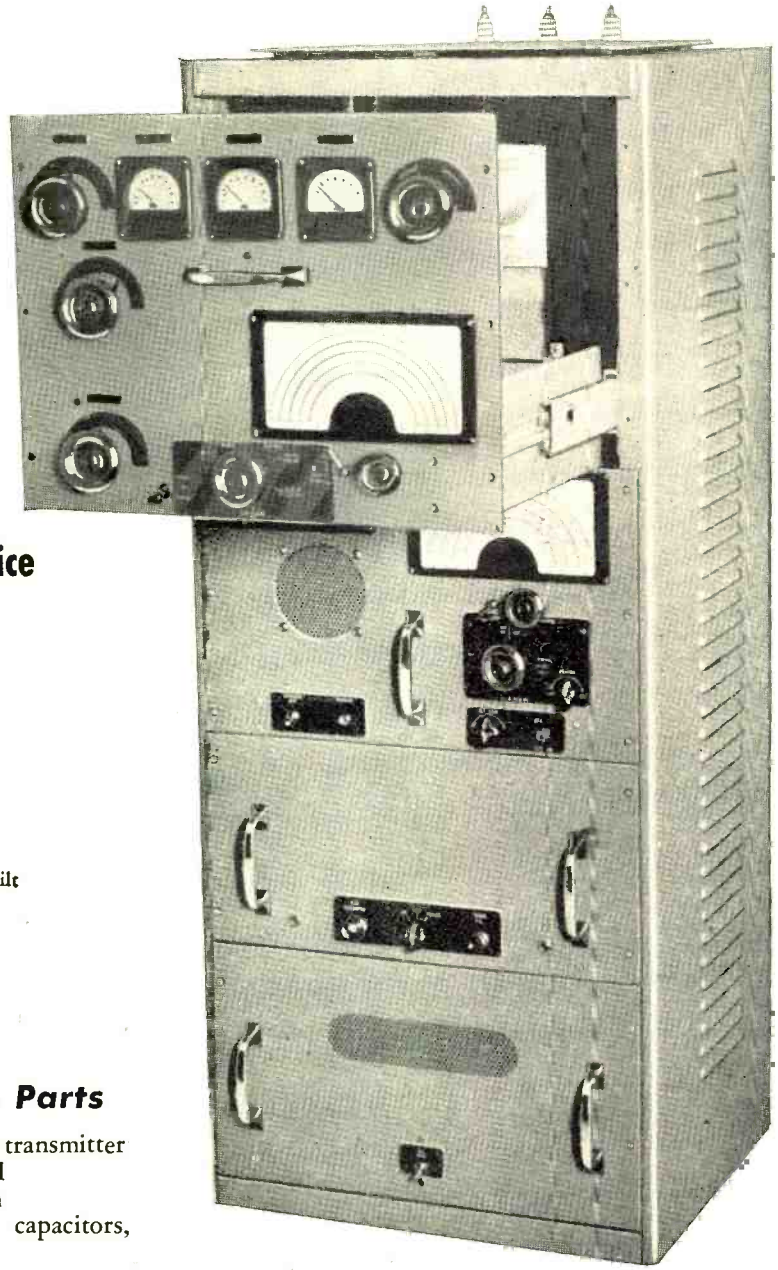
A data sheet covering this new line

A Complete Station!

Model AN/FRC-1

300 Watt Transmitter

9 TUBE SUPERHETERODYNE RECEIVER



- **Amateurs** • **Airports**
- **Ship-Shore** • **Police** • **Gov't Service**

Phone, CW and MCW
Band-Spread Receiver with Built-in Speaker
Complete Station — Nothing Else to Buy
Push-to-talk Relay System
CW Break-in Operation
E.C.O. With Frequency Meter Accuracy
Receiver Range 1.48 mc. to 12.5 mc. (4 Bands)
Transmitter Range 1.49 mc. to 12.5 mc. (5 Bands)
All Important Circuits Metered
Final: 1-813 Modulator: 2-811's Class B
Power Supply, Modulator, Receiver and Power Amplifier Built in Separate Roll-Out Decks
Operates on 90 to 120 V.A.C. or 200 to 230 V.A.C.
No Modification Necessary — Ready to Operate
Universal Antenna Matching Network
Cabinet Size: 52⅛" X 21½" X 17¾"

Remote Control Unit and Spare Parts

Remote Phone or CW Operation up to 70 feet from transmitter
Unit Contains 5" PM Speaker and Volume Control
Remote Unit Has Primary Power ON-OFF Switch
Spares include 30 tubes (complete replacement) capacitors, resistors, relays, fuses, etc.

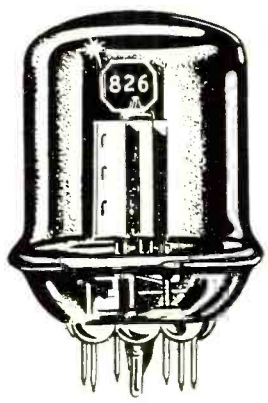
Model AN/FRC-1 Transmitter-Receiver, Complete with Speedex Key and push-to-talk microphone, ready to operate—only $495.00.

Remote Control Unit and Spare Parts and Tubes—only $39.00.

Shipped in original crates (3). All units brand new and guaranteed. Weight 800 lbs. Prices are F.O.B., Chicago. $100 with order required on C.O.D. shipments.

Write for Special Listing AN/FRC-1 for Complete Details

Standard Make Type 826 —60 Watt UHF Transmitting Tubes at 49c each! The growing popularity of the higher frequency bands makes this general purpose tube an outstanding value. These 826's are brand new, inspected, and in their original cartons. Shipped only in boxes of 8 tubes at $3.92. (Add 50c for mailing anywhere in U.S.) Ceramic Tube Sockets for 826, 829B—50c each.



WELLS SALES, INC.

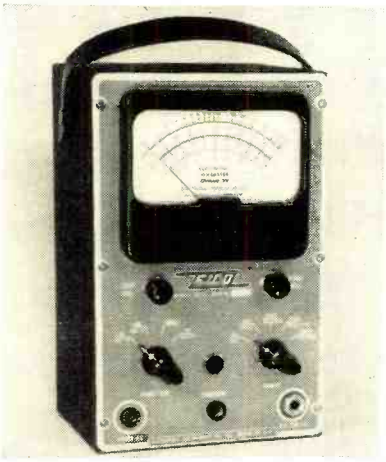
320 N. LA SALLE ST., DEPT. R-4 CHICAGO 10, ILL.

of cabinet rack assemblies may be secured from *Newcomb Audio Products Co.*, 6824 Lexington Ave., Hollywood 38, California.

V.T.V.M.

Electronic Instrument Company, Inc. of Brooklyn, New York has announced the addition of the Model 221 vacuum tube voltmeter to its line of test equipment.

The new instrument features completely electronic operation on all



functions and ranges, accurate electronic a.c. range, a burnout-proof meter, special type electronic bridge circuit which is said to practically eliminate all zero drift after a short warm up period, two per-cent accuracy on all ranges, 26 megohms input resistance, and a 4½ inch meter with two per-cent accuracy.

The electronic a.c. and d.c. ranges measure 0-5, 10, 100, 500, and 1000 volts while the electronic ohmmeter covers the range from .2 ohms to 1000 megohms in five positions. A wide-range db. scale is also provided.

More information on the Model 221 can be obtained from *Electronic Instrument Company, Inc.*, 926 Clarkson Avenue, Brooklyn 3, New York.

DUMMY ANTENNA RESISTORS

The development of two new series of dummy antennas, Types D-101 and D-251, has just been announced by the

Ohmite Manufacturing Company of Chicago.

These new units which replace the former glass-enclosed Types D-100 and D-250, are composed of wirewound vitreous-enameled resistors connected in parallel and mounted inside a black

"TAB"

That's A Buy

CONDENSER OIL RATED WVDC CD
Tapped 2 & .5 & .3mfd/200V ..... 15 for $1.50
CD 2mfd/330VAC/1000WVDC ..... 5 for 1.98
5mfd/600WVDC/220VAC & brackets 2 for 1.49
7mfd/660V 89c; 10mfd/600V 1.25
3.3mfd/225TAC $1.25; 4mfd/600V ..... .49
20mfd/600V/$2.50; 4fmd/330VAC/1000V 1.39
15mfd/330VAC/1000V/$3; 2mfd/2000V 2.25
3mfd/2000V/$3; 4mfd/3000V 5.00
2mfd/5000V/$10; 4mfd/5000V 15.00
2mfd/12500V/$25; 1mfd/25000V 75.00
1mfd/4000V/$3.75; .00025mfd/25KV 4.95
2x1mfd/400V/12 for $1; 3x.1mfd/400V/10 ..... 1.00
1mfd/400V/12 for $1; 2mfd/400V/5 for 1.00
.5mfd/500V/10 for $1; 1mfd/500V/8 for 1.00
.05mfd/600V/30 for $1; 2x.05mfd/600V/25 for 1.00
3x.05mfd/600V/15 for $1; 3x.22mfd/600V/12 ..... 1.00
.1mfd/600V/10 for $1; 2x.1mfd/600V/8 for 1.00
3x.1mfd/600V/8 for $1; 2x.25mfd/600V/6 for 1.00
3x.25mfd/600V/5 for $1; .5mfd/600V/8 for 1.00
2x.5mfd/600V/6 for $1; 1.22mfd/600/8 for 1.00
.1mfd/1000V/4 for $1; .25mfd/1000V/4 for 1.20

"TAB" FOR TUBES

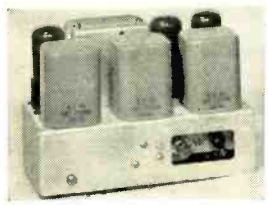
OZ4	$1.10	28D7	$0.89	9006	$0.49
1B3/8016	2.00	30	.74	902A	2.85
1E7G	.98	35Z5	.61	2AP1	1.95
1L4	.98	35L6	.74	2AP1A	4.95
1P5G	.79	50L6	.72	3AP1	3.25
2A5	.75	80	.52	3BP1	2.75
2C40	.73	83V	1.25	3DP1	2.75
2D21	.98	OC3/VR-105	.74	3FP7	2.75
2X2	.49			3GP1	3.95
2V3G	.98	OC3/VR-150	.74	3JP12	3.95
3A4	.75			5AP1	2.75
3B7/1291	.95	211	.79	5BP1	3.75
3D6/1299	.95	250TH	18.00	5BP4	3.75
3S4	.90	304TL	6.95	5CP1	3.75
5R4G	1.00	307A	3.25	5FP7	3.95
5T4	1.53	446A	1.98	5HP1	3.95
5U4G	.69	450TH	25.00	7BP7/1813	3.95
5W4	.98	450TL	29.95	9JP1	3.95
5Y3G	.53	WL531	18.00	12DP7	5.95
5V4G	1.00	703A	4.95	1B24	2.95
5Z3	.80	717A	.89	1B27	2.95
5Z4	1.00	723	2.95	1P24	2.95
6AB7	.98	723AB	4.95	2E22	1.50
6AC7	.72	725	4.95	10Y	.35
6AG5	.97	803	9.00	15E	1.49
6AG7	.98	804	8.95	2C26	.39
6AJ5	.98	805	4.95	2C34/RK34	.49
6AK5	.81	807	1.49		
6AL5	.95	808	1.95	2C48/145A	.88
6AR6	1.28	811	2.49	3B24	.74
6B4G	1.29	813	8.90	3C23	4.95
6H8G	.98	814	5.95	4E24/25T	10.00
6C4	.39	815	3.95	2J21	12.75
6C5	.75	816	1.15	2J32	16.95
6C6	.73	826	1.45	2J55	18.00
6C8G	.98	829B/3E29	3.90	2K29	4.95
6D4	.98	836	1.10	VT127	2.95
6D6	.74	837	2.25	631P1/SN4	3.75
6E5	.98	845	4.95	CK1005	.30
6F6/1613	.69	860	2.49	C6J	4.95
6F7	1.20	861	9.00	F127A	12.00
6F8	1.20	864	1.00	T200	12.00
6G5/6H5	.98	865	1.00	4J47	35.00
6G6	1.08	868	1.00	2BA15	5.95
6H6G	.48	872A	2.20	CE215	5.95
6H6M	.68	884	1.10	2RA6	3.95
6J4	1.98	922	1.49	CE206	3.95
6J5	.72	923	1.39	FG104	14.95
6J6	.81	931A	2.49	FG105	16.95
6J7	.88	954	.49	5D21	19.00
6K6GT	.74	955	.49	**TUNGAR***	
6K7	.78	956	.49	199698*	$2.95
6K8	1.20	957	.49	20X672*	2.95
6L6G	1.24	958A	.49	289881*	2.50
6N7	1.23	1613	.69	**MAZDA PL****	
6S7	1.20	1616	2.75	44** Box	$0.40
6SA7G	.98	1619	.39	47** Box	.50
6SC7	.84	1622-6L6M	1.49	49** Box	.60
6SN7	.91			86** Box	1.40
6SG7	.95	1624	.79	**SOCKETS**	
6SJ7	.79	1625	.39	Acorn—6 for	$1.00
6SL7	1.00	1626	.45	866	.24
6V6GT	.98	1629	1.39	872/211	.49
6X5	.87	1635	1.00	803/304	.90
6Y6G	.88	1641	.84	813	.44
7C5	1.00	2050	1.18	829/832	.25
12A6	.29	2051	.88	807	.24
12AH7	1.00	7193	.49	705/715	.69
12K8	1.08	8005	4.25	Magnal	.49
12SA7	.79	8012	3.95	Diheptal	.69
12SG7	.88	8013	3.95	2X2HV	.30
12SH7	.88	8016/1B3	2.00	**TUBES GTD**	
12SK7	.98	8020	4.95	except open Fil. & Breakage	
12SL7	1.08	9001	.49		
12SN7	.85	9002	.59		
12SQ7	.75	9003	.49		
12SR7	.81	9004	.49		
25Z5	.70				

CONDSR OIL or MICA rated WVDC
1mfd/1000V/3 for $1; .05mfd/1500V/2 for ..... $ 1.00
2x.1mfd/500V/2 for $1.25; .5mfd/1500 ..... .75
.1mfd/2000V/2 for $1.80; 0.1mfd/3000V 1.49
Silver Mica .02681 or .0490 W.E./4 for 1.00
.01mfd/600V/20 for $1.20; .012/25 000V 4.98

CIRCUIT BREAKERS
HEINEMAN 10ma, 3, 5, 10, 15, 20, 30, 35 & 40, 80, 100, 180 Amp $1.95 @ ..... TEN for 16.00
SQ'D & KLIXON & CH 5, 10, 20, 25, 33, 35, 60, 70 Amps 98c ea. ..... TEN for 7.00
CERAMICONS .001 or .0001mfd ..... 12 for 1.00
EES TELEPHONE TEST SET & RINGER. 19.95
VOLTAGE REGULATOR Raytheon New 95-130V/60 cy. Out 115V/60W 10.95
V'REGULATOR Same 198-242Vinpt/50 60cy Outpt220V/500 Watts,/5% regltn 29.95
WIRE #10/1000 ft. $12.95; #18/1000 ft AN 4.50
WE PM DRIVER 25 to 55 Watt Waterproof & blastproof $12.95 @ ..... 2 for 20.00
TRUMPET & WE DRIVER 35 to 55W 29.95
OSCILLOSCOPE 3" KIT tubes & pwr. Sup 15.95

TRANSFORMERS 115V/60cy INPT
2750V/ONE AMP @$54 ..... TWO for $99.00
5500V/1Amp/220V inpt @$54 ..... TWO for 99.00
7500V or 15000V'Doubler/35ma 15.95
10800VCT or 21600V'Doubler/95ma 19.95
3000V/10ma $4.50; 4000V/10ma 5.50
5000V/10ma $6.95; 2.5V/3A/20KV 4.95
1320V/375VCT/110ma, 5V/3A, 2.5V/3.25A & 6.3V/2.75A Cased HV insltd 8.95
1350VCT/150ma, 6.3V/5A, 5V2A UTC 6.95
640VCT&1250V/250ma $4.95 ..... 2 FOR 8.95
500VCT/60ma, 6.3V/4A Hmtclly Cased 1.29
1100VCT/212ma $5.95; 10V/8A/12KV 6.95
5V/115Amp $9.95; 30V/4Amp 3.25
1000VCT/45ma;795VCT/80ma; 3x5V/3A & 6.3VCT/1A, 6.3VCT/.3A HV/Hmtcily Csd. 4.95
7.5VCT/6.5A, 6.3VCT/3A 3.75
700VCT/150ma; 10V/3.25A, 2.5V/10A & 6.3VCT/2A, 5V/3A: HV Insltd CASED 5.50
115 or 230V/10Amp/2KW Transformer 19.95
93, 103, 112, 117 or 230V/1.6KW 14.95
115 or 230V/8Amp/1.8KW AutoTransf 14.95
115 or 230V/50-60cy/3.4Amp 4.95
110 or 220 or 220 or 440V/190W 4.50
2.5V/1.75A, 4V/6A/20KV Cased 5.50
2.5V/1.75A, 6.3V/2A/20KV ins GE Cased 5.95
TRANSFORMER ONLY for Two 866A's. 3.95
872A's COMBINATION TRANS. sockets 12.00
872A TRANSFORMER 115 60cy 6.95
866A COMBINATION Tubes, sockets, X'former 5.95
1320 VCT/275ma, 6VCT/3A, 2.5V/2A, 5V/4A 7.95
720/20ma, 5V/3A, 6.3V/3A CASED 2.95
220Vin/7.5V/24A/HV-CASED 5.95
220VInpt, 10VCT/5A or 110VInpt/5VCT/5A. 2.95
570VCT/180ma, 5V/3A, 12V/4A CSD 3.95
510VCT/125ma, 5V/2A, 6V/4A CSD 3.25
TRIPLETT TUBE CHECKER TRANSF 2.95
220 to 440V-or-110 to 220V/250 Watt 4.95
AUTO TRANSF 6V/2A, 150V/1.6A, 35V/1.2A 3.95
SEL RECT TR/115V/60c, 42.5V/2A 4.25

CHOKES
15-29Hy/150ma, SWINGING CASED 2.95
12 Hy/300ma $3.95, 3Hy/40ma ..... 3 for 1.00
15 Hy/400ma or 20 Hy/300ma/15KVins 7.95
3 Hy/400ma; 15KV $2.75, 8 Hy/200ma/ 2 for 2.89
8 Hy/150ma new UTC cracked bkite T'Bd ..... 2 for 1.78
0.5 Hy/100ma/4 for 98c, 50 Hy/150ma 1.95
8 Hy/110ma $1.29; 12 Hy/275ma 3.29



AUDIO AMPLIFIER PEAK CLIPPER & LOW PASS FILTER-C'DEC CQ ART13 CONVERSION includes Amplifier, tubes parts, diagrams, data for rewiring ART13 Amplifier INCREASE MODULATION SPECIAL $8.25

GIBSON GIRL XMTTER, ONLY NEW $10.95
GIBSON GIRL SCR578, COMPLETE 19.95
BC1073 WVEMTR 150-210mc's LN* 10.95
BC230 XMTTER 2.5 to 7.7mc's LN* 5.95
COMPASS RCVR BC433/MN26 LN* 21.95
SAME Compass Rcvr LESS TUBES LN* 14.95
APS13/RCVR & XMTTER less tubes LN* 6.95
ARN-5/BC733 RCVR less tubes LN* 9.95
APN-1 ALTIMETER less tubes LN* 12.95
BC457/458/459-696 Like New* ..... ea. 5.95
BC456 MODULATOR less tubes LN* 1.69
BC212 TANK Intercom & tubes & Dyn 3.95
BC191/BC375 one TU & Tubes LN* ..... ea. 9.95
SCR211 FREQUENCY MTR LN* 38.00
USN Flashlight perspective projector & ENLARGER 16-C-166 TM 5.95
S'BAT USN HYDROMETER KIT BOXED & SPARES & THERMOMETERS NEW. 1.98
FM TUNER & TEN TUBES Higain & pwr. Supply 115V/60cy-Sens 5microV 69.95
TBY VIBRAPACK & S'BATTERY 9.95
BOX KITE NYLON 2.49
BALLOON 4 ft. & Hydrogen gas Generator 4.50
GIBSON GIRL HAVERSACK waterproof. ..... .98
STROBO FLASH AN/-1503/ TWO LAMPS Inpt 12V, Complete power supply, Cables & batteries & 2 KRYPTON Hi-intensity lamps 12,000,000 lumens 98.50
STROBO FLASH #1503 CONVERTED to 115VAC & 3 KRYPTON lamps mtd in Reflectors & check bulbs 198.50
STROBOFLASH KRYPTON lamps & igntn Transf; 12,000,000 LUMENS/15 to 30,000 flashes, sealed new ..... 2 for 21.00
CONDSRS STROBOFLASH GE 8mfd & 660VAC/2000WVDC/32mfd/4 units pyranol 11.50
EXT CORD Hvy-Duty/SJ/16'/M & F plugs ..... .98
MILLEN 150mmf/3000V Variable Condsr. 1.00
Cond Var Split Stator 90mmf per Sec. ..... .98
BELL 115VAC HOLTZER CABOT 1.49
C'RN for XTALS, RECTIFIER & KITS

WRITE SigCorps TM & Tech Diagrams.
SEND FOR BARGAIN "TABOGRAM."
"TAB" MONEY BACK GUARANTEE.
$5 MIN. ORDER F.O.B. N.Y.C.
ADD SHIPPING CHARGES & 25% Deposit.

ANT TUNING UNIT 1001A/1500 to 7000KC/-1kwRF/P1-NETWORK ADJUSTABLE IN & OUTPUT CASED COMPLETE RFmeter, COILS, CONDSR Tuning INSULATORS/F 'MANUAL. WILL MATCH & LOAD MAJORITY ANTENNAS, CAN BE ADAPTED TO HIFREQ'S
SLIGHT CHANGES: NEW GTD $11.95
IF DBL SLUG tuned 10-13mcs/hiQ ..... 3 for 1.00
AIRCRAFT INSTS A "TAB" BUY
WESTON OIL TEMP 0-110°C e ec 2.49
LEWIS CYL TEMP 0-350°C elec 4.95
WESTON CARB TEMP 0-70°C elec 2.49
U.S. OIL TEMP 60-220°C & Bulb 2.49
Englehard .11 to .07 Fuel Air Ratio 3.49
U.S. OIL PRESSURE 0-200 Gauge ..... .98
KOLLSMAN 10-50"Hg Manifo d pressure. 3.49
KOLLSMAN RPM 500-2500 Gauge 2.49
KOLLSMAN SQ'D 0-1000 & 10000 RPM elec 4.50
SPERRY Turn Indctr A-5 type/Gyro 7.95
SPERRY AUTO PILOT #4GYRO bank & climb 17.95

Precision Resistors
FOR METERS BRIDGES, AMPLIFIERS TEST EQUIPMENT ALL STANDARD MAKES

*1%	**5%	†10%	(Rest 1%)
2000**	4300**	5100**	12000**
30000**	84000**	150000**	220000**
245000**	250000	950000	1155

ABOVE SIZES 30c each asstd....10 for $1.89

.116	89.8	580	2580	8500
.42	100	600	2600	9000
.5	105	612	2635	9445
.7	101	640	2700	9710
1.3	107	700	2860	10,000
1.75	113.1	733	2900	10.500
2	120	750	3000	12.000
3	121.2	800	3100	14.460*
4	125	900	3290	14.600
4.35	150	910	3384	15,000
5	160	1000	3500	15.000
5.025	165	1030	3730	17.000
6	170	1110	4000	17.000
7	182.4	1150	4300	18,000
7.5	200	1155	4440	19,000
7.8	209.4	1175	4444	20,000
7.9	230	1225	4500	20,520*
8	235	1250	4720	21,500
10	240	1260	4850	22,000
12	245.4	1322	4885	23,000
14.5	250	1350	4900	24,000
20	260	1500	5000	25,000
25	280	1510	5000	29,909
26	286	1600	5100	30,000
30	299	1640	5270	33,000
37	300	1650	5500	37,000
40	320	1800	5730	40,000
45	340	1830	6000	50,000
45.1	400	1865	6200	54,400*
49	418.8	1900	6300	60,000
50	426.9	2000	6500	65,000
55	440	2080	7000	68,000
56.7	452	2142	7500	75,000
60	480	2300	7700	80,000
71.4	487	2400	7950	84,000
75	500	2485	7950	90,000
80	520	2490	8000	91,000
81.4	540	2500	8250	95,000

ABOVE SIZES Each 45c.....Ten for $3.00

0.1meg	16675	.25meg	.4meg	.6meg
.1	.175	.254	.402	.62
.12	.185	.265	.422	.654
.13	.201	.268	.458	.7
.135	.22	.294	.478	.75
.14	.229	.314	.5	.7613
.14	.24	.33	.57	.8
.147	.245	.3335	.575	.9
.15	.25	.3535		.95
.15				

ABOVE SIZES Each 60c.....Ten for $5.00

1meg.	2	4	5	11.5
1.2	2.855	4.23	9.05	12.83
1.579	3	4.5	10	20
1.8	3.673			

ABOVE SIZES Each 90c.....Ten for $6.95

VICTOREEN VACUUM PRECIS. RESTRS.
.83meg, 1meg, 1.5meg, 2meg, 3meg, 3.75meg, ½of1%accy @$1, TEN for $7.50
IRC NAVY PRECIS. 1Meg/½of1% HV WW 1.69
IRC NAVY WW 2Meg/1/5of1% HV Caged 4.95
SPRAGUE 10 or 12 meg/12KV resistors @ ..... .98
IRC 30 meg MVA/HV $1.89 @ ..... 10 for 15.00
WST & GE 0-150VAC/2½" B'Csd New 3.95
WST/Indctr 0-100 & 100-0-100 microamtr 2.95
DeJur 0-1ma/2½" B'Csd & Std scale 3.00

WST & GE "DB" mtr -10 p us 6 DB/2½" $3.95
GE RF mtr 1 or 5 Amp/2½" B'Csd ea 3.95
GE GALVO 2.5 & 25 ma-Ocenter/3½" B'Csd 3.95
GE 2000V/1000 ohms V & Resistor 5.95
WST AN 30VDC/2½" B'klte Cased 2.49
W.E. 0-200 or 0-500VDC/1000 ohms V/3½" ea. 4.95
HICKOK 4" Illuminated MTR Tube Chkr. 7.95
WESTON 4" TWIN GALV 10 & 40 ma/.5% 12.95
XTAL-DIODES 1N21A, 22, 23A, 25, 26, 47/boxed lead sealed NEW G'insp @ $1; 12 for 10.00
1N34 X'DIODE @ $1.15/2 for $2.20/10 for 10.00
TS268 XTAL DIODE TEST SET New 19.95
DYNMTR 6 Vin/out 240V/100ma or 12 & 24Vin/500V/50ma; PM New Navy 3.49
DYN 28Vin/out 540V/250ma used LN* 2.50
DYN 12 & 24Vin/275V/110ma/P'Magnet 1.95
DYNMTR 28Vin/out 250V/60ma ..... 2 for. 1.98
DYN 12 & 24Vin/220V/100ma & 440V/200ma 5.95
DYN/24 Vin/300 V/260ma/150V/10ma/14.5V/5A 4.95
PE94A same as above plus filters & start 9.95
GE GLYPTAL #1276 CEMENT Gallon 4.95

"TAB" • **Dept. 4RN, Six Church Street, New York 6, N. Y., U.S.A.** • **"TAB"**
NEW GUARANTEED • • • CORNER CHURCH & LIBERTY STS., ROOM 200 • • • ELECTRONIC PARTS

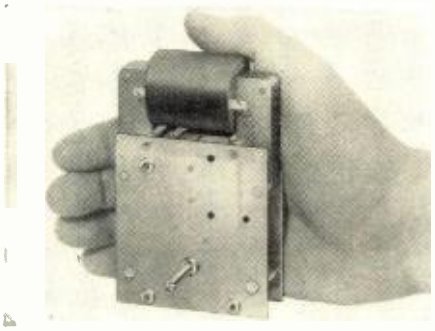
wrinkle-finished perforated steel cage. The cage is equipped with legs for convenient mounting.

Two types of terminations are provided depending on whether the unit is to be used in conjunction with a coaxial cable or with a parallel transmission line.

Ohmite Manufacturing Company, 4951 West Flournoy Street. Chicago 44, Illinois will furnish full details on these units to those requesting them.

FRACTIONAL H.P. MOTORS

T. C. Smith Manufacturing Company of Springfield, Illinois is currently marketing a new fractional horsepower motor which is said to



possess remarkable torque capacity for its size.

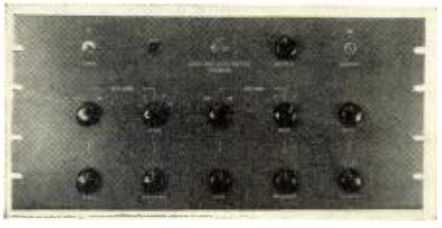
The unit, designed to be used in coin machines, directional antennas, etc., has a stalling torque of 75 inch-ounces at its rated voltage. Small enough to fit in the hand, this new motor is a shaded-pole. induction type. With 20 watts input at 115 volt, 60-cycle a.c., the no-load speed is 20 r.p.m. on the output shaft. Lower input wattages are available at correspondingly lower stalling torques, with output shaft speed at no-load substantially unchanged.

A particular feature of this motor is its magnetic clutch. With the de-energizing of the motor, this clutch prevents any over-travel of the output shaft. (This does not include gear train coast when the motor is running free.)

Performance curves and other information on the motor will be supplied on request to T. C. Smith, President, *T. C. Smith Manufacturing Company,* 920 Washington Street, Springfield, Illinois.

TV TEST GENERATOR

A new electronic generator which produces grill-like patterns to check the linearity and speed the precise



alignment of television picture tube circuits has been announced by the *Test and Measuring Equipment Section* of *Radio Corporation of America.*

The new "Grating Generator" (Type WA-3A) is designed to provide both television set manufacturers and television broadcasters with a means for determining the correct linearity alignment of deflection circuits for television receiver picture tubes and television camera pickup tubes.

The generator produces on the picture tube a pattern consisting of crossed horizontal and vertical bars. The horizontal bars are used for checking vertical alignment and the vertical bars are for checking horizontal alignment. Equal spacing between bars indicates perfect linearity. Crowding or spreading of the bars signifies improper alignment. Curvature of the bars reveals the effect of stray magnetic fields. Thus, by observing the grating pattern on a kinescope, it is possible to adjust the scanning velocity to produce uniform distribution of picture details.

Full details on the Type WA-3A Grating Generator will be supplied by the *Test and Measuring Equipment Section, Radio Corporation of America,* Camden, New Jersey.

FEATHERWEIGHT IRON

Transvision, Inc. of New Rochelle, New York has introduced a featherweight soldering iron weighing only 3 ounces but capable of doing the work of a 200 watt iron, according to the company.

The iron heats in 20 seconds from a cold start and features fingertip button control. The unit retains heat with the switch off up to one minute then needs only three seconds to reheat for

continuous operation at maximum efficiency.

An intermittent control feature prevents tip corrosion and necessity of frequent cleaning. The long, thin tip permits soldering in tight corners. Tips are interchangeable to suit the work at hand and various types of tips are available.

Transvision, Inc., 385 North Avenue, New Rochelle, New York will supply additional details on request.

VOICE-ACTIVATED RECORDER

The development of a voice-activated instantaneous start-stop clutch mechanism has been announced by the *Magnephone Division* of *Amplifier Corp. of America.*

Available as optional equipment on any of the company's "Magnetape" recorders, this new voice-clutch is activated by the voice of the speaker,

A *MUST* FOR FM & TELEVISION SERVICE SHOPS!

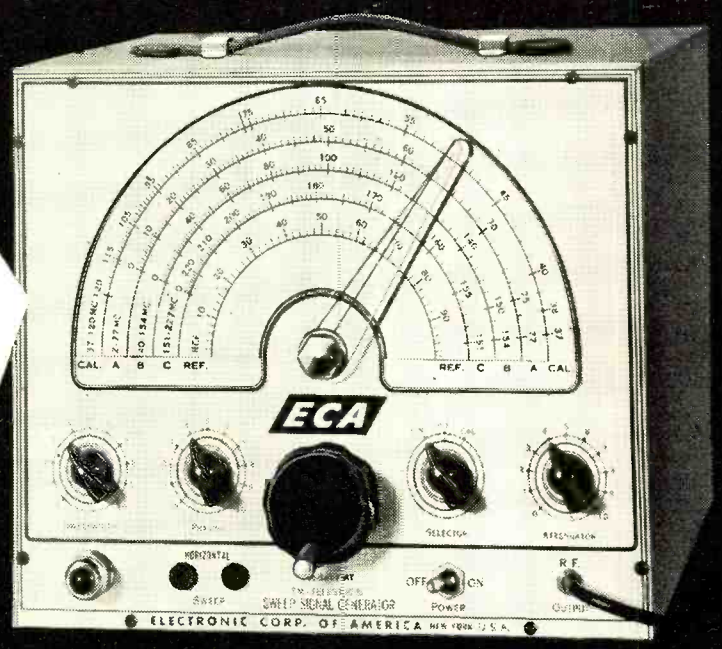
Now... AT A SENSATIONALLY

LOW PRICE!

ECA QUALITY

FM & TELEVISION *Sweep Signal* GENERATOR

$34.95 COMPLETE



Here's great news for FM and TV Service Shops! A new, top quality sweep signal generator—product of a manufacturer with vast resources, advanced engineering "know-how", and wartime experience in producing test equipment—now available, DIRECT FROM THE FACTORY—at a phenomenally low price!

ECA
ELECTRONIC CORP. OF AMERICA

FRONT PANEL CONTROLS

- A — Sweep width 500 KC to approx. 10 MC
- B — Phasing control
- C — Tuning vernier control 10 to 1 ratio
- D — Selecto switch FM — RF — CAL
- E — RF Output control
- F — 60 cycle horizontal sweep output
- G — Amphenol RF output shielded connector

FREQUENCY RANGE 3 BANDS

(No band switching necessary)
(2 to 227 Megacycles)

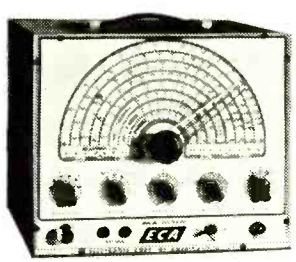
- A — 2 — 77 MC
- B — 40 — 154 MC
- C — 151 — 227 MC
- D — Calibration and reference scales
- E — Dial scale length

TUBE LINEUP

- A — 6C4 — Fixed frequency modulated oscillator
- B — 6C4 — Continuously variable beat frequency oscillator
- C — 6C4 — Mixer — Cathode follower output tube
- D — 5Y3 — Rectifier tube

GENERAL INFORMATION

- A — High frequency insulation throughout
- B — Maximum output 500,000 U/V
- C — Power required 105-125 Volt 50-60 AC 35 Watts
- D — Power line filter built in
- E — Special Midline capacity tuning condenser
- F — Pilot light line indicator
- G — Generator output can be used either frequency modulated or pure RF

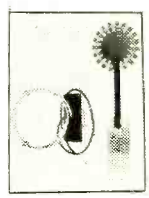


AM SIGNAL GENERATOR

8 RF bands. Frequency coverage 100KC-75MC. External modulation from 40 to 30,000 cycles. Internal modulation at 440 cycles. Phase shift audio oscillator and internal modulator. A.C. 105 to 120 volts, 50 to 60 cycles. Special Hammarlund variable condenser; 3 step RF attenuator Continuously variable RF-AF attenuator control. Ultra stable two terminal RF oscillator. Pilot light line indicator. Cathode follower output tube. Modulator percentage continuously variable from front panel, internal or external, 0 to 100%. Heavy 16-gauge steel cabinet. Complete with 4 (standard brand) tubes. Amphenol co-axial connecting cable, ground cable, operating instructions and guarantee.

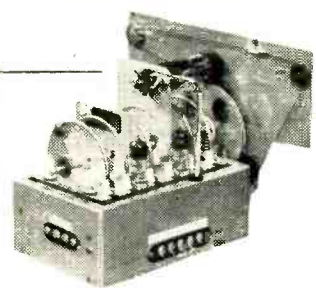
$32.50

RADIATION LOOP AND ALIGNMENT WAND



Provides loose coupling. Checks loop-oscillator tracking. Increases efficiency of receiver's alignment or mistracking. Enables the service engineer to make gain measurements. Professional appearance and results. May be used on any signal generator. Complete with operating instructions.

$5.95



FM FRONTEND

Complete with 3 tubes, including Magic Eye. 88-108 MC.

For use with 10.7 MC I.F.S., high Q resonant tuned lines. Heavy silver overlay on lines and contacters. High frequency insulation throughout I-RF stage, detector, and oscillator. Large 7" sliderule dial. Chassis floated, non-microphonic.

$15.95

BACKED BY ECA WITH R.M.A. GUARANTEE. WRITE FOR ECA CIRCULAR ON PARTS AND ADDITIONAL EQUIPMENT.

RUSH YOUR ORDER TODAY... TO INSURE PROMPT DELIVERY. ORDERS FILLED IN SEQUENCE AS RECEIVED. PRICES F.O.B., N. Y. C.

ELECTRONIC CORPORATION OF AMERICA

353 WEST 48th STREET • NEW YORK 19, N. Y. • PHONE: CIRCLE 6-1985 *Cable Address: ECAEPLT*

singer, or by other preselected sounds. The unit so equipped continues to record as long as the sound is maintained

and for approximately five seconds thereafter, to compensate for any pause. Actually, the time the recorder will operate after the sound has ceased depends on the length of time the speech or music has been going on, and on its volume, thus, the instrument's period of expectation increases with the increased possibility of additional sounds following.

A catalogue, No. 4901, containing information about the complete line of standard and portable magnetic tape recorders and a description of the new voice-operated clutch may be secured by writing *Magnephone Division, Amplifier Corp. of America,* 398-2 Broadway, New York 13, New York.

REPLACEMENT KIT

Clarostat Mfg. Co., Inc. is now merchandising a new kit which is designed to provide servicemen with a maximum number of replacement parts with a minimum of stock.

Known as the "Han-D-Kit" No. 5, this kit contains twelve of the most popular values of plain, tapped, and slip-drive controls, together with a selection of twelve attachable shafts and four "ad-a-switches"; six most-needed ballast tubes; five "Greenohms" or 10 watt wirewound power resistors; plus a double-ended wrench, authorized service plaque, and a copy of the company's latest catalogue.

The entire assortment is packed in a green-finished steel cabinet with hinged cover which can later be used as a filing cabinet or handy box.

Additional details on the new kit may be secured from *Clarostat Mfg. Co., Inc.,* 130 Clinton St., Brooklyn, New York.

-30-

VWOA ELECTS OFFICERS

THE Chicago Chapter of the Veteran Wireless Operators Association has named Thomas Rowe to the post of chairman for the ensuing year. Serving with Mr. Rowe will be E. A. Nicolas, vice-chairman; R. Higgins, assistant vice-chairman; and E. A. Beane, secretary-treasurer.

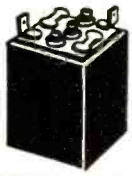
The following members were elected to the permanent Executive Committee of the Chicago Chapter: L. W. Bear; E. A. Beane; F. Britten; L. O. Gorder; R. Higgins; W. J. Halligan; W. F. Marsh; and G. I. Martin.

-30-

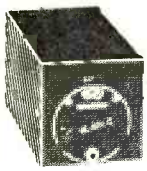
HAMS! EXPERIMENTERS! Look at these EXCLUSIVE "G & G" BUYS!

TERRIFIC VALUE!
24-VOLT STORAGE BATTERY, BRAND NEW!
Made by Delco. 12 cells, heavy duty, very rugged. Shipped dry, uses standard sulphuric acid electrolyte.

VERY SPECIAL . . . **$14.95**



6-VOLT STORAGE BATTERY
Navy Standard BRAND NEW. 15 ampere-hour rating **$4.95**



SETCHEL-CARLSON BEACON RADIO RECEIVER BC-1206-C
Receives A-N beam signals, operates on 24-28 V DC. 5 Tubes: 3—14H7, 14R7, 28D7. Tunes 195 to 420 Kc. Size 4"x4"x6⅝" wide. 4 lbs. Slightly used, A-1 condition. Each **$4.95**
Same as above, BRAND NEW, in original carton **$7.95**

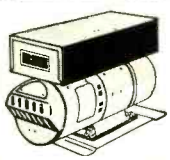
RADIO RECEIVERS
All Brand New in Original Cartons
BC-454A 3.1 to 6 Mc complete with tubes . **$5.95**

40-WATT VFO DRIVER
BC-457A 4 to 5.3 Mc **$5.95**
BC-458A 5.3 to 7 Mc **5.95**

PE-104-A VIBRATOR POWER SUPPLY
Works on 6 volt or 12 volt battery. Supplies 84 volts and 51 volts DC also 1.4 volts "C" bias. Size 7"x4"x 3¾". Fits BC-654 (SCR-284) exactly. Can be used to operate many types of receivers now on market.
ALL BRAND NEW, very low price **$4.95**

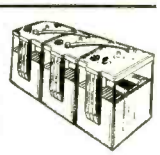
---

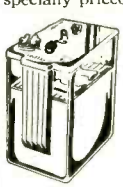
80 VOLT A.C. INVERTER
Sig. Corps PE-206A. Terrific Value! 80 Volts AC Output, 800 cy. 28 V DC Input 6000 RPM. Complete with Filter.
Value $100.00.
Your Cost **$6.95**



BC367 Interphone AMPLIFIER
Here's a terrific value for you! Unit comprises a 2-watt audio amplifier with input and output transformers; 600 cycle audio oscillator for signalling. Housed in compact metal case. Originally built for Signal Corps. Complete with two 6V6 tubes. Slightly used, your cost **$4.95**
BRAND NEW, in original carton **$6.95**

WILLARD 6-VOLT STORAGE BATTERY
27 amp. hrs.
3-cell battery, transparent plastic case, very specially priced **$4.50**





WILLARD 2-VOLT STORAGE BATTERY
20 Ampere-Hours
Exact replacement for GE portables—brand new.
Each **$1.49**

ONE-QUART BOTTLE BATTERY ELECTROLYTE
Made by Willard, for above storage batteries. 1 quart sufficient for two 2-volt cells. Hermetically sealed. SPECIAL. per qt. bottle **95¢**

7-PRONG 2-VOLT RADIO VIBRATOR for Portable and Farm Sets Replacement for GE LB 530 . . . . . **$1.65**

SPECIAL!
Delco 12-cell Storage Battery
17 ampere-hours. Only a few left at **$16.95**

BC-645 XMTR RECEIVER 15 TUBES 435 TO 500 MC

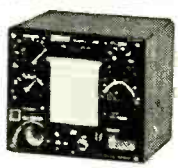
BRAND NEW!
$9.75
2 for $18.95

The electronic equipment that saved many lives in the war. Set can be modified to use for 2-way communication, voice or code, on following bands: ham band 420-450 mc, citizens radio 460-470 mc, fixed and mobile 450-460 mc, television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs.
PE-101C DYNAMOTOR for above BC645 . . . . . **$2.95**

UHF ANTENNA ASSEMBLY
A rare bargain for UHF experimenters! Consists of 7 aluminum rods, in calibrated lengths as follows:
3 rods 12" long for 200-247 Mc
1 rod 9½" long for 248-313 Mc
1 rod 7½" long for 312-400 Mc
1 rod 5⅛" long for 402-517 Mc*
1 rod 4⅛" long for 512-667 Mc
All rods in handy fabric pouch. Two UHF coaxial coupling insulators included. All BRAND NEW, in original carton, yours for only **$2.45**
*2 of these rods suitable for BC-645 Transceiver.

TU-75-B XMTR TUNING UNIT
Hams! You'll want this! Tuning unit uses 3—815 tubes. Has 5 tuning condensers, coils, all components easily converted to 2-meter rig! BRAND NEW, in original carton, with tubes, all yours for **$14.95**

RCA AVT-112A AIRCRAFT XMTR



2500 to 6500 Kc, 6 tubes, compact, powerful, operates on 12 volt source.
Less crystal,
BRAND NEW **$12.95**

MacElroy Automatic KEYER
Suitable for keying transmitter, or for code practice. Has photoelectric cell and sensitive relay. Variable speed motor operates on 110 volts 60 cycles AC.
Very Special Price! **$14.95**

Down Come Prices! CATHODE RAY TUBES

All Brand New, in Original Cartons

5BP1 Lots of 4, each **$1.79**
5BP4 Lots of 4, each **1.95**
3FP7 Lots of 4, each **1.49**

304TL Eimac, each **$2.95**
GE-211 Each **1.22**

Western Electric Field Phone Set EE-8

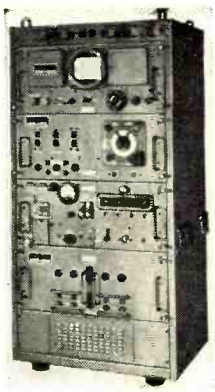
Leather case, with handset, generator, ringer, etc. Requires 2 flashlight cells. Wonderful value!
As is ea. **$4.95**
Good Used ea. . . . **8.50**

QUANTITY PRICES
Inquiries welcomed from institutions, wholesalers, dealers, large users . . . Phone, write, wire for quantity prices.

Please include 25% Deposit with order—Balance C.O.D. Minimum order $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

G & G GENUINE MAJESTIC **RADIO PARTS SERVICE**
53 VESEY STREET • NEW YORK 7, N.Y.

SENSATIONAL Smash Value!
COMPLETE I.F.F. Equipment RC-188-A



Bargain opportunity of a lifetime! This I.F.F. equipment originally cost about $20,000 . . . now buy it for a tiny fraction of cost! Easily converted for Television. Complete assembly consists of Control unit with 5" C.R. Tube, transmitter and receiver assembly (157 to 185 Mc). Indicator unit, and Power Supply (450 watts) operating on 110 volts, 60 cycles AC. All assembled, ready to operate. 62 Tubes included: 8—6V6GT, 9—6SL7GT, 14—6SN7GT, 1—5CP1, 2—9006, 1—6Y6G, 2—6E5, 1—100TH, 2—6J5, 2—2C26, 1—3E29, 1—6H6, 7—6AG5, 3—6AK5, 1—6C4, 3—2X2, 1—6X5GT, 3—5U4GT. Overall size 55" high, 28" wide, 20½" deep. Shpg. weight 750 lbs. Your cost, complete, BRAND NEW, in original packing **$195.00**

HEADPHONES—*All Brand New!*
Individually packed, complete with phone plug.
HS-33 600 ohms, in lots of 3 . . . . . **$2.45** each
HS-23 2000 ohms, in lots of 3 . . . . . **1.85** each
HS-30, With earplugs, LOTS OF 12 . . . . **44c** each

HANDSET

Cradle-type handset with butterfly switch, unbreakable black plastic. 4-ft. 3 wire cable, BRAND NEW, individually packed, each **$2.75**
Same as above but slightly used, each **$2.25**

---

140 MMFD MIDGET TUNING CONDENSER
Long shaft.
Lots of 3, each . . . . . **44¢**

---

118 MMFD TRANSMITTING CONDENSER
Very Special Ham Value! 31 plates, Airgap .109" overall length 4⅜", ceramic insulation, normal list price $11.85 . . . . . each **99¢**

BEEDE DC METER, new, black bakelite case, 3" round 0-1000 DC Ma. Special **$1.95**

ASTATIC CRYSTAL PICKUP, with L-26 crystal cartridge **$1.79**

SPECIAL 409.5 KC CRYSTAL
Lots of six . . . . . each **29¢**

FREQUENCY METER CABINET

For BC-221 Series freq. meters. BRAND NEW! 3 compartments. Massively built. 14½"x10½"x10". Value $20.00.
Yours for only **$2.95**

HANDMIKE T-17

Shure model T-17 mike 200-ohm carbon single button, with press-to-talk switch, 5-ft. rubber cord and plug. BRAND NEW, individually packed, in lots of 3, each . . . . . **88¢**

RADIO PRODUCTION RECORDS TOPPLE

PRODUCTION of television and radio receivers, including FM, broke all industry records in 1947 according to a report recently released by the Radio Manufacturers Association.

A year-end tabulation showed a total of 17,695,677 sets produced by RMA member-companies. Preliminary estimates indicated that total production by all radio set manufacturers may exceed 18,500,000 as compared with 15,000,000 in 1946, the previous industry record.

Television sets produced during 1947 numbered 178,571 against 6476 manufactured in 1946 by member-companies. A total of 1,175,104 FM-AM receivers were produced in 1947 as compared with 181,485 in 1946. Production of both automobile and portable radios was more than double that of 1946. Auto radios numbered 3,029,637 as compared with 1,153,458 in 1946 while portables totaled 2,153,095 and 1,022,689 the year previously.

Approximately 72 per-cent of all home receivers produced by RMA member-companies were table models, while radio consoles amounted to about 13 per-cent of the output. Portables accounted for the other 15 per-cent.

A breakdown of FM-AM receivers shows 289,497 table models; 11,112 table model radio-phonograph combinations; 22,239 consoles, and 852,256 radio-phonograph consoles. Television production included 116,315 table models, including converters; 37,039 straight consoles, and 25,217 radio-phonograph consoles. —30—

Spot Radio News

(*Continued from page 20*)

their entire conversation to giggles and to assuring each other that they couldn't think of a thing to say, but nothing. Often, calls are more serious. Not long ago another Tokyo ham got a message through to Chicago for an emergency shipment of streptomycin, but failed to pick up the reply. J2ROC picked it up and relayed it. Again, when a jeep accident killed a young lieutenant at Manila, J2ROC arranged for his parents to be flown to the funeral.

THE DISTANT HAMS came by their talents just like most do in the States. Tex Bowden built his first crystal set in Dothan, Alabama, and finally worked up to a ham shack in his back yard. About the same time, Stan Rodby was tinkering in his home town, Virginia, Minnesota, by cutting up his mother's pie tins, borrowing her mason jars, and somehow getting a rig that made with the voice and music. Neither one of them had a formal engineering training.

GETTING BACK to communications in the States, it is going to be improved by leaps and bounds all along the radio front this year according to word from the Long Lines Department of the *American Telephone and Telegraph Company's* house organ for that division. The little magazine is named, if you haven't guessed, "Long Lines." It reports that during 1948 "cable-laying trains will complete the placing of hundreds of miles of coaxial cable in projects already under way." New ones will also be started. Also, some coaxials will be equipped to provide new television circuits and construction will begin on two new radio relay links—between New York and Philadelphia, and between New York and Chicago. Television network now working between Boston, New York, and Washington will be extended to Richmond, Virginia. Two other television circuits over coaxial are contemplated this year between Philly and Chicago, and Chicago and St. Louis. These last will be ready for service by early 1949, *AT&T* predicts.

ULTIMATE GOAL in the immediate future is television terminal facilities, including operating and monitoring facilities, networking programs originating in any one of nine cities—Richmond, Pittsburgh, Cleveland, Chicago, St. Louis, New York, Philadelphia, Baltimore, and Washington. Beyond that is projected a coast-to-coast hook-up, linking big West Coast centers with the east via lines laid through Dallas, Ft. Worth, and El Paso to Los Angeles.

BY CONTRAST, turn back the clock as the Signal Corps did recently and you can get a glimpse of the incredible progress that has been made in communications within the last 85 years. On March 3, Signal Corps celebrated its 85th birthday anniversary, with special mention to a Civil War era doctor who was considered something of a crank by many of his contemporaries. Truth is, he was one of the fathers of modern communications and, through his pioneering, paved the way for modern radio. Maybe you've heard the story: The Doc was a telegrapher who finally took up medicine and wrote a thesis on how to use a sign system for deaf mutes based on the Morse code. This led him to a study of signalling generally, and he wound up during the Civil War as an assistant surgeon in the Army who insisted on messing around in his spare time with what he called "wigwag"—a system with flags and torches which are perpetuated to this day in the insigne of the Signal Corps. The system was used for the first time during the Civil War and was so successful that on March 3, 1863, the Congress set up the Signal Corps as a separate unit. First chief signal officer was a major—later a brigadier general—named Albert J. Myer—the "crank" Doc who had developed wigwag.

IF FACSIMILE broadcasting has done nothing else, it has attracted public attention and added a word or two to the language in recent weeks. Most spectacular facsimile newspaper enterprise is one that began in mid-February in New York. The New York

Go to WESTERN for Values . . .

DESK STAND MICROPHONE T-32

The perfect mike for hams and for PA work, factory call systems, etc. Single-button carbon transmitter with long, easy-acting press-to-talk switch, felt-padded base, and 6' cord terminating in PL-68. Transmitter is Western Electric 635A, 30 ohms at 1 MA, 2 MA maximum. Designed for clear, crisp speech. 4db from 300 to 3000 cps with cut-off at 265 cps. HAMS: Buy at least three while you have the chance. PA MEN: Stock up on these mikes for your speech amplifier installations. ONLY **$2.79**

LINESMAN'S HANDSET

An ultra-sturdy handset, receiver and mike, with press-to-talk switch and 5'9" cord terminating in two wire-tapping clips. Clips have wire-piercing point and alligator jaws with powerful spring on one end, and 3/16" diameter plug on other end. Handset is designed to be banged around in a tool chest. Construction is almost entirely steel. Here is a lifetime telephone unit at a once-in-a-lifetime price. New **$4.95**

EE-8 TELEPHONES

Portable field telephone in case with hand-crank ringing generator. With schematic. Highest quality at less than toy price. All you need to put it in operation is 2 flashlight batteries for each unit and 2-conductor wire to the other unit or units.
Fair used, each **$4.95**
Good used, each 5.95

TUBE SPECIALS OF THE MONTH
All New, in Cartons

2051 Gas Tetrode Relay Tube. Use as sawtooth generator with absolute grid control of synch, or as relay, or to energize relay, in photocell or other systems using grid-voltage triggering. Plate supply may be 115V, 60 cy, and tube will not be fired by line-voltage surges at plate. Cathode current may be as high as 375 ma peak for trigger circuits. Heater takes 6.3 V at 0.6A.
A Dream Tube For Experimenters! **$1.47**
3 for **$1.29**
5 BP1 ..... 1.95
5 BP4 ..... 1.95
304 TL 1.95

SCR-522 CONTROL UNIT

BC-602-B, brand new, export packed. 1 "off" push-button switch, 4 channel-selecting push-button switches, 5 pilot lamp assemblies with pilot bulbs and film dimmer and lever switch with locking control. **With Schematic** ..... **98¢**

HEADSET BUYS

HS-23 (Black plug), high impedance. Used, almost like new. With rubber cushions **95c**
HS-33 (Red plug), low impedance. Used, almost like new. With rubber cushions **95c**
4' Extension Cord for either of above **65c**

AUTOSYN BEAM INDICATORS

From ADF system. Each unit comes complete with instructions and schematic. Use any two of the 3 units below as a complete system. Power the system with 15 to 24 V, 60 cy.
Recommend as Transmitter: Compensator Unit from Loop LP-21. Calibrated 0-360°. Comes with loop drive motor and gear train, may be used separately **$2.95**
Choice of Receivers: I-81, 3" dial, pilot's ADF indicator, calibrated 0-360° **$2.45**
I-82, 5" dial navigators ADF indicator, has finer divisions and has rotable reference scale **$2.95**

RELAYS

Starting Relay: Leach, 3-contract, 20 amp cont. duty, 2 NO, 1 double-throw at 20 amp in the unenergized position, about 10 amp in the energized position. Coil 22-30 vdc, resistance 180 ohms. Brand new **98c**
Telegraph and Local Relay: 2 make, 1 break. Micrometer adjustment. 2 coils, each 150 ohm. For use with 115V DC. Special: 2 for **$1.29**

ANOTHER LAZY Q-5'er

Use Receiver BC-1206. I. F. is 142.5 kc or slightly lower depending on the model. Tunes 200 to 400 kc, can easily be extended to 455 or 456 kc. Very compact about 4"x4"x7". Complete with all controls on the front panel. 5 tubes. Input 24 volts dc.
BRAND NEW **$5.95**

THE LAZIEST Q-5'er

FL-8-A, used when flying radio range. RANGE-VOICE-BOTH switch selects 1020 pass ONLY, or voice freq **minus** 1020 cps, or by-passes filter completely. Put in series with hi-impedance headset when listening to 1 kc MCW **95c**

SCR-518-A

Radar altimeter, receiver and transmitter at 515 mc. Has fast-screen CR tube, hi-voltage power supply with inverter, connectors, cables, 29 good tubes: 1—6SK7, 3—8012, 2—6SJ7, 1—6C8G, 1—6SN7GT, 1—6F8G, 1—23D4, 1—6Y6G, 1—6V6GT, 10—6AC7, 3—2X2, 1—954, 1—955, 1—956, 1—6J5, 1—1808P1 cathode ray tube.
Brand new, in original packing **$24.95**

BARGAIN OF THE MONTH
2-METER TRANSMITTER SCOOP!

The famous AN/ARC-5 VHF Transmitter (T-23/ARC-5), brand new 100-156 mc but less tubes, crystals, and the holders for the 832A tubes. Furnished **with complete schematic.** 4 Xtal-controlled channels selected by 3 motor-driven turrets. Motor can be spun by hand for manual band switching or driven by low-power rectifier power pack. Tubes required are 2—1625 and 2—832A. **Don't pass this up at ONLY** **$4.95**

COAXIAL CABLE BUYS

RG-8/U: 52 ohm coax. cable, brand new, cut to length, min. quant. 100 feet **$2.95**
RG-7/U: Low capacity 95 ohm coax. cable, only 12.5 mmfd./ft. Similar to RG-62/U. Brand new. Ideal for high-quality PA installations. Air and polyethylene dielectric, vinyl overall. O.D. 0.370". Loss at 1mc is 0.15 db/C', at 30 mc is 1 db/C'. Cut to length. Minimum quantity 100 feet. per foot ..... **6½¢**

PANEL METER

0-1 MA, DC. 3½" round bakelite case, body 2¾", black calibrations on large clear-reading face, calibrated 0-4KV in 40 divisions. New. SPECIAL AT **$2.49**

SENSITIVE OUTPUT METER

BX-1140 Control Box for SCR-625 Mine Detector contains slug-tuned coils, switches, resistors etc. in addition to a panel meter with built-in rectifier, movement sensitivity 200 microamps DC full scale. 2" face **$2.29**

POWER-PANEL VOLTMETER, AC 0-300V.

Complete with external resistor. Fixed coil around moving vane. 2% accuracy. Additional multiplier resistance easily added to make it read very high voltages. Norton, Round. Flush mount, 5¼" flange diameter, 4¼" body diam. Very large, clear scale. New. Only **$6.95**

80 and 40 METERS

7-tube Superhet RA-10, Bendix DF and communications receiver. 200-1100kc and 2-10 mc. In excellent condition, inside like brand new. Complete with tubes and dynamotors. Easily converted to 110V. **Schematic furnished.** **$14.95**

ANTENNA MAST SCOOPS

Doublet Antenna Kit, used with the famous Hallicrafters BC-610, consisting of 7 steel-alloy mast sections in a handy canvas bag. Each section is 5'6" long, 1½" OD with the last 6" rolled to a smaller OD to telescope into the end of the preceding section. No taper. Assemble into mast up to 35' high or shorter by any multiple of 5'. Finished in weatherproof olive drab. **Ideal for erection of FM and Television Beams!** Drop your coaxial cable right through the center! Brand New, export packed. **$14.95**
Kit of 7 and bag **$14.95**
Aluminum Mast Sections: Each 4'10¼" long, 2" OD, with 10" long, 2¼" OD tube swedged over one end. The plain end of one section telescopes 4¾" into the enlarged end of the next section, so you erect mast as high as you please in multiples of 4'5¼" per section. No taper. Light and sturdy. Drop your coaxial cable through the center. Per section **$2.39**

R-89/ARN-5A

Glide path receiver. Crystal control of local oscillator. 332-335 mc complete with relays, 7—6AJ5, 1—12SR7, 2—12SN7, 1—28D7, and 3 crystals: 6497 kc, 6522 kc, 6457 kc. 90-cycle band-pass and 150-cycle band-pass filters, excellent for making an intermodulation checker. Beautiful cabinet and chassis as foundation for many interesting experimental and construction projects. Broad pass band on 20.7 mc IF's ideal for television. **Schematic furnished.**
Used, excellent. Only **$6.35**
New, in original packing 8.95

BC-733-D

Localizer receiver of the blind landing system. Companion to the glide path receiver. Also contains 90 and 150 cycle band-pass filters. 108.3 to 110.3 mc. by relay selection of crystals in the local oscillator. Wide pass-band on 6.9 mc IF's ideal for FM. Has a wonderful AVC system using rectified output of an RF oscillator as pwer supply for 100 volt DC bias. With relays, crystals, and 10 tubes: 3—717A, 2—12SG7, 1—12SQ7, 1—12A6, 1—12AH7, 2—12SR7. **Schematic furnished!**
Condition: Used, excellent, only **$6.35**

ANTENNA SYSTEM AS-27-ARN-5

Dual antenna for the two receivers above. Two separate ¼ wave dipoles in one mounting. New, export packed **$3.95**

AN/ARC-4

Receiver-transmitter component. Range 140-144 mc. Xtal-controlled, 4-channel, complete with 20 tubes, 4 Xtals, and 24v dynamotor. Good used.
A real buy at only **$17.86**

VIBRATOR EQUIPMENT

Generate 60 CPS with 3H6694. Western Electric 4-pin vibrator. 12VDC input. 3 for **$1.98**
3H6691-17 Vibrator, 6V in, for 150 V, 100 MA. 7-pin. 3 for **$2.49**
3H6785-3. Vibrapack. Mallory. 12V in, 225VAC out at 50 MA. With transformer and input and output hash filters. Rotate vibrator in socket for either negative or positive grounded systems **$1.89**
2Z9625-33. Vibrator transformer. Pri 1.5V DC either side of CT, tapped for 122 VCT, 22 ma. Potted. 4"x2 13/16"x2 11/16". 3 for **$1.49**

ATTENTION BROADCAST ENGINEERS

Aerovax capacitor type 15020, .25 MFD, 15,000 VDC. A last-chance steal at **$4.95**

COMMAND SET TRANSMITTERS

BRAND NEW, with Tubes, Crystals, Schematics
T-20/ARC-5, 4-5.3 mc $5.95
T-21/ARC-5, 5.3-7 mc 5.95

TRANSFORMER AND CHOKE SPECIALS

Output: Hi-Fi used in Scott-made Navy receiver. Fully potted. Pri. 5000 ohms, output secondary 600 ohms, CT. inverse-feedback secondary 60 ohms CT. A rare buy at only **$1.49**
Output: Hammarlund Super-Pro 6F6 push-pull class AB self biasing, 10,000 ohm CT primary, two secondaries: Monitoring headset output 8000 ohms and power output 600 ohms **$1.89**
Output: Push-Pull 6L6's, 20 watts to 50 ohm load. Impedance ratio 15,000 to 50. Fully potted **98c**
Output: 10 assorted ouncers for **1.89**
Driver: For push-pull output. Used in Bendix radio-compass receiver. Pri. 6000 ohms. Sec. 3000 ohms CT. Tertiary 15 ohms **79c**
Filter Choke: Westinghouse, potted, 15H at 150 MA, insulated for 300 volts. 183 ohms DC **$1.49**
Filter Choke: Navy CRV 30820, potted. 10H at 100 MA. A rare buy at only ..... **59¢**
Filter Choke or AF Filter: 3C323-145C. 3.7H at 145 MA; insulated for 1500 VDC; 125 ohms DC; enclosed case, hermetically sealed; very compact; 2⅛"x2¼"x3 11/16". Last chance at this price! 3 for **$1.77**

R-5/ARN-7 RADIO COMPASS RECEIVER

Very late model ADF receiver. Includes broadcast band. Frequency 100 to 1750 kc in 4 bands. 5-gang tuning capacitor. With 15 tubes: 4—6K7, 1—6L7, 1—6J5, 2—6B8, 2—6F6, 1—6N7, 1—6SC7, 2—2051, 1—524. SCHEMATIC FURNISHED. With shock-mount base.
Like new. SPECIAL **$19.95**

LOOP LP-21. Brand new ADF loop antenna for radio compass receiver. Complete with motor, compensator, and Autosyn transmitter. In Zeppelin housing.
A real buy at **$6.95**

½ TO ¾ KW ANTENNA TUNING UNIT

BC-939-A, used with the famous BC-610 (commercial HT-4) Hallicrafters transmitter, ¾ KW into final. ½ KW output. Some of the boys use this tuning unit for a full KW into final. Brand new, complete with 0-15 RF ammeter. 2-18 mc. Two tuning controls, one coupling control. A never-to-be-repeated opportunity!
Don't miss it! Only **$19.95**

RT-7/APN-1

Radio Altimeter Transceiver. Transmits and receives frequency modulated signals. 418-462 mc. Complete with 14 tubes: 3—12SJ7, 4—12SH7, 2—12H6, 1—VR-150, 2—955, 2—9004. Contains 28v dynamotor. Excellent parts value. Make wobbulator out of the frequency shifter. With schematic. **Used, Excellent** **$7.95**

DYNAMOTORS AND INVERTERS

BD-77 Dyn. Unit: 14 v in, 1000 v. 350 ma out. With relay fuse box and filters **$5.35**
BD-87 Dynamotor Unit: part of SCR- ( )- 183, 186, 187, 14v in, 350v, 130 ma out. Includes filter and voltage divider **$2.75**
BD-93 Dynamotor Unit: Part of SCR- ( )- 283 28 v in, 350v, 130 ma out. Includes filter and voltage divider **$2.25**
DM-21 Dynamotor: Part of BC-312 and BC-314. 14v in, 235v. 100 ma out **$2.47**
DM-34 Dyn.: 12v in, 220v, 80 ma out **2.29**
DM-35 Dyn.: 12v in, 625v, 225 ma out **3.25**
PE-55 Dyn. Unit: 12v in, either 16 or 25 amp. 500v out, either 200 or 400 ma **$3.75**
PE-73 Dynamotor Unit: Part of BC-375. 28v in, 1000v, 350 ma out with filter, starting relays etc. **$4.65**
PE-206 Inverter Unit: Rotary converter. 28v in, 80v at 500 VA, 800 cy. out **$3.95**
DYNAMOTOR UNIT PE-101-C: Made for the BC-645, useful for any other mobile job. Choose 12 or 24 vdc in, get outputs of 800 v at 20 ma plus 400 v at 135 ma plus 9v at 1.1 amp. Brand new.
Special at only **$2.75**

SEND FOR YOUR COPY OF OUR FREE CATALOG

WESTERN RADIO CO., Inc. • 3633 South Racine Avenue Chicago 9, Illinois

Times put out a "fax" paper, broadcasting six daily, four-page editions to fourteen department stores. The editions are produced by the New York Times staff and broadcast by the paper's FM station, WQXQ.

-30-

Television Receivers

(*Continued from page* 62)

provide a passband of approximately 4.5 mc. To maintain a constant bandwidth, C_4, which is used in the lower six channels, has a value of 250 $\mu\mu$fd. For the seven upper channels, C_5 is used, with a value of 140 $\mu\mu$fd. This compensates for the change in coil Q's with frequency.

The construction of C_4 and C_5 is shown in Fig. 12. The units are composed of two large circular plates with a third circular plate inserted between them and isolated by mica sheets. The two outer plates are grounded and represent one plate of the condenser. The inner plate, which is the other side of the condenser, is in two separate pieces of different thicknesses. By changing the number of mica sheets, the two capacities are obtained. C_6 and C_7 are coupling and d.c. isolating condensers.

Servicing

An indication that trouble exists in the r.f. section of the receiver is the complete absence of video and audio outputs. Absence of an image does not mean a completely dark screen, for the receiver's internal sweep oscillators continue to function. What is visible is the scanning raster. See Fig. 13.

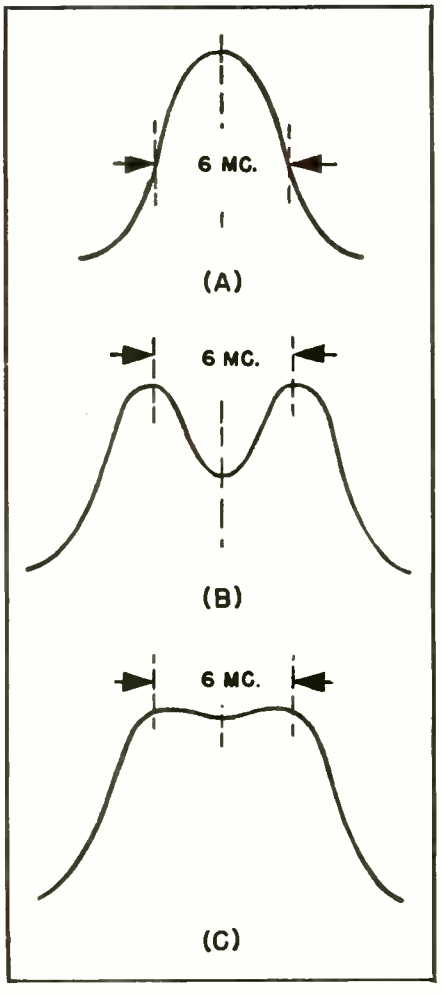
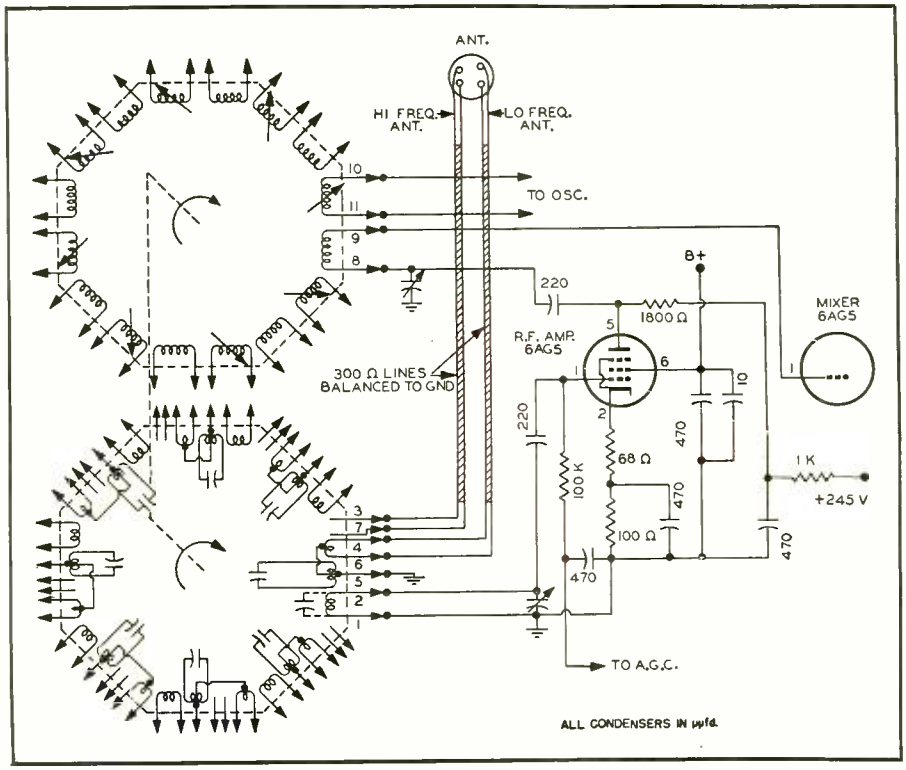


Fig. 9. Response curve for the plate circuit of the Philco r.f. amplifier (A), input circuit response (B), and their combined response (C).

Fig. 8. The r.f. amplifier used in Philco television receivers.



KEEP YOUR EYE ON THE Special OF THE MONTH

5" TELEVISION FOUNDATION KIT

This TELEVISION FOUNDATION KIT consists of the most essential (and expensive) parts needed in constructing a television receiver. Starting with the hi. volt. power supply. for the scope. right through to the antenna. This kit contains: high voltage scope transformer (for 5" or 7" tube). 2x2 filament transformer. lo. volt. transformer for receiver. cathode ray filament transfomer. filter choke. 6.3 filament transformer for 16 six volt tubes along with five volt transformer for the 5u4. the two hi. volt. filter condensers. blocking oscil.. transformer for all R.F.'s. sound and video I.F.'s. peaking coils and discriminator transformer. The rectifier tubes 2x2 and 5u4. the picture tube 5BP4. and an all aluminum Elincore dipole antenna are also included.
A 26-page instruction book. including a large 12 by 18 schematic diagram. theory of television. circuit functions. explanation of scanning. preliminary volt. measurements. parts lay-out and final adjustment of the television receiver which facilitates easy alignment without the use of elaborate test equipment. comes with each unit. The only knowledge necessary to build this set is the ability to read the simple schematic diagram. Most radio men will have many or all of the minor parts not included in the foundation kit. Special, only **$34.75**

REMAINING SET OF NECESSARY TUBES $16.95
COMPLETELY PUNCHED CHASSIS FOR ABOVE KIT 5.50

7" TELEVISION FOUNDATION KIT

This kit. which includes the famous Ray-Lectron Coil Kit. gives the discriminating television experimenter an opportunity to construct a television set of excellent quality. employing a 7" electrostatic Cathode Ray Picture Tube. All the special coils required are in this kit; and these coils have been carefully designed for maximum band-width and sensitivity. This exacting design features a 4.25 megacycle IF bandwidth. which will enable video operation of any size picture tube with maximum possible resolution. By following the instructions supplied it is possible to build this quality set at home. and at low cost. The television circuit which we suggest is comparatively simple. and the home constructor will find the remaining parts readily available at most radio supply houses. after our kit is purchased. By building your own set you will teach yourself many of the technical details of television receivers which you cannot learn from a book. We place emphasis on the RF and IF design because the RF and IF coils are the heart of the television set. Regardless of circuit refinements. if the RF and IF coils are not properly designed. the pictures will not satisfy you.

CONTENTS OF KIT

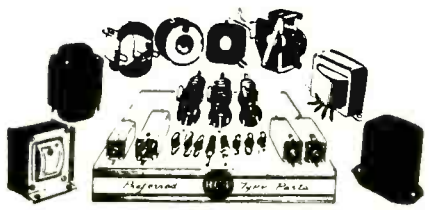
This kit includes the most essential (and expensive) parts needed in the construction of a television receiver. It contains the Hi. Voltage scope transformer (for 7" tube). 2x2 filament transformer. lo. volt. transformer for receiver. Cathode ray filament transformer. filter choke. 6.3 filament transformer for 16 six volt tubes along with five volt transformer for the 5U4. the two Hi. Volt. filter condensers. blocking osc.. a six channel tuner containing 1 Antenna Coil. 6 RF Tuning Coils. 1 Oscillator Tank Coil. all mounted on bakelite switch assembly plate; 5 Shielded Video IF coils; 1 Shielded Discriminator Coil; 3 Video Peaking Coils; the rectifier tubes 2X2 and 5U4. the picture tube 7EP4 and an all aluminum dipole antenna. An instruction manual containing complete assembly instructions. and circuit diagram with detailed parts list for a 20 tube. 7 inch picture tube set is also included.
This whole assortment complete is very moderately priced at only $69.50
Remaining set of necessary tubes 14.95

TUBE KITS

Complete set of tubes for SCR-522	Complete set of tubes for BC-348	Complete set of tubes for BC-312
$17.95	**$7.95**	**$7.95**

Specify Model Numbers

HERE IS THE TV KIT YOU HAVE WAITED FOR—ALL GENUINE RCA PARTS



Now, for the first time you are offered a basic kit consisting of the finest essential components *enabling you to build anything from a 7" to a 20" Television Receiver.* These parts are the best the industry has to offer—All genuine R.C.A. Also included is a schematic diagram and a complete parts list of the minor components necessary to make up a complete TV receiver. Described and pictured below are the various components included in this sensational kit.

KIT CONSISTS OF:

- Deflection Yoke Type 201D1
- Width Control Type 201R1
- Horizontal Linearity Control Type 201R3
- Power Transformer Type 201T6
- Yoke Mounting Hood Type 201X1
- Focus Coil Type 202D1
- Vertical Output Transformer Type 204T2
- Filament Choke Type 204L1
- Television I.F. and Video Coil Kit Type 204X2
- Vert. Blocking-Oscillator Transformer Type 208T2
- Horiz. Blocking-Oscillator Transformer Type 208T3
- Horiz. Output Transformer Type 211T1

The parts in this kit, if purchased separately, would list at over $139.00. Niagara saves you over 50%, or a big $70.20. GET YOURS TODAY.

SPECIAL

$69.50 COMPLETE

BUILD YOUR OWN TELEVISION SET TODAY

WATCH THIS SPACE EACH MONTH

HI-VOLTAGE POWER SUPPLY

Hi & Low Voltage Rectifier Power Supply Model C F T—20169 formerly used with the DAQ Direction Finder. This power supply contains 2500 v. at 3 mils—325 v. at 100 mils. Also contains a sweep amplifier. voltage regulated. Power Supply can be used to power a television receiver or perfect power supply for an Oscilloscope, or General Lab. use. Unit is mounted in a cabinet with all controls including pilot lights & switches on front panel. Wt. approx. 40 pounds—

LIMITED QUANTITY **$29.95**

DO YOU OWN AN SCR-522?

We have a complete power supply containing all the necessary parts down to the line cord, pilot light switch & terminal blocks & delivers the following voltage—300 v. DC @ 250 mills. 150 v. of regulated bias and sufficient 12 v. to operate the tubes of both receiver and transmitter. Complete at the amazingly low price of $14.95

Model 200-EA. 5-ELEMENT 2 METER BEAM KIT. Folded di-pole driven element. All-aluminum construction. Feed with low impedance coaxial cable. Amateur net price $8.40

BC-348 Owners
CONVERTER for Broadcast Band

Convert that BC-348 without any alteration in your circuit. Our special converter takes power from receiver. Just tune your set to 450 kc. and forget it. All tuning is done on a converter panel covering 550 to 1600 kc.—double conversion means High Sensitivity. Excellent Fidelity and Higher Selectivity—complete basic kit with schematic and full instructions—less chassis dial and tuning knobs. Terrific Buy at $6.50

POWER!! POWER!!

Niagara can supply a power supply kit which will completely power the ARC 5 Transmitter used as a VFO or any one of the ARC 5 receivers. All basic components included for delivering 300 v. @ 150 mills & 24 v. or 12 v. for the filaments—no rewiring of equipment necessary. This kit will also power the BC-348, BC-312. and the BC-1206. A good buy at $7.50

New . . . JUST OFF THE PRESS!

TELEVISION CATALOG

Send for Your COPY TODAY!

TELEVISION

NIAGARA RADIO SUPPLY CORP
160 Greenwich St., New York 6, N. Y.

"TELEVISION IS HERE TO STAY." If you are thinking in terms of Television—whether you own a receiver or planning to build one—get Niagara's new giant Television catalog—all in one complete and comprehensive booklet on everything for Television. Kits, Components, Test Equipment. Antennas and miscellaneous—We have them all—Make us your TELEVISION HEADQUARTERS — you will save considerable time and money. Clip the coupon.

Please send copy of your Television Catalog to:

Name .....

Address ..... Zone .....

City ..... State .....

WRITE FOR LATEST BULLETIN 3N8. 20% deposit with all orders unless Rated. All prices F.O.B. N. Y. City

NIAGARA RADIO SUPPLY CORP.
160 GREENWICH ST., NEW YORK 6, N. Y.

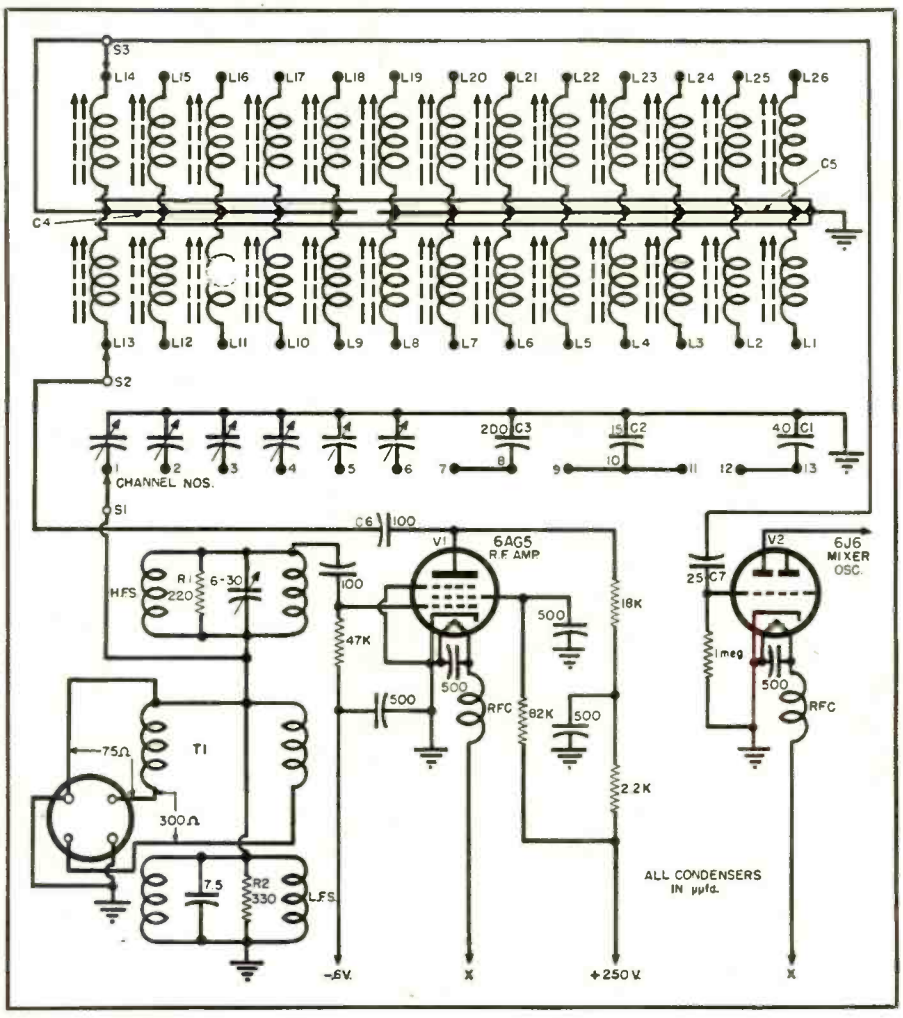
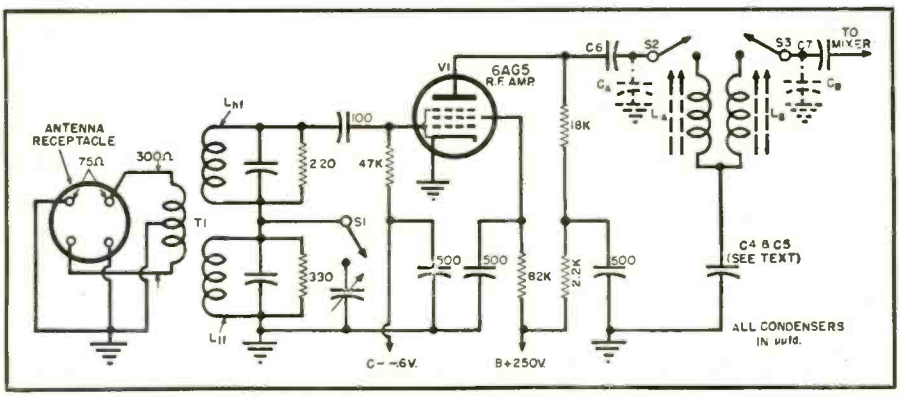


Fig. 10. The r.f. amplifier and tuning circuit for Motorola television receiver.

The entire secret of servicing television receivers lies in the proper interpretation of what appears on the screen plus what is heard from the loudspeaker. When both types of outputs are missing, the trouble obviously lies in some stage through which both signals must pass. On the other hand, if only one signal is affected, the defect is located in some portion of the system exclusively devoted to that signal. Since both signals must pass through the r.f. amplifier, here is the first place to look when neither an image nor sound is obtained. Only a scanning raster will be visible on the screen.

Assume, then, that a scanning raster is visible, but no image or sound is obtained when the set is tuned to a station known to be operating. These symptoms indicate that the trouble lies in one of the front-end stages of the receiver. Since tubes are, by far, the greatest source of trouble, they should be tested first. This is best done by substitution, using tubes known to be good. If the set is still inoperative, the trouble lies elsewhere in this section, either in the tuned circuits or in

Fig. 11. A simplified diagram of the r.f. amplifier for Motorola television receiver, Model VT101. See Fig. 10 (above) for parts values.



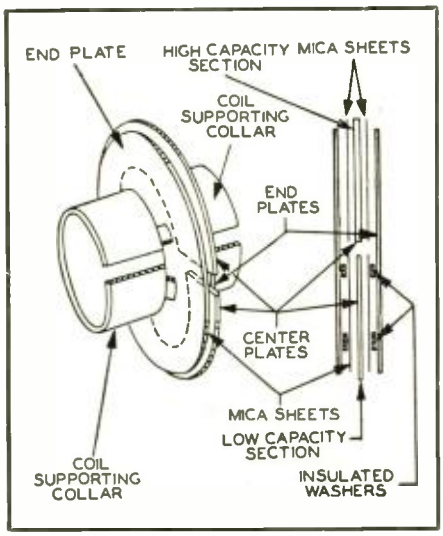


Fig. 12. Construction details of condensers C_1 and C_2 shown in schematic. Fig. 10.

the resistors and condensers. Since the tuned circuits can be checked without removing the set from the cabinet, they are tackled first.

The tuning circuits of television receivers can be classified in three ways.

1. Continuous tuning.

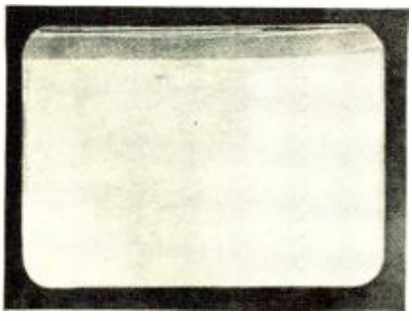
2. Selector switch with each channel completely separate, electrically.

3. Selector switch with each channel dependent electrically on the other channels.

To the serviceman, the foregoing information concerning the receiver to be repaired is very important because it will tell him whether or not the tuned circuits are at fault. For example, the *Belmont* receiver employs continuous tuning. However separate coils are employed for the high and low bands. Consequently, if the receiver will function on one band, but not on the other, then obviously the tuning coil of the band affected is at fault. On the other hand, if neither band is working, then it is fairly safe to assume that the trouble lies in some common component, but not in both tuning coils.

The same type of analysis can be employed for the other methods of tuning. In *G.E.* and *Philco* receivers, a completely separate tuning circuit is switched in for each channel. When all channels are affected, some common component, such as a tube, resistor, or bypass condenser must be at

Fig. 13. A scanning raster on a TV screen.



fault. In the *RCA* circuit, all of the circuits are in series. However, the analysis made when the circuit was previously analyzed shows how the reasoning is modified for that particular type of circuit. Therefore, know which type of tuning the receiver employs and then check circuit operation on different channels.

Servicemen may wonder how to check channels for which there is no station available in the vicinity. A rough test, but one which will reveal whether or not a signal can get through, is to detach the transmission line from the receiver input terminals and scrape the line leads across the input terminal posts. Bursts of noise will be heard in the speaker (even with FM) and flashes of light will appear in the scanning raster. If the signal cannot pass through the r.f. section, then voltage and resistance measurements are the only remaining step to take. This requires the removal of the chassis from the cabinet.

Alignment procedure for the entire r.f. end of the receiver will be given after all of these stages have been analyzed.

(*To be continued*)

International Short-Wave

(*Continued from page* 74)

better antenna for their 19-meter outlet (15.115) in operation by this time, to give better reception to the U.S.

The new station in Honduras, HRQ, 6.125, is definitely at San Pedro Sula. CE920, 9.22, Punta Arenas, Chile, signs off 2200, good signal. ZBW3, 9.525, Hongkong, signs off 1000, fair to poor signal, can be recognized by heavy hum on carrier. *Radio Raja,* 9.360, Java, signs off (in *English*) at 1130. (Park, British Columbia)

Radio Italiana has been heard in California on 6.085 (in dual with 9.630) around 1045-1130 or later; on Sundays appears to be 1110-1130 or later, featuring "Broadcasting Throughout the World"; on alternate Sundays uses French-*English* and German-Swedish; 6.085 appears to be used as an alternate for 11.810. (Dilg)

PLA8, 8.91 (announced), *Radio Batavia,* Java, has definitely replaced the 11.440 outlet in the U.S. beam, 0930-1000; YDC, 15.15, is used in parallel yet, beamed to Australia and Malaya; PLA8 is heard in Texas but appears to be slightly *higher* than 8.91. (Stark)

CE1180, Santiago, Chile, has been measured 12.004. DAKU, Berlin, measured 15.920, has been heard with news pickups to New York at 1400 on Sunday. OAX4W, Lima, Peru, is heard evenings on measured 9.393 (is listed 9.390). HI8Z, 7.225, Santiago, Dominican Republic, is heard in West Virginia at 1800-2100. (Arthur)

Sutton, Ohio, sent these tips: XEDP, 6.135, Mexico City, *new,* "Radio Educacion," heard evenings to 2200 sign-off; CR7AA, 5.860, Lourenco Marques, Mozambique, heard 0100-0200 sign-off; HI8Z, 7.225, Santiago, Dominican Re-

public, heard 0730-0800; HI2T has moved from 11.900 to 5.970, heard to 0000, located Cuidad Trujillo, Dominican Republic; YSHQ, 6.510, El Salvador, *new*, heard 2000-2300 sign-off; Ponta Delgada, Azores, on 11.090, signs on in Portuguese at 1500.

By this time Oslo, Norway, should be using 11.850 in parallel with 9.61 in the 2000-2100 daily beam "for Norwegians abroad" and which they say is beamed especially to North America. (Bishop, Ohio)

XORA, Shanghai, has been jumping around, varying from 11.68 to 11.700. (Hutchins, Radio Australia, via Dilg). Hutchins also reports that XGOY, Chungking, is using 15.170 (normally a summer frequency); did not give schedule but it may be for the transmission at 0500-0630 (one hour *earlier* in summer).

Radio Belgrano, Argentina, is back on 9.455, signs off 2200. XGPB, 6.11, China, exact location unknown, signs off at 1000, fair to poor. A Javanese outlet is heard on 7.27 to 1130 sign-off; AIR on 7.26 has news 0930 and signs off 1000; KZBU, 6.10, Cebu, Philippines, has news 1100; the USSR is using 9.48 lately in Home Service, irregularly around 0200-0600 and 0800-0900. (Balbi, California)

* * *

World-Radio Handbook

"World-Radio Handbook for Listeners" (in *English*) is one of the finest international radio guides I have yet seen. I heartily recommend it to every short-wave enthusiast.

It includes "Who's Who in World Radio"; a practical account of broadcasting in countries all over the world with information of benefit to listeners; a list of long- and medium-wave stations in Europe, the Near East, and North Africa with frequencies, wavelengths, and strengths; and a list of short-wave stations in all countries with frequencies, wavelengths, and strengths. It is comprehensive and highly accurate.

This guide is to be provided in two editions—the Summer Edition will be published in May, the Winter Edition in November. It may be had *direct* from the author for 14 International Reply Coupons. Address is O. Lund-Johansen, Lindorfsalle 1, Hellerup, Copenhagen, Denmark.

* * *

Club Notes

England—The British Short Wave League now has as its president, G. Musk; secretary, A. W. H. Wennell, 145, Uxendon Hill, Wembley Park, Middlesex; editor of its monthly house organ, *"Short Wave Review,"* W. H. C. Jennings; council, T. Burton, L. Le-Breton, E. J. Logan, S. Pearce; editorial office is at 82, Craven Park Road, London E. 15.

U.S.A.—George Jacobs, president, The Grand National Radio Society, informs us that all reports or announcements for publication in the club's monthly house organ should be sent *direct* to Ed Shirley, Route 1, Cassadaga, New York. This club has a fund for giving free memberships to all

"shut-ins" and disabled veterans; such persons who are interested should write *direct* to Walter Downes, R.F.D. 2, Box 328, Jeannette, Pa., stating details of the individual case.

* * *

This Month's Schedules

(*Note:* About this time of year many stations change to summer frequencies and/or to summer time schedules. The best way to ascertain such changes is by listening. When time changes occur, you may find many stations broadcasting one hour *earlier* than listed herein.—K.R.B.)

Albania—ZAA, 7.853, Tirana, is heard daily with news at 1515; best Sundays when has less CWQRM. (Southall, Pa.)

Algeria—Radio France, 11.835, Algiers, is heard well afternoons in East; now signs off 1800. (URDXC)

Anglo-Egyptian Sudan—Radio Omdurman informed Gillett, Australia, that its 9.700 outlet employs a standard telegraph and telephone type E.S. 4 transmitter with power output of .35 kw. to antenna, fed into folded dipoles made up for this frequency. Peddle, Newfoundland, reports the 13.32 outlet is heard there 1200-1430 daily; should have *English* on Fridays *only*, 1230-1300.

Angola—CR6RN, 9.475, Luanda, has recently been heard signing off at 1705 some days, other days at 1625. (Foerster, Illinois). Good signal reported in East.

Antarctica—CARA, aboard the "Rancagua," of the Chilean Antarctic Expedition, uses voice on 16.595 (approx.) when they have a schedule with Punta Arenas (which probably replies on approximately 6.705), around 2055; QSO's are for talks between the officers and crew of the ship and their families; sometimes they also have special programs to station CE920, 9.200, "Radio Ejercito," Punta Arenas, and to other stations of the network *"Coperativa."* Schedule then is around 1930, also on 16.595; first program was heard January 9 at 1945, when the ship was in Chile Bay, Antarctica; programs are interesting—patriotic in theme; in contacts announce as "Patrulla Antarctica del Ejercito de Chile." CARA also uses the calls "X8" and "M8," when working on phone. The "Rancagua" also has available frequencies of 11.029 and 7.351; the 11.029 outlet is used mainly for c.w. contacts with CCP (Ponta Arenas), CCS (Santiago), and so on, as well as with other Chilean ships. CARA sends a good signal to Brazil, but has bad QSB. Among broadcasters from Antarctica (*heard on c.w.*) are CDA, Puerto Soberania, the Chilean base at Antarctica; KICJ, Ronne Antarctic Research Expedition aboard "Port of Beaumont"; a frequency of 6.159 aboard the ice-breaker U.S.S. "Burton Island" of the U.S. Naval Antarctic Expedition for completing surveys of the last Byrd Expedition, and USFA aboard "Slava," the Russian Antarctic Whaler Expedition. (Villela, Brazil)

Three Victoria amateurs left Perth, Australia, in early winter for Heard Island to set up and operate base stations for the Australian Research Expedition to Antarctica; another amateur left for Macquarie Island in January. These amateurs—and possibly others—will use any of the bands allocated for amateur use; calls will include VK3OY, VK3ACD, VK3AMG, VK7AE, and others. Base stations on Macquarie and Heard Islands will be for communication with Sydney, New South Wales; callsigns and frequencies allocated include these: Macquarie Island, VJM, 9.940; VJM2, 12.255; VJM3, 15.845; VJM4, 19.255; Heard Island, VJH, 9.940; VJH2, 12.255; VJH3, 15.845; VJH4, 19.255. *Radio Australia* has announced that weak signals had been reported in Perth, Western Australia, from one of the VJH outlets, no other details were given.

Argentina—LRM, 6.180, Mendoza, verified by registered airmail letter from Julio E. Pozo, director; QRA is Radio Aconcagua, E. Civit 460, Mendoza. (Cushen, N.Z.) Has been heard lately with frequency relays of *Radio El Mundo* programs. (Kary, Pa.) LRY1 has moved to 9.545; *Radio Belgrano* signs off at 2200, strong. (Balbi, California)

Australia—VLC7 has moved to 11.81 from 11.84 where it is used to East Coast (North America), in parallel with VLB, 9.54, 0800-0915 (will be one hour *earlier* in summer).

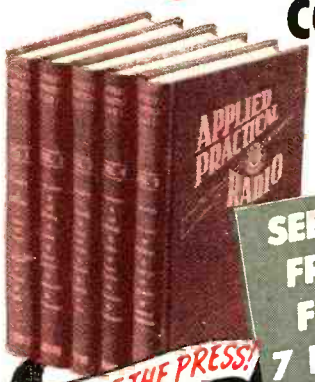
Radio Australia recently announced several changes in schedules, including: 2330-0045 to West Coast (North America), VLA7, 17.800, VLC4, 15.320, VLG10, 11.760; VLB5, 21.540 (to Africa, may be off Sat. and Sun.); 1000-1115 to West Coast (North America), VLC3, 11.760, VLB9, 9.615; 1000-1115 to Africa, VLG4, 11.840, VLA6, 15.200; 0900-1000 to British Isles and Europe, VLG10, 11.760, VLA6, 15.200; 1500-1645 to British Isles and Europe, VLA6, 15.200, VLB9, 9.615; a frequency of 15.230 appears to be in use to British Isles and Europe to 1815 closedown, probably from 2210 or earlier; 1645-1815 to Forces, VLB11, 15.160; 1645-1815 to East Coast (North America), VLA9, 21.600; 1700-1815 to South America, VLG10, 21.680. DX sessions are heard in these various beams on *Sunday*—to West Coast (North America) at 0025; to British Isles and Europe 0902; to East Coast (North America) 1800.

From Graham Hutchins, DX Editor, *Radio Australia,* come these schedules for transmitters of the Australian Broadcasting Commission in the Inland Short-Wave Service: Monday to Saturday — Melbourne, VLR2, 6.150, 1500-1715; VLR, 9.540, 1730-0330; VLR2, 6.150, 0345-0900; VLH4, 11.880, 1500-1715; VLH5, 15.230, 1830-0315; VLH3, 9.580, 0328-0900; VLG6, 15.230, 1500-1700; Brisbane, VLQ3, 9.660, 1500-0900; Perth, VLW7, 9.520, 1700-2045; VLW3, 11.830, 2230-0515, VLW7, 9.520, 0530-1100. Sunday—VLR2, 6.150, 1545-1715; VLR, 9.540, 1730-0215; VLR2, 6.150, 0230-0900; VLH4, 11:880, 1545-1815; VLH5, 15.230, 1830-0315; VLH3, 9.580, 0328-0900; VLG6, 15.230, 1545-1700; VLQ3, 9.660, 1500-0900; VLW7,

BIG MONEY IN RADIO

SEE THESE BRAND NEW RADIO BOOKS FREE

COYNE'S New 5 Volume Set "APPLIED PRACTICAL RADIO"



SEE IT FREE FOR 7 DAYS

JUST OFF THE PRESS!

You men who want to go places in Radio, and who know how much a solid working knowledge of the field helps to get the big money—this is IT! Over 1500 pages of down-to-earth Radio, from simplest principles to newest Television! It's all there easy to understand—how and why it works . . . how to construct, install, service. PA, short-wave, auto-radio, aviation, radio-phonographs. FM, testing instruments and trouble-shooting short-cuts, phototubes—you name it, COYNE'S got it, in "Applied Practical Radio"!

PRACTICAL! CLEAR! COMPLETE!

5 big volumes—1000 illustrations and diagrams, with step-by-step photographs which "break down" the equipment for you to show what makes it "tick". Up-to-the-minute, complete, easy to follow . . . **written as only COYNE books are written!**

GET THIS BOOK FREE for LOOKING AT SET

Brand New! Explains circuits of latest sets

VALUABLE BOOK FREE for Looking at 5-Volume Set

Send This Coupon NOW

You must SEE these books to know how easy it is to prepare for the big jobs in radio. Here's our special offer:—we'll send the complete 5-volume set for your 7-Day FREE Examination. And with it, we'll include our valuable, new guide for all radiomen, "150 New Radio Diagrams Explained", absolutely FREE! If you keep the 5-volume Set all you pay is $3.00 within 7 days after the books arrive and $3.00 per month until $16.75 is paid—or you can pay $15.00 cash price. If you don't want the set, return it and you OWE NOTHING. But either way you keep the "150 Radio Diagrams Book" as a gift. That book is ABSOLUTELY FREE.

SEND NO MONEY **REMEMBER—Coupon is not an order,** just a request to see set free and get the FREE BOOK. But **offer is limited,** so act at once!

COYNE ELECTRICAL & RADIO SCHOOL (Founded 1899)
500 S. Paulina St., Dept. 48-T3, Chicago 12, Ill.

EDUCATIONAL BOOK PUBLISHING DIVISION
COYNE ELECTRICAL & RADIO SCHOOL
Dept. 48-T3, 500 S. Paulina St., Chicago 12, Ill.

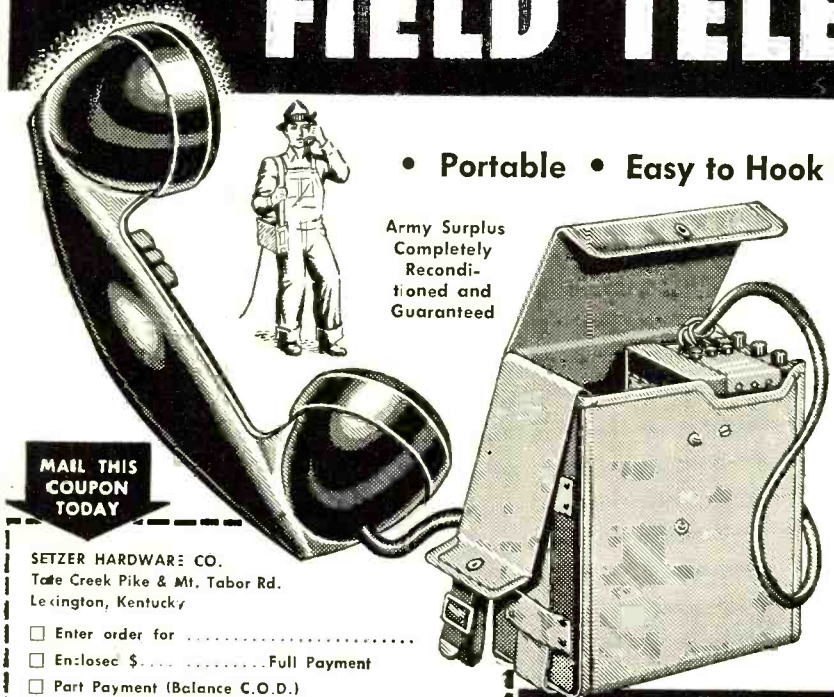
O. K., send me postpaid, your new 5-volume set, **"Applied Practical Radio"** on 7 days' Free Trial per your offer in Radio News. Be sure to include as a gift the book of **150 New Radio Diagrams Explained,** absolutely FREE.

FREE BOOK

NAME ..... AGE .....
ADDRESS .....
TOWN ..... ZONE ... STATE .....

Talk 10 Miles! Use Flashlight Batteries!

FIELD TELEPHONES



• Portable • Easy to Hook Up • Clear Reception to 10 Miles

Army Surplus Completely Reconditioned and Guaranteed

Price Per Unit Complete With Handset **$9.95** F. O. B. Lexington, Ky.

INCLUDES CARRYING CASE

Save time and many steps with these portable field telephones—useful wherever you need communication. Used by the Signal Corps from Nome to Naples, these Army surplus telephones are priced at a fraction of what the government paid for them. Every set tested. Every set in perfect operating condition, ready for use. Operates on 2 standard flashlight cells with easy-to-attach 2-wire connection. Weight 10½ lbs. Complete with carrying case.

MAIL THIS COUPON TODAY

SETZER HARDWARE CO.
Tate Creek Pike & Mt. Tabor Rd.
Lexington, Kentucky

☐ Enter order for .....
☐ Enclosed $..... Full Payment
☐ Part Payment (Balance C.O.D.)

NAME .....
STREET ADDRESS .....
CITY ..... STATE .....

SETZER HARDWARE CO.
TATE CREEK PIKE & MT. TABOR ROAD LEXINGTON, KY.

9.520, 1545-2040; VLW3, 11.830, 2100-0515; VLW7, 9.520, 0530-0900. Many of these outlets are heard with good signals in the U.S., Canada, Africa, Britain, on the Continent, and elsewhere.

It was announced recently over VLH3, 9.580, that two new stations are planned for Australia—10 kw. each with directional antennas—to be located at Perth and Brisbane, respectively; will supplement services of VLW and VLQ; should be in operation by mid-1948, according to announcement. (Brownless, England)

Austria—Kary, Pa., reports KOFA, 7.221, Salzburg, heard in clear, but with bad fading, with news 0130-0145; announces "This is BDN, the Blue Danube Network."

Under the unusual callsign of XL2C, the Austrian Post, Telephones, and Telegraphs Dept., Vienna, has been operating a circuit with New York since September 12, 1946; on 17.600, for the exclusive use of U.S. Army and civilian personnel; station is Austrian-staffed, under American supervision; schedule is 12 hours daily—0800-2200; other frequencies available are 19.730, 9.130, 7.478 (on voice); the transmitter is 2.5 kw., and since they use single sideband, some degree of intelligibility is noted without use of b.f.o. (Kary, Pa.)

Azores—Kary, Pa., recently heard CUM, 6.925, calling CUJ, Lisbon, Portugal, at 1727, later calling Bissau, Portuguese Guinea, latter could not be found.

CSX-2, 4.845, Ponta Delgada, "Emissora Regional dos Azores," has good signal in East 1700-1900; leaves air with Portuguese National Anthem. (URDXC)

Bahrein Islands—Radio Australia's North African observer reports Manama on Bahrein Islands in the Persian Gulf as playing American, French, and German recordings, heard on frequencies from 6.910 to 7.200 but seems now to have settled down on 7.070; on the air weekdays 1000-1130, Sats. and Sun. 1000-1200; quality poor; announces in Arabic and Persian, but just before closing down, also identifies in French.

Barbados—VPO3, 10.605, Bridgetown, is often heard in Newfoundland around 1500-1615. (Peddle) Is used for special relays.

Belgian Congo—Leopoldville's frequencies have been a bit unsettled this winter, but seem to be using 9.783 and 9.745 mainly at 1300-1645, news 1530-1550, 1640-1645; 9.745 is used 1700-2300, news at 2100-2120, 2250-2300; (between 2100-2300 is beamed to North America); the 1530-1645 period is beamed to Britain and to British Colonies in Africa.

Elizabethville is heard quite well in South Africa on Sunday *(only)* 0800-1000 on 11.900, .150 w., and 7.145, 50 w., using the call OQ2AB; QRA is Radio Elizabethville, Box 1038, Elizabethville, Belgian Congo; verifies via letter (in French), takes several months. (Laubscher, South Africa)

Worris, Florida, received these schedules from *Radio Congo Belge*—

OCT3, 0000-0200 on 9.38, 6.295; 0515-0700, 11.72, 6.295; 1100-1500, 9.38, 6.295. Location is Leopoldville.

Brazil—Villela, ISW monitor in Sao Paulo, advises that "Radio Anchieta," PST-2, 7.410, has changed schedule to 1330-1530; still asks for reports to "Radio Anchieta," Secretaria da Educacao, Pateo do Colegio, Sao Paulo, Brasil; letters are acknowledged over the air at end of broadcasts.

British Honduras—Eyles, Georgia, says ZIK-2, Belize, around 10.600, is still heard at 1330 with news.

British Somaliland—New Zealand sources report *Radio Somali*, Hargeisa, is now being heard on 7.350, moved from 7.126. (Cushen, N.Z.)

Bulgaria—Radio Sofia III, 9.350, has replaced *Radio Rodina* (Military Radio) on same frequency, latter having been suspended; *English* news is scheduled daily at 1350, and for a time at 1650 to compensate for BCB 850 kcs. which is temporarily off the air. (URDXC)

Burma—The Burma Broadcasting Service has advised *Radio Australia* that it does *not* have calls for its transmitters; XYZ and XZZ were allocated prewar, but have not been reissued (Hutchins, Radio Australia)

Cameroons—Radio Douala, 7.950, was heard recently in Pennsylvania to 1457 sign-off; woman announced "Ici Radio Douala," and then station left the air with march (*not* "La Marseillaise"); surprisingly clear signal despite noise and ham QRM. (Kary) A Swedish ISW monitor lists schedule of 1300-1500, news in French at 1330, says sometimes has heavy CWQRM.

Canada—CBC's International Service now has a North American Service on Saturdays to 0000 over CKOB, 6.090, and CKLO, 9.630. (Beck, N.Y.) Official 1948 schedules for VE9AI, Edmonton, Alberta. are 6.005:—April 2130-0200; May 2230-0200; June 2300-0200; July 2300-0200; August 2200-0200; September 2045-0200; October 0815-0900, 1945-0200; November 0815-1000, 1845-0200; December 0815-1045, 1815-0200. On 9.540—April 0815-2130; May 0815-2230; June 0815-2300; July 0815-2300; August 0815-2200; September 0815-2045; October 0900-1945; November 1000-1845; December 1045-1815; power is 200 w. and the station relays medium-wave CJCA.

Celebes—According *to Radio Australia,* schedule of *Radio Makassar,* back on 9.357 and using 5.030 in parallel, is 1730-1930, 2200-0130, 0400-1000.

The 9.357 outlet sends a good signal to Britain, heard signing off 1000 with announcement, "Radio Macassar, situated on the Island of Celebes, one of the largest islands of the Eastern Archipelago and broadcasting from Macassar, capital of the State of East Indonesia." (Pearce)

Ceylon—Radio SEAC, Colombo, airmails these schedules—Main Program, 17.82, 1930-0135, 0500-0700, 0715-1115; 15.12, 1930-0135, 0500-1115; 9.52, 1930-0135, 0500-1115; these frequencies are also used in the Sunday beam to United Kingdom, 1330-1530, and for

this beam 17.77 is also listed; while 6.075 and 3.395 are *not listed* for the Sunday beam to Britain, it is believed they are being used also (for listeners in India and Pakistan, as announced); other *daily* schedules include 6.075 and 3.395, 1930-0135, 0500-1115. Ceylonese Forces Program is listed on 17.82, 0700-0715 daily. (NOTE: On Saturday there is usually an "alternate" program of sports and music at 0900 on 17.82, 6.075, and 3.395 outlets.)

Newscasts are scheduled over *Radio SEAC* at 2000 (London relay), 2200 (London relay), 0030 (world news headlines), 0130 (world news headlines), 0600 (world in review), 0730 (world and home news from Radio SEAC), 0900 (Radio Newsreel from London), 1100 (world news from London). (Park, British Columbia)

ZOH, 4.900, Colombo, runs to 1700 on Sundays; gives program summary 1055, news 1100. (Pearce, England)

China—XPPA, Kweiyang, has moved to 7.100 from 9.450. (URDXC) Now signs off at 1000 and does *not* carry XGOY news relay at 0900. (Dilg, California) Schedule is listed 1755-1900, 2330-0100, 0500-1030. (Carter, Washington)

The Communist-controlled stations in China may have gone back to former schedule; Dilg, California, recently noted that on a Sunday, XGNC, about 6.570 (drifts), remained on until 0945 when signed with "La Paloma"; should have news at either 0630 or 0730.

T. Y. Woo, director, XGOA, Nanking has informed Cushen, N. Z., that he regrets that DX reports have been acknowledged only by cards, and that cooperation of DX-ers is appreciated, but due to lack of personnel in the *English Department,* they can't hope to write each listener personally. (I have just received an attractive QSL card from this station, verifying reception of the 11.835 outlet in the portion of daily North American beam audible in East around 2230-2300.—K.R.B.)

Our observer in Western Australia, Major, sends along these details regarding XGOE, The Educational Broadcasting Station of Kwangsi, Kweilin, Kwangsi, China; director is Lu Hin Shue; station operates on 9.868 at 0500-0900 daily, using 100 watts and a crystal-controlled m.o.p.a. broadcasting transmitter; antenna is Hertz type, half-wave, 60 feet high, running E-W; civil service and *English* broadcasts were discontinued in September; prior to that time the XGOY news relay had been carried; now that period is devoted to programs of Western music. Mr. Major reports XGIO on approximately 9.99 at 0530-0630 with Western music, also heard 0800-0830; this station is listed on 8.433, location Nanking, and has been reported used chiefly for sending dispatches.

XGOY's 49-meter outlet has been measured 6.145. (Park, British Columbia) May drift. Appears to be scheduled now 0635-1145, news 0700, 0730 (at least some days) 0900, 1100. XGOY will probably be using 15.170 shortly, watch for it on 19 meters.

XURA, Taiwan, is back on 7.220 from its 49-meter outlet (around 6.180); runs to 1000 and carries XGOY news relay at 0300. (Dilg, Calif.) Address is XURA, Taiwan Broadcasting District, Central Broadcasting Administration, Chong Sung Park, Taipeh, Taiwan, China. Schedule received from station is 0400-1015. (Carter)

Colombia—HJAP, "Radio Colonial," Cartagena, is reported moved from 4.925 to 9.895.

Czechoslovakia—Peddle, Newfoundland, heard a station on approximately 7.100 on New Year's Eve at 1500-1515 announcing in Czech and *English* between musical numbers—"Czechoslovakia wishes you a Happy New Year"; no other details. A new outlet?

OLR4A, 11.84, Prague, can sometimes be "pried out from under" CXA-19 QRM in the 1900-2000 North American transmission; usually has news commentary around 1937-1943; signs off at 2001 with Czech National Anthem. (Kary, Pa.) The 6.010 outlet is heard in Britain signing on 1130, with R8 signal. (Pearce)

Dutch Borneo—Radio Pontianak uses YCN, 5.480, 40 w., YCN2, 6.650, 150 w., YCN3. 8.090, 250 w., 0545-0730 (usually on YCN2). (Cushen, N. Z.)

Ecuador—HCJB, Quito, is noted at 0000-0100 on its *new* frequency of about 5.97. (Beck, N. Y.) Is officially listed 5.995; the station would appreciate reports on reception of this *new* outlet.

"La Voz de Manabi," Portoviejo, formerly 7.140, is lately reported on 4.765, evenings (EST).

HC2RL, 6.635, has been heard intermittently, from around 2100 to 2200, announcing in Portuguese, Spanish, and *English.* (Arthur, W. Va.)

England—Tommy Kneitel, New York, writes: "GKU3 verified by letter; said, 'With reference to your reception of GKU3 on 12.455 on November 1, conditions were probably exceptionally good. We normally monitor the American NSS time signals on 12.630 at 1000, 1400, 1600, 2000 GMT, and excellent reception was obtained over last weekend. SX-28 or HRO receivers are used in conjunction with a rhombic antenna, and all signal measurements are made electronically with a decimal counter chronometer.' It was stated that a 350-w. transmitter with call letters GMT is also in operation at 1000-1030 GMT each weekday; from 1000-1015 GMT an unmodulated 2-megacycle carrier is radiated and 1015-1025 a 1000 c.p.s. modulation is applied. Provisional corrections to the radiated frequencies are announced 1020-1030 GMT. These are stations of the Royal Observatory, Greenwich."

Finland—Official detailed schedules of the Finnish transmitters are: OIX2, 9.50, Lahti, 1925-1935 (*English*), 2300-0000 (Finnish), 0350-0710 (Finnish), 0715-0725 (*English*), 1000-1150 (Finnish), 1150-1230 (Finnish), 1230-1255 (French), 1255-1440 (Finnish), 1440-

1600 (Finnish), 1705-1715 (French); news 1925. 0715. OIX4, 15.19, Pori, 2300-0000 (Finnish), 0350-0710 (Finnish), 0715-0725 (*English*), 1150-1230 (Finnish), 1440-1600 (Finnish), 1705-1715 (French); news 0715; OIX5, 17.80, Helsinki, 1925-1935 (*English*), 2300-0000 (Finnish) 0350-0710 (Finnish), 0715-0725 (*English*), 1000-1150 (Finnish), 1150-1230 (Finnish), 1230-1255 (French), 1255-1440 (Finnish), 1705-1715 (French); news 1925, 0715; OIX7, 6.12, Helsinki, 1925-1935 (*English*), 2300-0000 (Finnish), 0350-0710 (Finnish), 0715-0725 (*English*), 1000-1150 (Finnish), 1150-1230 (Finnish), 1230-1255 (French), 1255-1440 (Finnish), 1440-1600 (Finnish), 1705-1715 (French); news 1925, 0715. (Callahan, Pa.)

Helsinki programs are heard in New York after 0045 on 9.50 and 6.12. (Beck)

France—New QRA of the French Press and Information Service in New York is 610 Fifth Ave., Room 401. (Kelly, N. Y.) Latest schedules from Paris list *English* at 2115-2130 and French at 2130-2145 on 11.845, 9.68, 9.55. (White)

French Equatorial Africa — Latest schedules of *Radio Brazzaville* are 0000-0225. 17.85, 11.972, 9.984, 9.440, 7.000, 6.024, news and commentary 0030-0045; 0500-0745, 21.002, 17.850, 15.596, news and commentary, 0715-0730; 1100-1630, 17.850, 11.972, 9.984, 9.440, 6.024, 9.984 (also 21.002 to 1235 and 7.000 from 1300), news and commentary, 1345-1400, 1545-1600; 1705-2030, 11.972, 9.984, 9.440, 7.000, 6.024, news 1715-1730, 1900-1910.

French West Africa—At last report, *Radio Dakar*, 11.713, 6.917, was scheduled 0200-0230, 0715-0800, 1330-1700, and irregularly at 1700-1745; *no English*. Brehmer, Sweden, says the musical signature of this station is a French song called "Sur les Ponts d'Avignon."

Germany—Leipzig, 9.73 (may vary), now begins at 0000. (Beck, N. Y.)

Miers, ISW monitor in Berlin, says "Berlin does *not* operate any s.w. transmitter at present, has been off the air since February 1947; I do not know anything about a short-wave station of BFN in Germany." He lists current schedules for German s.w. outlets as Frankfurt, 6.190, 0000-1800 daily; Stuttgart, 6.180, weekdays 0500-1800, Sundays 0200-1800; Munich, 6.160, weekdays, 0000-1800, Sundays 0000-1900; Leipzig, 9.730, except Saturdays, 2300-1800, Saturdays 2300-2100 (note this one has been heard recently signing *on* 0000); Hamburg, 6.115, 0000-1830 daily; Baden-Baden, 6.327, 0000-1800 daily. Pearce, England, reports the BFN station formerly on 6.490 is now heard on 6.510 with strong signals afternoons (in Britain); may announce 6.513 and/or as "Radio Bumeveld."

Greece—Simonian, Mass., reports a Greek Underground Station on 7.700 at 0100-0130; begins with Greek National Anthem, then a man and woman alternate with talks in Greek; signs off with anthem; good signal.

Greenland—World-Radio Handbook, Denmark, gives this data on radio in Greenland—Normal clock time is GMT *minus* 3 hours; address, Radiostation Godthaab, Greenland; frequency 5.942 (50.49 m.); 1 kw.; daily program 1645-1745; weather report 1645; news in Danish 1700; ships' positions 1715; news in Eskimoan 1730; announcement in Danish is "God Aften; her Gronlands Radio"; interval signal, chimes and first movement (six bars, played twice), of the "Funeral March" by Norman Andersen which was composed for Kjell Abel's play, "Silkeborg." (Skoog, Sweden)

Guatemala—Kary, Pa., reports what appears to be a new Guatemalan on 6.660, announcing "'Radio Oriental' en la ciudad de Zacapa (?)"; he is not certain of location; call is not given.

TGRB, Guatemala City, is now heard on 6.91, moved from 6.86, off 2200. (Beck, N. Y.)

Haiti—HHYM, 6.000, Port-au-Prince, a relatively *new* outlet, is reported by Kary, Pa., as heard signing off 2054 with anthem; announced call and frequency in *English* just prior to close-down, stating this was "second" broadcast of the day; slogan appears to be "Radio Phillips." Official schedule is 1200-1400, 1830-2100. (Precourt, N. Y.)

Honduras—Stark, Texas, reports a station on about 6.122 to 6.125 as HRQ; may be at San Pedro Sula; heard around 2100.

Iceland—Holmberg, Sweden, has just airmailed us that Reykjavik has announced a regular transmission on 12.235 on Sundays 1115-1145, consisting of news and Swedish music; this may be only a part of the regular transmissions that have been projected for some time by Iceland State Broadcasting. (Complete current data on s.w. schedules for this country will be appreciated.—K.R.B.)

New Zealand sources report TFI, 5.021, testing with TFN, 15.350, at 1330-1400 on December 31, in *English*, French, Swedish, and Icelandic. This may mean that services are to be expanded to include various languages, as forecast to me by the station some time ago.

India—Delhi's outlet on 15.160 gives program schedule for *all* transmissions at 0500. (Cushen, N. Z.)

Gillett, Australia, has received this data from VU7MC, Mysore—there are transmissions daily at 2030-2240, 0330-0440, 0700-1140 on 6.065 and 968 kcs.; at present the s.w. outlet uses 300 watts, while the BCB channel has only 30 watts. Plans are under way to increase power to 5 kw. on s.w. and to 10 kw. in broadcast band; it is hoped that new equipment will be installed during this year; news is listed for 2130, 0730. VU7MC belongs to the Government of Mysore, address is Akash-Vani Broadcasting Station, Mysore, India.

The Madras outlet on 4.920 has been heard with fair to good signals recently early mornings in the East; best around 0730 when relays the

news from Delhi, followed by local news.

Iran—Radio Tabriz recently verified a "harmonic" for Kary, Pa.; stated report checked with log, but that 12.180 where Kary had heard the broadcast, was a harmonic of 6.090; said appreciated report, as their technicians had since checked and had corrected this harmonic radiation. Verified by letter, divided in half, one side in *English*, the other in Arabic; report was sent September 8, verie mailed November 4th, received by Kary on January 26. Schedules were listed as 0500-0630 (except on Fridays when runs 0130-0600) on 11.960; 0930-1330 (daily) on 6.090, news 1300. However, *Radio Australia* announced more recently that *Radio Tabriz* has moved from 6.090 to 6.105 where it operates daily at 0900-1230, with French news 1210, *English* news 1220. It is believed this change was made due to a *new* powerful Russian outlet heard on 6.090 at 1000 in Persian and at 1100 in Arabic.

Italy—Radio Italiana recently informed Worris, Florida, that "our transmitters are located in Lombardy, at Busto Araizio near Milan, and for the moment our programs are relayed by land-line from Rome, since the short-wave center just outside Rome was destroyed by the Germans during the war and will not be back in service for some time yet." Listed power of 50 kw.

Japan—JKF, 9.655, Nazaki, is heard in Pennsylvania around 0000 and later with strong signal. (Kary) Is heard often in Britain (announcing JOAK, medium-wave outlet) with Home Service from around 1700 when has news in Japanese; often has *English* lesson at 1730 by an American instructor. (Pearce)

JKE-2, Yamata, 4.860, has been heard early mornings in East in late winter with AFRS programs at 0730; JKF-2, 4.910, is also heard with relay of Home Service; AFRS outlet is best. (Kary, Pa.)

JVU-2, 11.845, is heard often working point-to-point with the U. S. on around 2340. (Park, British Columbia) Also reported heard in East.

Java—Stark, Texas, reports that *Radio Batavia* announced that PLC, 11.440, would be replaced by PLA on about 8.916 for the beam at 0930-1000 (to U. S.). I am still hearing a good signal on 15.145 to 15.150 in this transmission; the 19-m. outlet is beamed to Australia and Malaya.

Cushen, N. Z., airmails us these schedules for certain Indonesian outlets—Semerang, YDH, 2.510, 60 w., YDH2, 11.030, 100 w., 0730-1000; Soerabaya, YDI, 3.240, 250 w., 1800-2000, 2330, 0215, 0430-1015, YD12, 4.370, 300 w., 1830-2000, 2330-0030, 0530-0930. PMS4, 13.600, 250 w., no schedule given.

"Voice of Indonesia," 11.000, Djogjakarta, broadcasts for North America daily, 1730-1930; a transmission for the British Isles and Europe (also in *English*) is scheduled 1200-1300

(*Continued on page* 169)

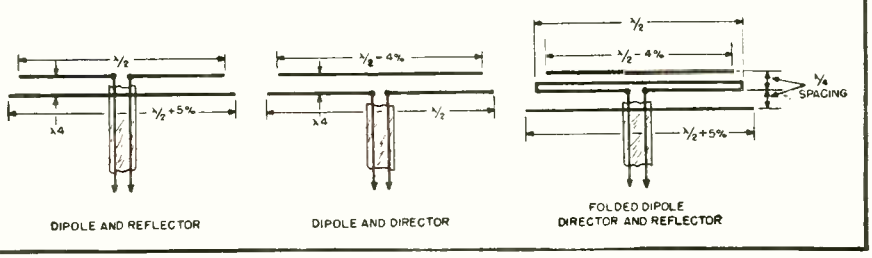
REFLECTORS AND DIRECTORS

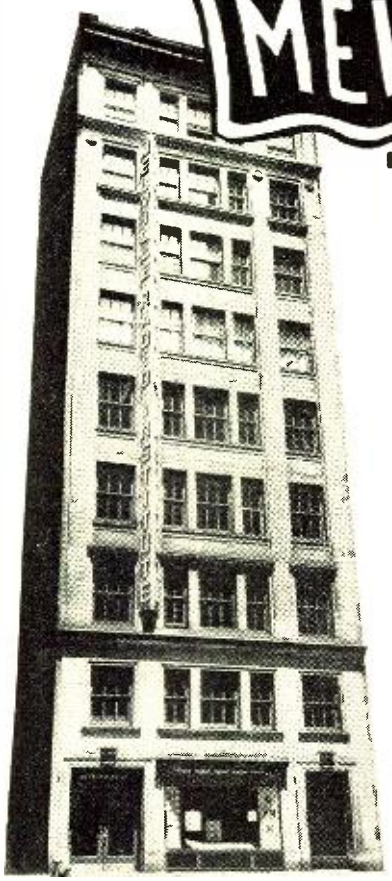
By EDWARD M. NOLL

A DIPOLE antenna (simple dipole, folded dipole, etc.) can be made uni-directional by positioning a reflector in back of, or a director ahead of, the dipole element. These elements, called parasitic because they have no direct connection to the dipole, are spaced a quarter-wave from the dipole. The reflector is 5 per cent longer, and the director 4 per cent shorter than the half-wave dipole. The dimensions are given in the chart. If both reflector and director are used, the sensitivity is still greater in a given direction but the bandwidth is reduced to some extent.

If a director or reflector is used and it is spaced a λ/4 wave from the dipole there is little change in the antenna resistance. When either type of parasitic element is moved nearer the dipole, however, antenna resistance and bandwidth is decreased. Inasmuch as the bandwidth of a folded dipole is inherently broad, a parasitic element is often moved nearer the folded dipole to reduce antenna resistance and allow it to be matched to a lower impedance line. —30—

CHANNEL	1	2	3	4	5	6	7	8	9	10	11	12	13	L	H
λ/2 length	120	98	86	81	72	67	31	30½	29¾	28¾	27¾	27	26½	84	28¾
Reflector	126	103	90	85	75½	70¼	32½	32	31½	30½	29½	28¼	27¾	88	30½
Director	115	94	83	78	69¼	64½	30¾	29¼	28¾	27¾	26¾	26	25½	81	27¾
λ/4 spacing	63	51½	45	42½	37¾	35¼	16¼	16	15¾	15½	14¾	14¼	13½	44	15½





MELVILLE RADIO INSTITUTE

Outstanding PRE-WAR Technical Training Center for

TELEVISION & RADIO

Under the personal direction of Frank Melville, former Airlines, Merchant Marine, and Broadcast technician, you may soon quality as:

- **RADIO TECHNICIAN**
- **AIRLINES RADIO OFFICER**
- **PT. TO PT. TELEGRAPHER**
- **RADIO AMATEUR**
- **MERCHANT-MARINE RADIO OFFICER**
- **TELEVISION TECHNICIAN**
- **HOME RECEIVER REPAIRMAN**
- **VISUAL TELEGRAPH OPR. (SLIP TAPE)**

MELVILLE RADIO INSTITUTE believes vocational training means vocational training. Thus we, like many radio schools, teach ample theory. But, unlike most schools, two-thirds of our technical students' time is spent in laboratories and shops, where, with superior equipment, they learn by doing — not memorizing.

FREE employment service is available to all MELVILLE graduates.

Visit the 10-story MELVILLE Building today as our guest and observe the school in operation.

Day and evening classes approved for veterans. Licensed by the State of New York.

MELVILLE RADIO INSTITUTE
Melville Building
15 West 46th St., N. Y. 19 · LO 4-0340

MAIL THIS COUPON NOW!

MELVILLE RADIO INSTITUTE R.N.
Melville Building
15 West 46th St., New York 19, N. Y.

Gentlemen: Send me Free information about your school.

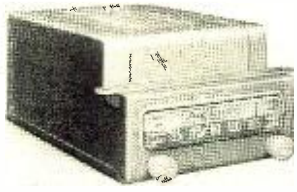
Name.....

Address.....

.....

OUTSTANDING VALUES NOW AVAILABLE

AUTOMATIC CAR RADIO



The Best Buy on the Market

Six tube superheterodyne. Two dual purpose tubes, giving 8 tube performance. Simple Universal Mounting.
Equipped with G.E. 5" Speaker.

FITS ANY CAR
FEATURES:

- 3 gang tuning condenser
- Beautifully finished case
- Hearing this fine radio is a thrill

***Only* $39.95 includes**

One 66" 2 POINT SIDE MOUNT, RUST PROOF ANTENNAS, a $5.95 SELLER.

SPECIAL ON RECORD CHANGERS DETROLA

FEATURES:

- Plays 12-10 in. or 10-12 in. records
- Extremely smooth action
- 9" turntable
- Size 12" x 12" —6½" deep

This changer is compact enough to fit in most installations.
PRICED AT ONLY..... **$14.95**

REGAL PORTABLE RADIO

A fine performing set, AC-DC and Battery operation. Attractive case, small and sturdily built. Slide rule dial, 4" heavy magnet speaker.

You and your customers will be pleasantly satisfied with this fine bargain.

Your Cost—$20.95. Price of Batteries $2.01.

CROWE HEADS for AUTOMOBILE RADIOS

A dial to fit any radio and car 1940 thru 1948
Custom Dash Mounting Dials

Under 1940—Universal Underdash Mounting Dials. Dealers Price..... **$3.82**

Tuning Units 706-T1 up thru 720-T1. Dealers Price **$1.71**

Tuning Units with switch 706-T2 up thru 720-T2. Dealers Price..... **$2.40**

Volume control units 700-V1. Dealers Price **$0.73**

Volume controls units with switch. 700-V2. Dealers Price..... **$1.80**

Cable kits to fit Delco-Arvin-Philco. Dealers Price **$1.74**

When ordering, specify Make, and Model of car and make and model of radio.

Complete dial kit consists of "Head, Tuning Unit, and Volume Control Unit.

We carry a complete line of all auto radio equipment and accessories.

Radio Parts Company, 614 RANDOLPH ST., CHICAGO 6, ILL.

A.V.C. Amplifier

(*Continued from page 67*)

with this oscillator beating with the receiver high frequency oscillator. Adequate shielding would become necessary as well as selecting a frequency for the oscillator that would be above the tunable range of the receiver.

Careful consideration should be given to the selection of the audio amplifier tube to be used in an a.v.c. circuit.

The 6G6 tube is capable of producing 50 volts across a 75,000 ohm plate load resistor at less than 3% distortion. In some applications this high output with low distortion becomes quite desirable.

The use of a 6SK7 will give satisfactory operation with the exception of high output voltage.

The bias filter network consists of the VR75-type tube, resistors R_{12}, R_{13} and condenser C_8. Resistor R_{12} should be adjusted to cause 10 milliamperes to flow through the VR tube. If the inverse peak voltage of the bias rectifier tube is being exceeded due to the secondary voltage of the power transformer, a resistor should be inserted between the high voltage winding and the cathode of the bias rectifier tube, reducing the voltage to a point of satisfactory operation.

Theoretical Operation

The 6G6 amplifier (see Fig. 1) is a conventional resistance-coupled stage. The output of the amplifier is connected by C_4 to the a.v.c. level control, R_8. Condenser C_5 breaks the d.c. path to ground through R_8. The output of the amplifier is fed into the #1 diode (Pin #5) of the a.v.c. amplifier tube where it is rectified, placing a d.c. potential on the grid of the a.v.c. amplifier tube. R_9 is the diode load resistor, and R_{10} and condenser C_7 comprise the grid filter network, which allows only d.c. voltage on the grid. Condenser C_6 completes the diode rectifier circuit as far as a.c. is concerned. Resistor R_{11} is the cathode dropping resistor. Resistor R_5 is the diode load for plate #2 (Pin #4). Condenser C_2 and resistor R_4 comprise the a.v.c. filter. Resistors R_{12}, R_{13} and condenser C_8 complete the bias filter network.

An a.v.c. voltage is fed to the 6G6 grid through resistor R_2. Negative voltage of 75 volts is connected to the cathode dropping resistor R_{11}. 150 volts positive is connected to the plate of the a.v.c. amplifier tube. When a.v.c. control resistor R_8 is rotated to ground position, no bias is created by diode plate #1; therefore, the a.v.c. amplifier tube draws maximum current.

Consider the triode section of the a.v.c. amplifier as nothing more nor less than a variable resistor.

When the grid voltage of the 6SQ7 is zero, the plate current is maximum

and the resistance of the tube (plate to cathode) is minimum. Placing a voltmeter from ground to the cathode of the tube will indicate a positive voltage, although 75 negative volts are being applied to the cathode through resistor R_{10}. This condition is due to the plate drain of the 6SQ7, which has 150 volts positive voltage on the plate. Under these conditions the cathode is positive with respect to ground, and plate #2 is negative with respect to the cathode; therefore, there is no current flow between plate #2 and the cathode.

An input voltage is fed into the grid of the 6G6 amplifier tube and resistor R_8 is rotated, applying a.c. voltage to diode #1. Diode #1 rectifies this voltage causing a voltage drop across resistor R_9. This, in turn, causes the grid of the 6SQ7 to become negative. The negative grid voltage reduces the amount of plate current, causing the resistance of the tube to go up. This, in turn, causes the cathode to become negative with respect to ground. Since the cathode is negative in respect to ground, diode #2 becomes positive with respect to the cathode, causing current to flow from diode #2 to the cathode. This then results in a voltage drop through resistor R_5 causing a negative voltage with respect to ground which is fed to the grid of the 6G6, and this bias reduces the gain of the amplifier stage.

Do not become alarmed if this explanation is not clear the first time it is read.

The circuit is highly sensitive and linear because the a.v.c. voltage is actually supplied by a separate source and not by the rectified audio output.

The a.v.c. amplifier simply regulates the amount of voltage required for a particular application.

Condensers C_2 and C_7 should be adjusted to cause the desired amount of a.v.c. time delay.

The operation of the a.v.c. amplifier for r.f. applications is the same as just described. Circuit values are changed as indicated in Fig. 2. In r.f. applications no controls are required.

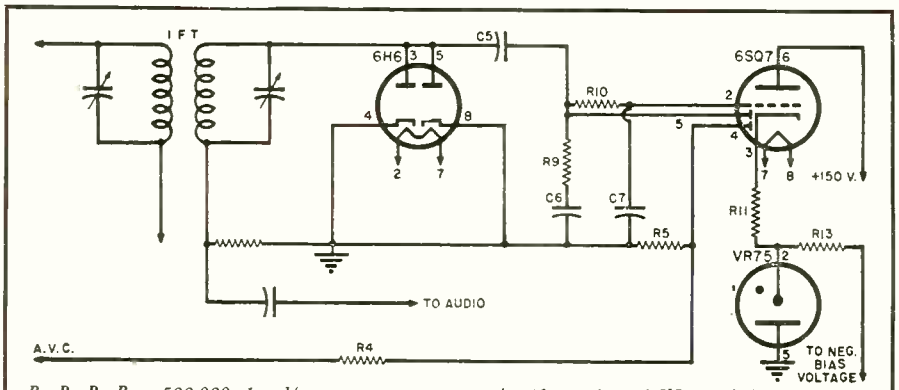
This circuit can easily be adapted to any receiver now employing a.v.c. The use of this a.v.c. circuit would require the addition of a rectifier tube and the 6SQ7 a.v.c. amplifier tube.

For r.f. a.v.c. applications, use of a VR tube in the bias supply is not absolutely necessary. The tube could be replaced by a resistor to ground, and this resistor should be adjusted so that approximately 75 volts appear across the resistor. Slight variations caused by the elimination of the VR tube can readily be tolerated in r.f. application and in some audio applications.

A.V.C. Applications

The use of an a.v.c. amplifier which will maintain comparatively constant output when large input variations are encountered becomes highly desirable.

Airplane control towers experience



R_4, R_5, R_9, R_{10}—500,000 ohm, ½ w. res.
R_{11}—150.000 ohm, ½ w. res.
R_{13}—30,000 ohm, 5 w. wirewound res. (Adjust for 10 ma. through VR75 tube)
C_5—50 μμfd. mica cond.
C_6, C_7—.02 μfd., 400 v. cond.

Fig. 2. Circuit diagram of a.v.c. amplifier for r.f. applications.

reception of extremely weak signals which increase in intensity many times in a matter of minutes. The use of a poor a.v.c. control system requires the operator to reduce the gain of the receiver so that loud signals can be tolerated. A sensitive a.v.c. system would allow the same operator to increase the sensitivity of the receiver, therefore improving the reception of weak signals.

The a.v.c. amplifier also has many audio applications. When used in such applications, there are limitations to the amount of control that can be tolerated. Since the function of the control is a matter of changing bias voltages, the distortion of the controlled amplifier stage will increase as control voltage is increased.

The amplifier shown in Fig. 1 is capable of maintaining a reasonably constant output voltage with less than 3% distortion when the input is varied as much as 6 db. Control in excess of 6 db. variation will cause the distortion to rise, but in certain applications this distortion increase can be tolerated.

The use of high power audio oscillators in place of frequency changers has become common practice. One of the main difficulties of this type of equipment is voltage regulation under varying loads. The a.c. voltage which causes the a.v.c. amplifier to function can be picked up from practically any stage in an amplifier circuit. By picking up this voltage at the output of the amplifier, varying loads at the output of the amplifier will cause the a.v.c. amplifier to function which, in turn, reduces the gain of the amplifier, resulting in a comparatively constant output level.

The circuit can also be used as a compressor, but as a compressor, the circuit has nothing to offer over the conventional type of compressor circuit, since both circuits simply apply negative voltage to the grid of an amplifier tube. —30—

MONITORING C. W. SIGNALS

By HARRY L. ULYAT, W4JPW

THE idea discussed here is one which has been used successfully in the monitoring of a c.w. signal here at W4JPW.

Since I am one of those hams who likes to monitor my c.w. signal to make sure it is sounding all right, especially when I'm using a bug, I tried a number of methods, including the building of a separate oscillator, keying with a relay, etc., but all these systems had the disadvantage of keeping the family awake nights.

If I used phones, I would have had to unplug them from the oscillator to the receiver at the end of every transmission or else slip on a different set of phones.

I have found that a war-surplus BC-221 makes a very good monitor for a c.w. signal and at the same time keeps a constant check on the frequency. The only problem involved with this unit was that of switching the phones from the meter to the receiver.

Noticing that there were two phone jacks on the frequency meter, I looked into the circuit and found that the jacks are in parallel and the connection to the plug tip was made to the "B plus" circuit through a condenser, thus isolating the "B plus" from the phones. I took a piece of shielded wire and connected a phone plug on either end. One end was plugged into the receiver output and the other into one of the frequency meter jacks. The phones were then plugged into the other jack in the meter.

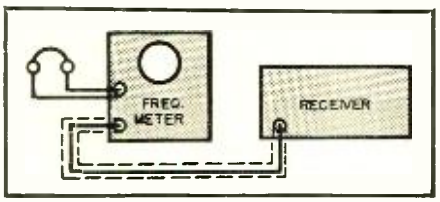


Diagram shows method of connecting BC-221 frequency meter for monitoring purposes.

As a result, I hear the station I am working with the same phones that are used for monitoring my own signal and at the same time I am able to keep a constant check on my frequency without keeping the neighborhood awake in the "wee sma' hours." —30—

This Great Line of DELCO RADIOS

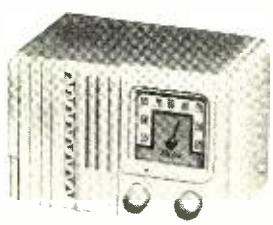
DELCO MODEL R-1409—Three-way portable radio—AC-DC and battery—with alligator-grained fabric and unique plastic front. Built-in loop antenna. Self-contained charger.

DELCO MODEL R-1253-WALNUT (R-1254 MAHOGANY)—Strictly de luxe—an exquisite piece of furniture, a high-fidelity AM-FM short wave radio and an automatic record changer with balanced tone arm.

is backed by three Great Names

General Motors · Delco United Motors

DELCO MODEL R-1229—Five tubes plus rectifier tube. Mahogany finish, maple grille. Built-in loop antenna.



DELCO MODEL R-1230A IVORY PLASTIC (R-1231-A MAHOGANY PLASTIC)—Four tubes plus rectifier tube. Smart new plastic cabinet. Built-in loop antenna.

DELCO MODEL R-1238—Handsomely designed in walnut veneer and silver-gray plastic. Four tubes plus rectifier tube. AC-DC Built-in loop antenna.

Looking over the current Delco line is like previewing your profits—there's a wide range of *products* and *prices* with which to interest a wide range of *prospects!* Each one of these immediately available models gives you plenty to talk about in the way of features and performance. And each one has *character* because it is backed by three great names: General Motors, Delco, United Motors.

If you want to move merchandise, get merchandise that will move! Six of the popular Delcos are shown here. There are others to round out the line. Look into this right away. Contact your nearest United Motors distributor or write to United Motors Service, General Motors Bldg., Detroit 2, Michigan.

DELCO MODEL R-1236—Ivory plastic cabinet. Four tubes plus rectifier tube. Automatic tuning. Built-in loop antenna.

UNITED SERVICE MOTORS

DELCO RADIO

A GENERAL MOTORS PRODUCT

Delco radios are distributed nationally by United Motors Service. See your United Motors distributor about the Delco Radio line.

PRINTED IN U.S.A.

INDEX OF Advertisers

APRIL 1948

PATENT ATTORNEYS

LANCASTER, Alwine & Rommel. Registered Patent Attorneys. Patent Practice before U. S. Patent Office. Validity and Infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request. Suite 414, 815 15th St., N. W., Washington 5, D. C.

PATENT Attorney, registered U.S. Patent Office. I. Jordan Kunik, 75-F Pearl, Hartford, Connecticut.

CORRESPONDENCE COURSES

USED Correspondence Courses and Books bought, sold, rented, and exchanged. Catalog free. Lee Mountain, Pisgah, Alabama.

LEARN elements of radio at home. Ideal course for beginners. $15.00. Write Waca Radio School, 1421 Sixth St., S.E., Minneapolis 14, Minn.

USED Correspondence Courses and Educational Books, bought, sold, rented. Catalog free. Educational Exchange, Summerville, Georgia.

AMATEUR radio licenses. Complete code and theory preparation for passing amateur radio examinations. Home study courses. American Radio Institute, 101 West 63rd Street, New York City 23.

MISCELLANEOUS

RADIOMEN, servicemen, beginners, make more money, easily, quickly. $250 Weekly possible. We show you how. Information free. Merit Products, 216-32R 132nd Avenue, Springfield Gardens 13, New York.

A FAST growing appliance and furniture business in Texas oil-booming city for sale. Owner retiring. Write: Henry A. Schaefer, Cisco, Texas.

QSLS, SWLS. Samples free. W5FAY Press, 6118 Goliad, Dallas, Texas.

BC-348-J, N, Q, OWNERS only. Special Service Manual now available. Contains Schematic, Wiring Diagrams, Alignment, etc. $1.00. John W. Martin, 3516 Sacramento, El Paso, Texas.

PHONOGRAPH Records, 20c. Catalogue free. Paramount, NJ-313 East Market, Wilkes-Barre, Pa.

TESTING Equipment. All types and models. Expertly repaired and calibrated. Free estimates. Metropolitan Electronics. 42 Warren St., N. Y. 7, N. Y.

26 YEARS experience radio repairing at your fingertips. I've repaired 45000 radios. Have perfected simple system you can follow step by step. No calculations or formulas. Total price $2.00 postpaid or C.O.D. Money back guarantee. Ross Radio, 14615-C Grand River, Detroit 27, Mich.

BRITISH INDUSTRIES FAIR

THE second postwar British Industries Fair, the world's largest national trade fair, is being held in England from May 3rd to 14th.

More than 3000 exhibits, representing 87 different trades will be open to an expected record crowd. The fair is being held in three big exhibition centers with the engineering industries showing their products at Castle Bromwich in Birmingham and the lighter industries at Earls' Court and Olympia in London.

—30—

ADDENDUM

Some of our readers have written in asking for the dimensions of the takeup pulley and feed spindle used in the mechanical assembly of the magnetic tape recorder ("Build Your Own Magnetic Tape Recorder," Fig. 4, page 41, February, 1948 issue).

The takeup pulley should be ¾" in diameter while the feed spindle is 1" in diameter.

Photo Credits

Page	Credit
39, 40, 41	Walter Steinhard
44, 45 (bottom)	The Houston Corporation
48	Joe Tillotson, Staff Artist
59	Philco Corporation
72	Shure Brothers
118	Permo Products
120 (bottom)	Station KDYL
128	Westinghouse
172	Acme
174	American Airlines

WILCOX CW 3 7 Tube Receiver (Complete with Coils) **$12.95**

Complete with 1 set of coils—5.1 mc. to 10 mc. & additional set of tubes. Brand new in original cases. Export packed. Highly selective Superhet. 5.100 to 10.000 KC range. The h-f oscillator is xtal controlled. 110V. AC. 60 cycles 2-6K7; 1-6K8; 2-6C8G, 1-7SN7; 1-80. Single stage r-f amplifier single stage i-f, second detector, b.f.o., audio output and output limiter stage and a rectifier, less crystal. While they last at this low price of.....**$12.95**

Prompt Delivery—Write RNA. 25% deposit required on C.O.D. order. Shipped F.O.B. N.Y.

MICHAEL STAHL, INC.

39 VESEY STREET

Tel. WOrth 4-2882-3-4 New York 7, N.Y.

EXTRA SPECIALS FROM OUR FREE CATALOG

★ 5 tube Kit: 50L6, 35Z5, 12SA7-K7-Q7..$2.75
★ 5 tube Kit: 50B5, 35W4, 12AT6-BE6-BA6 $2.75
★ Acorn tubes: Nos. 954, 955, 956, 957, 958A ..... .49
★ Hear Aid.: CK501AX to CK509AX..... .49
★ Proximity fuse diodes, 6.3 fil..... .49
★ 70L7:..... .79 0Z4:..... .89
★ TUBE SPECIALS: 69c each, 10 for.....$6.00
1R5, 1S5, 1T4, 1V3S4, 6AK5, 6AH6, 6AL5, 6AN5, 6AT6, 6BA6, 6BE6, 6C4, 6H6, 6J6, 6N4, 6N7, 6X4, 12BA6, 12BD6, 12SA7, 12BE6, 25Y5, 50B5, 717A, 9001, 9002, 9003, 9006.
★ Electrolytics: 20/20 @ 150..... .39
20 @ 150.... .25 8 @ 450.... .28
(Fresh, pop. brand): 50/30 @ 150..... .49
16 @ 450.... .49 8/8 @ 450.... .59
★ 5" Alnico #5 PM Speaker, 16 oz. slug..$1.39
★ Power Transformer, most pop. type (#P-6297). Prim. 117 V, 60 Cy. Sec. 240 V Center Tap, Rect. Fil. 5 V at 2.0 A. #1 6.3 V at 2.0 A. Center Tap ONLY.....$2.49

Lowest Prices Anywhere — Quality Items

Write for Free Catalog.

20% Dep., Bal. C.O.D. — Min. Order $3.00

COMMERCIAL RADIO DEPT. N1

36 BRATTLE STREET BOSTON 8, MASS.

LEARN RADIO!

IN ONLY 10 MONTHS

PREPARE FOR A GOOD JOB!

COMMERCIAL OPERATOR (CODE)
BROADCAST ENGINEER
RADIO SERVICEMAN

Television Servicing—15 Months

Veterans get $130.00 Equipment

SEND FOR FREE LITERATURE

BALTIMORE TECHNICAL INSTITUTE

1425 EUTAW PL., DEPT. R, BALTO. 17, MD.

MOTOR GENERATORS

Brand New War Surplus Machines built by Allis Chalmers Co. to U. S. Navy Specifications.

Input: 115 V. D.C. at 14 amps., 3600 rpm. Output: 120 V. A.C., 60 Cy. 1 ph. at 10.4 amps., 1000 Watts continuous duty. Ball bearings. Splashproof. Fully enclosed. Centrifugal starter. Frequency adjustable to load. Price **$87.50.**

Same machine but for 230 V. D.C. input. Price **$125.00.** Spare parts kit with extra brushes, brush-holders, field coils, bearings, etc., for either machine, **$29.50.**

All prices FOB Tuckahoe, New York

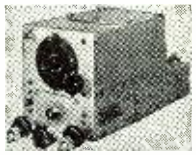
ELECTRONICRAFT, INC.

5 Waverly Place, Tuckahoe 7, New York

TUNING CONTROL KNOBS

For Command Set Receivers

69c. ea. 3 for $2. Postpaid in U.S.A.



BC 454, etc. series with locking sleeve. Brand new, not surplus. Makes tuning simple for fixed or mobile use.

Send for Latest Bulletin

ALVARADIO

903 S. Alvarado, Los Angeles 6, Cal.

Classified

Rate 20c per word. Minimum 10 words.

RADIO ENGINEERING

RADIO Engineering Broadcasting, Aviation and Police Radio, Servicing, Marine Operating and Electronics taught thoroughly. Expenses low. Write for catalog. Valparaiso Technical Institute. Dept. N, Valparaiso, Ind.

FOR SALE

274N DIAGRAMS, original schematics and practicals on all components. 50c each. Postpaid. Specify type. Others available. Write for listing. Aerotronics Services, W6WLN, 5424 Ruthelen St., Los Angeles 37, Calif.

SHAKEPROOF tinned solder terminals, will fit #6 or #8 screw. $2.20 per thousand, postage paid. H. Ruess, 429 E. Carson St., San Antonio 8, Texas.

BATTERY Bargains: New 24 volt 17 amp. hr. convertible to 12 volt, 34 amp. hr., in metal case with cover. Non-spillable vents. Hundreds of uses. Orig. $57.00, now $7.95 plus freight. Weight 52 lbs. Shipped dry. Also 24 volt, 11 amp. hr., $6.95. Silver Creek Precision Corporation, Silver Creek, New York.

WIRE, for Webster, Sears, Air King, and other Recorders. ½ hour spool, $2.90; 1 hour, $4.95; Air King Wire Recorder, $129.50 complete. McCoy Sales Company, P. O. Box 335, Berea, Ohio.

RADIOS, Record Players, tubes, parts. Send for free bargain list. Hallmark, 592A Communipaw, Jersey City 4, New Jersey.

MN-36A LOOPS; MN-31 Loop Director Units; MN-37A Bearing Indicators, large; MP-10 Series Power Supply Units; MP-8 Series Power Supply Units. J. D. Reed Co., Inc., Municipal Airport, Hangar 8, Houston 17, Texas.

TELEVISION diagrams, 35c each. 18 wire-wound, non-inductive, precision resistors mounted and fully wired on low-loss, wafer-type, rotary switch, ready to connect to your meter to make highest grade instrument. While they last, price, $2.50. Radioco, 1110 Marshall Bldg., Cleveland, Ohio.

CONSTRUCT your own oscilloscope, experimental equipment, etc. New 5BP1 Cathode-Ray tube, 5-inch screen, $2.95, plus postage! Scientific, 1026½ W. 9th, Los Angeles, Calif.

TELEVISION diagrams, 35c each. "RCA," "Philco," "Viewtone," "Certified," "Transvision," "U.S.T." Any three above, $1.00. Others available. RadioVision, 2064 Ocean Parkway, Brooklyn 23, N. Y.

RCA AUDIO Chanalyst. A complete sound system test set. Almost new. $275.00. Rocky Mountain Radio Council, 21 East 18th Avenue, Denver 2, Colorado.

13,000 FEET RG 7/u High Frequency Cable. New. Make offer. T. & T. Tool, 317 East Third St., Tulsa, Okla.

ELECTRICAL Wiring Kit contains 30 amp. 3 pole disconnect switch, 5 fuses, 7 G.E. solderless tapeless large receptacle outlets, 65' two wire Romex cable, misc. screws, clips, everything to make complete installation in workshop, basement, barn, shed. Originally packed for Army, $12.00 to $15.00 in any store. Our price $5.00 per kit. Reitz and Company, Bellevue, Ohio.

RADIO Tubes, bargains, nationally advertised radios, test equipment, etc. Address Radio Tubes, Box 108, Elizabeth City, N. C.

WURLITZER 412 Juke Box phono mechanism, good condition, $35. Rek-O-Kut RK12 recording motor assembly with overhead feedscrew, magnetic cutter head, $65. H. Jensen, Box 424, Route 3, Ogden, Utah.

WESTON Meters and Test Instruments. Used. Reasonably priced. McKnight, 606 Linn, Peoria, Ill.

B. C. 348 RECEIVER, excellent condition, converted to A.C., including speaker. $90.00. S. Cavalier, 311 Columbia Blvd., Woodridge, N. J.

HQ-129-X. SPEAKER, cabinet. New and perfect. No reasonable offer refused. W2LFJ, 10 Lincoln Avenue, White Plains, N. Y.

1942 SCOTT Philharmonic, $125.00. A. Hood, 65 Glenwood Road, Montclair, N. J.

P. M. SPEAKERS, 12-inch dual Alnico magnet, 30 watt, transformer, metal case, volume control, $9.50 complete. Handsets, used, good, $1.29 each. Selenium rectifier 12 v. at one amp., $1.49. Cash with order or C.O.D. Dunn-Wright Electric, 471—7th Ave., Brooklyn, N. Y.

TELEVISION components for assembly of a modern 52-square inch screen receiver using the newest circuits and tubes. The only kit on the market featuring an aluminized cathode ray tube, A.F.C. on horizontal sync and a wired, pre-aligned r.f. tuner covering any combination from 1 to 13 television channels. Sound and Picture IF's are on one sub-chassis using new 6AH6 miniature tubes having a gm of 9000! The IF Strip and the 9000 volt RF Power Supply are sold in kit form. The main chassis is sold with all holes punched with suggested chassis layout print. All components individually priced. Our catalog lists television components exclusively and shows parts and circuits of the "hard to find items" you have been looking for. Send for it today. It's free! Television Specialties Co., 315 Madison St., Oak Park, Ill.

RADIO Tubes. Tremendous savings. List free. Crest Corp., Dept. B-2, 3949 Forest Park Blvd., St. Louis 8, Mo.

QSLs, SWLs. Free samples! WIHJI Press, P. O. Box 32. Manchester, New Hampshire.

SELSYNS, 115V 60C. made from dynamotors. No rewinding or machine work. Instructions, 50c. Paul Hawkins, 1306 E. 27th, Kansas City, Mo.

6V DYNAMOTOR from 12V surplus. No rewinding. Original output. Instructions, 50c. Satisfaction guaranteed. Paul Hawkins, 1306 E. 27th, Kansas City, Mo.

PANELS, magnesium: machined, painted, engraved. Gilpin, Box 638SR4, Mt. Clemens, Michigan.

NEW and used Collins, Hallicrafters, National, Hammarlund, RME, Millen, Sonar, other receivers, transmitters, test equipment, amplifiers, etc. Lowest prices. World's best terms. Shipped on approval. Write. Henry Radio, Butler, Mo.

BARGAINS in guaranteed filter condensers. Send for free sample and price list. William H. DePeau, 1435 North 15th St., Harrisburg, Pa.

YOU can accurately align superheterodyne receivers without signal generator. Complete instructions $1. Moneyback Guarantee! Chas. Gates, Pecos 1, Texas.

ERECO Beam Rotator. 110 VAC, heavy duty, variable speed, selsyn indicator, weather-proofed. Complete indicator and rotator ready to plug in. $69.95. Satisfied users all over the country. Buy from your dealer or direct. Free literature. Dick Rose, Ereco, 2912 Hewitt, Everett, Washington.

WRITE Dept. RN18 for our free wholesale list of Radio parts & accessories. R. C. Radio Parts & Distributing Co., 731 Central Ave., Kansas City 6, Kansas.

LOWEST Prices. Radio Tubes, parts. Bargain lists 3c. Potter, 1314 McGee, Kansas City 6, Mo.

SELENIUM Rectifiers, full wave, ½ ampere, $1.85; 1 ampere. $2.50. Half wave 5 amperes, $4.50; 2.2 amperes, $2.25; 1.5 ampere, $1.85. Bulletin Bursma Radio, Route 5, Grand Rapids, Mich.

CHOKES, swinging, rated 2-12 henries, 100-1000 MA. 5½"x7"x10½", heavy duty with porcelain insulators, $7.50; Filament transformers, 2.5 volts, 11 amps, cased, porcelain insulators, $2.50; with pair 866, $4.00. SKL Laboratory, Box 188, Lexington 73, Mass.

NEW cartoned tubes, 39c each. 100 assorted for $35.00. 1R5, 1S5, 1T4, 1U4, 3V4, 3S4, 5Y3gt, 6A8gt, 6C5gt, 6F5gt, 6J7gt, 6H6, 6K7gt, 6Q7gt, 6V6gt, 6SA7gt, 6SD7gt, 6SF5gt, 6SK7gt, 6SQ7gt, 6X5gt, 12A6gt, 12AT6gt, 12BA6, 12BE6, 12J5gt, 12K8, 12SA7gt, 12SF7gt, 12SK7gt, 12SQ7gt, 12SJ7gt, 25L6gt, 31, 32L7gt, 35B5, 35L6, 35W4, 35Z5, 47, 50B5, 50L6, 70L7gt, 80, 89, 117L7gt. Write for bargain flyer. Henshaw Radio Supply, 3313 Delavan, Kansas City 2, Kansas.

WANTED

BRUSH Model PL-20 pick-up arm. Condition of cartridge unimportant. Charles W. Wood, 735 Wilfred Ave., Dayton 10, Ohio.

WHO can supply Tube 1 P 25? Contact Dr. Ernest Rosenthal, 18 Asylum Street, Hartford 3, Connecticut.

AN/TRC-1 Equipments T-14 Transmitters R19 Receivers TS32 Oscillators, complete or parts, any quantity. Box 458, % Radio News, 185 N. Wabash Ave., Chicago 1, Illinois.

WANTED—Lathe Work. Paul Penney, 265 West Ave., Patchogue, N. Y.

HELP WANTED

RADIO serviceman who is a licensed electrician and is a salesman. Must have own transportation. Write or call. Williams Electric, Box 357, Marmarth, No. Dakota.

INSTRUCTORS in Radio-Electronics and Television. Prefer former Navy Radio Technician Instructors with Teacher Training. Must be willing to locate in Detroit, Mich. Write to Box 452, % Radio News, 185 N. Wabash Ave., Chicago 1, Ill.

change in conversion gain of a mixer tube in a receiver as the signal frequency is raised or lowered. This conversion gain tends to decrease as the frequency is increased. A second factor which can change the accuracy of the "S" unit is that as the frequency of the incoming signal is increased, the tuned circuits in each r.f. amplifier have a greater tendency to load down the tube in that stage and thus reduce its gain. If two radio carriers, one on ten meters and the other on twenty meters, have the same field strength in microvolts at a given location, a receiver may show the twenty meter signal to be "S8" while the ten meter carrier will be indicated as an "S5". To bear out these above mentioned facts, an a.v.c. voltage curve (Fig. 6) was made on the BC-348-Q receiver on two different frequencies with a changing signal strength input on each frequency. Such a.v.c. curves may be made on other communications receivers with similar results. It can be seen in Fig. 6 that a signal input of 9 microvolts on 14 mc. produced an a.v.c. voltage of .72 volt while the same signal input on 5 mc. produced an a.v.c. voltage of 1.6 volts.

Other conditions may exist which can also alter the accuracy of an "S" meter as a precise signal strength measuring instrument. The "S" meter is a very useful instrument if it is used with good judgment. However, one must bear in mind that it is primarily a comparative measuring device.

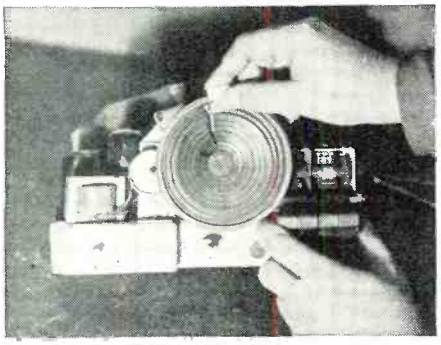
(EDITOR'S NOTE. *In order to accurately calibrate an "S" meter as described herein the constructor should have access to a precision signal generator.*)

-30-

RADIAL RIPS IN SPEAKER CONES

LONG rips or tears in speaker cones that project from the voice coil outward to the rim of the cone are best repaired not by cementing the edges of the tear together, but by carefully cutting the torn edges away with a razor so that an ellipse the length of the tear is formed.

If the edges of the tear were cemented together, the cone would be stiff there, and rattle. If the rip is left alone it will get longer, and the two edges will rub and make noise. Cutting the edges apart prevents this and does not appreciably reduce the efficiency of the speaker. A drop of speaker cement at each end of the ellipse will make the repair permanent. . . . . M. A.



"S" Meter

(*Continued from page* 69)

able to permit a scale for the "S" meter face to be drawn. This new meter scale may be made with little trouble. Two methods for making this scale are available to the builder.

Draw a scale on a good grade of white paper using India ink. The size and proportion of the scale and numerals may be determined from the old meter face by using a pair of compass dividers. Obtain the meter readings from the third column of Fig. 3C for each "S" unit. Then, using the zero mark on the meter face as a reference point for the compass dividers, lay off each "S" unit on the old meter face and transpose these distances onto the new "S" meter scale being drawn. At each point thus marked, draw a line. Under each line, draw in the appropriate "S" unit number.

If a more accurate and professional looking meter face is desired, the following procedure, which incidentally, the author used, may be carried out. The original meter face is photographed and enlarged about four times. Using this enlargement for size and proportion of figures, a new meter face is drawn exactly the same size as the enlargement. The "S" units are drawn on this large face using the same procedure mentioned before except that now, everything is four times as large. Better lettering and more exact markings may be made in this way. After this face is drawn, it is photographed and then reduced back to the original size when printed. The prepared meter face, whichever method is used, is then glued to the original meter dial plate and then put back into the meter.

Many errors affecting the accuracy of an "S" meter report may come into the picture. Often, too much importance is given to such a report by a radio amateur who "swears by the meter" on his receiver. The height and length of the receiving antenna will affect the amount of r.f. signal input to the receiver as well as the impedance match between the antenna and the receiver. A receiver situated at a given location but using two different receiving antenna locations and heights, will record two different signal strengths on the same signal. An "S6" signal using one antenna may become an "S9" signal with another antenna.

There are a number of factors which may affect the accuracy of the "S" unit in the receiver itself. There is a

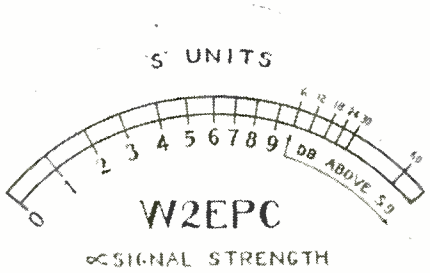


Fig. 4. An actual size print of the "S" meter dial scale for the receiver described. It is accurate for this equipment only and should not be used for any other receiver without recalibration.

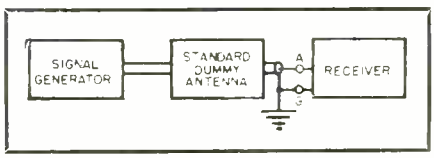
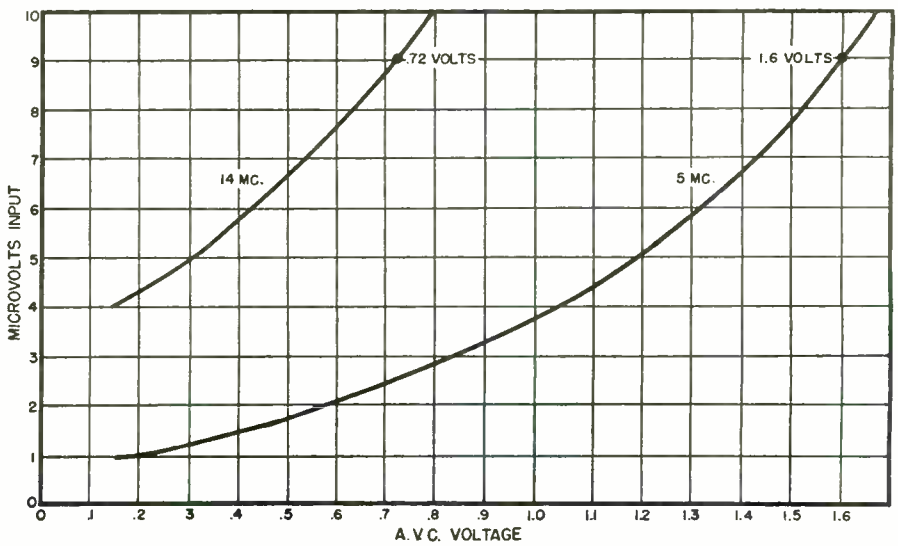


Fig. 5. Block diagram shows method of connecting signal generator to receiver.

Fig. 6. The r.f. signal input voltage vs. a.v.c. voltage for 5 and 14 mc.



search Products, Incorporated, and in the Specialty Products Shops before becoming a member of the Radio Division in June, 1942. He was known for his work with public address systems and theater reproducing equipment for sound motion pictures, being active in many installations.

* * *

WILLIAM W. CONE has been named Merchandising Manager of *Krich-Radisco, Inc.,* of Newark, New Jersey. In this capacity he will direct the wholesale distribution of leading American products.

Mr. Cone's business background includes 24 years' experience in the radio and television industry, five years of which were spent in the wholesale distribution end of the business. Previously he was associated with *Radio Corporation of America* in various posts, the last of which was as District Sales Manager. During the war years he was Manager of the War Service Department of the *RCA Tube Division.*

He is a member of the American Television Society and recently served as a member of the Television Broadcasting Association subcommittee which investigated the apartment house antenna problem. —30—

PARTS SHOW SPECIALS

THE special trains headed for the Radio Parts Show in Chicago will carry a record crowd from the New York, Philadelphia, and Washington areas.

Approximately 275 persons will leave New York on Saturday, May 8th in a streamlined section of the New York Central's "Commodore Vanderbilt." The traditional free dinner, midnight supper, breakfast, playing cards, and souvenirs will again play an important role in making the hours pass rapidly for the convention-bound industry men.

The Mid-Lantic Reps Limited, in two sections of the Baltimore and Ohio, will pull out of Philadelphia at 2 p.m. on Saturday, May 8th and from Washington at 4:30 p.m. Made up in two sections to accommodate show-bound radio industry members from Eastern Pennsylvania, Wilmington, Baltimore, Washington, Richmond, Western Maryland, and Western Pennsylvania, the Washington section will leave on arrival of trains from Norfolk and Richmond, while the Philadelphia section will stop at Wilmington and Baltimore.

Perry Saftler, 53 Park Place, New York, is in charge of the arrangements for the New York Special and persons in the industry planning to make the trip should contact him at REctor 2-5334, New York.

Sam K. MacDonald, acting for the Mid-Lantic chapter of "The Representatives," is in charge of the Philadelphia-Washington Special and may be reached at his firm, 1531 Spruce Street, Philadelphia. Mr. MacDonald advises that the Mid-Lantic Specials will also feature evening dinner, midnight snack, and breakfast.

—30—

house he was assigned to small motor sales in East Springfield, Massachusetts.

In 1925 Mr. Weatherholt was transferred to the Albany, New York sales office and a year later was assigned to the New York City office. He was named eastern resale manager, in 1940, and held this position at the time of his new appointment. During the war Mr. Weatherholt served as a Lieutenant Commander in the Navy.

* * *

WILLIAM E. WILSON, who has been sales manager of the *Acme Electric Corporation,* of Cuba, New York, for the past three years, was elected to the office of Vice-President in charge of sales.

Before joining *Acme Electric,* Mr. Wilson had been in Washington with the War Production Board in charge of radio and radar transformers. Previously he was associated with *Jefferson Electric Co.*

Mr. Wilson studied electrical engineering at the Armour Institute of Technology and has spent much of his time in sales engineering work. In his new position he will direct the sales activities for all company products.

* * *

ZENITH RADIO CORPORATION has named A. V. Duke as assistant sales manager. Mr. Duke, who has been doing special work in the sales department since the end of the war has been a *Zenith* employee for 20 years.

Joining *Zenith* in 1928, Mr. Duke became a member of the accounting department, and in 1931 became manager of the order department for the sales division. From 1933 to the outbreak of the war in 1941, he was a member of the export sales department.

During the war Mr. Duke handled confidential work for the accounting department in connection with advance payments on Government work, material purchases, and other administrative matters.

* * *

ALAN H. BODGE, former member of *Audio Devices'* New York Sales Department, will manage the newly-established Hollywood office of the recording disc firm.

Mr. Bodge's office will be located at 844 Seward Street, in Hollywood. A Dartmouth graduate, he spent four and a half years in the radar division of the Army Signal Corps before joining *Audio Devices* in the Spring of 1946.

* * *

HOFFMAN RADIO CORP., of Los Angeles, has appointed Carlton Wasmansdorff to take over the newly-created post in charge of development engineering. Mr. Wasmansdorff is a well-known figure in code and machine communication and noise elimination fields and for six years was superintendent of communications for the Glendale, California police department.

In the early war years he was in charge of the *Hoffman* Glendale Branch research and experimental laboratories. Formerly Mr. Wasmansdorff was associated with *Maguire Industries* as chief engineer and later spent several years in San Francisco with *Globe Wireless* as chief engineer and assistant to the vice-president in charge of operations.

* * *

BENDIX RADIO DIVISION recently announced the appointment of Horace H. Silliman as merchandising manager. In this department he will superintend liaison operations for the factory among national distributing organizations and major retail outlets.

Mr. Silliman joined *Bendix Radio* as district manager for New England and upstate New York four years ago. Last year he assumed the post of manager of distribution.

Filling Mr. Silliman's vacated position is Arthur C. Jordan. Mr. Jordan was recently the head of a national manufacturer's consumer sales organization and has served in important sales management positions with a number of leading manufacturers and distributors in Philadelphia and Washington.

* * *

CHARLES E. ANDERSON, recently appointed representative for *Snyder Manufacturing Company* of Philadelphia, augments the newly formed factory representatives' division. With his staff of three salesmen, Mr. Anderson will have Michigan, Ohio, Southern Indiana, Kentucky, Western Pennsylvania, and the western part of West Virginia for his territory.

He will maintain headquarters in the Rockefeller Building in Cleveland and also maintain an office in Cincinnati. Mr. Anderson has a twenty-year sales background in the x-ray, photographic, radio, and electronics industries.

* * *

FURST ELECTRONICS, manufacturers of specialized electronic instruments, have more than doubled their floor space by moving to larger quarters in the same building, at 800 West North Avenue in Chicago.

* * *

PAUL T. SHERIDAN, employee of the *Western Electric Company, Incorporated,* for nearly thirty years, passed away at his home in New York following a long illness. Mr. Sheridan was in charge of engineering and field service for the *Hearing Aid Department, Radio Division.*

Mr. Sheridan joined the *Western Electric* Engineering Department in March, 1918 and later served in the Supply Department in *Electrical Re-*

Within the Industry

(*Continued from page 30*)

Electric and was assigned to the *Test Department*. For two years he worked on equipment for the armed forces at Erie, Pa., Schenectady, New York, and Syracuse. In October, 1945, he transferred to an engineering section in the *Specialty Division*. Mr. Rudolph is also a member of the Institute of Radio Engineers.

* * *

C. F. FAISON of *Federal Telephone and Radio Corporation*, an affiliate of *International Telephone and Telegraph Corporation*, is now representing *FTR's* broadcast and mobile communications division in the Southwest United States. Mr. Faison formerly carried on his sales operations for *Federal* in New England but will now work from Dallas, Texas. His new headquarters will be in the branch office at 301 Southland Life Building in Dallas, Texas.

Mr. Faison has spent 22 years in the radio business and during this period he aided in the designing and construction of three complete sets of plants and studios and one of the largest two-way mobile radiotelephone police installations in the Southwest.

During the war Mr. Faison was a Lieutenant Colonel in the U. S. Army and was assigned as Chief Radio Engineer of the Corps of Military Police.

* * *

TELETRAN CORPORATION, a new concern, headed by Albert J. Goldman, for the manufacture of components for the television industry has announced it would begin production on deflection yokes and horizontal h.v. transformers.

Mr. Goldman, President of *Teletran Corporation* was formerly President of the *International Transformer Corporation*. Executive and sales offices will be located at 443 Greenwich Street, New York City, with the factory located at Ramsey, New Jersey.

In charge of the factory at Ramsey will be Charles C. Hastings, formerly associated with the *R. E. Uptegraff Mfg. Co.* of Scottdale, Pa. Production Manager will be Herbert Mark, who was previously connected with the *New York Transformer Co.*

* * *

WESTINGHOUSE ELECTRIC CORPORATION has announced the appointment of F. D. Weatherholt as assistant industrial sales manager with headquarters at East Pittsburgh.

Mr. Weatherholt has been with *Westinghouse* ever since his graduation from the University of Kentucky in 1921, where he received his Bachelor of Science degree in mechanical engineering. After completion of the Graduate Student Course at *Westing-*

"Your Own Store and How To Run It" (Thomas Y. Crowell Co., New York). In it he listed 59 ways to gain goodwill (See Table 1). Perhaps you won't need to use all of the suggestions, but the more of them you do use, the better. Make copies of them and have all your help study them and test them out from time to time in their ability and willingness to use them.

4. Cooperate with fellow small businessmen in developing the answers to your common problems. Some of the problems that can be settled through such action follow:

a. Develop material that actually aids in operating your business more efficiently. Take as one such problem proper store layout that makes for the best flow of traffic through the store; or as another, proper lighting of the store so that merchandise stands out so invitingly that people want to buy.

b. Plan to carry on careful, continuous, and useful research into the problems of marketing, merchandising, and sales promotion of your products.

c. Develop a program of publicity and public relations which is something separate from sales promotion.

d. Study how best to work with suppliers to secure from them the right kinds of goods at prices that consumers are willing to pay, to eliminate tie-ins and other deleterious and obnoxious practices which add to the costs of distributing goods.

e. Study the consumer, his buying habits and trends so that you can guide him to your business and have on hand new, fresh, inviting, and intriguing merchandise.

f. Study how to keep prices competitive so that the largest total volume of business will always be done.

g. Study what advantage can be taken of offers by trade associations like the *Edison Electric Institute* to train sales people of small concerns in the electric appliance field.

h. Study development of materials which will help retailers of appliances and radios to advise families in their trading areas on how to buy such goods and make the best use of them.

i. Secure as much aid from government as possible to help in carrying on and extending your business enterprises.

Finally you want to know how never to have an insufficiency of capital. Space cramps this discussion so I say never try to do more business than your capital permits; don't overload with merchandise that you cannot sell in time to meet your bills; do not get tangled up in unrelated goods or enterprises; keep your business as simple as you can; stick to what you know best and develop that for all it is worth, and do not expand your business until conditions are right for it. Save something from your earnings and plow that into your business, expanding as the increased capital permits. Above all become a man of decision. As problems arise undertake to find a solution right away. —30—

Radios	Ventilators
Television	Vacuum cleaners
Facsimile	Waxers
Hearing aids	Polishers
Washing machines	Space heaters
Irons	Room coolers
Dryers	Humidifiers
Ironers	Water supply systems
Sewing machines	Electric clocks
Refrigerators	Lamps
Electric ranges	Lighting fixtures
Dishwashers	Flashlights
Electric sinks	Fluorescent lights
Kitchen cabinets	Air conditioners
Home freezers	Razors
Grills	Massagers
Mixers	Curling irons
Toasters	Hair dryers
Waffle irons	Vaporizers
Juicers	Vibrators
Coffee makers	Electric pads
Roasters	Blankets
Water heaters	Sun lamps
Fans	Bottle warmers

Table 2. Partial listing of the most-requested electrical items for the home which can be stocked by the retail dealer.

out signs, open their doors and expect people to come to them and buy. Who are any of us that we have the right to expect this? You must work hard and consistently at persuading people that you have what they badly need and at prices that they can afford to pay. No matter what the conditions are outside your business even if they denote a depression, you go right on selling what you know people want.

Think of selling in a creative way. This means principally dealing with people in a pleasant way; tell them what *they* want to hear about your products and services. Put on a good show, make your sales act so good that people will not walk out of the store and close the door in your face. Show them what your product does for them, how it does it, the testimony of other purchasers, and how easily they may come into ownership of it.

Think of the various ways and devices you can use to attract and hold the attention of people. Use the mail or handbill method, thinking out carefully what to say and what gadgets you might use to get them to read what you write. Find out from the telephone company the many ways a phone can be used to build up business. Carefully select and train men and women to canvass homes to sell and secure leads for the future. Make good use of all the window and store display devices that leading producers of your products have developed over the years and which have proven successful.

This part might be concluded by calling attention to the *Coca-Cola Company*. Once as small as the smallest business of any reader they are today one of our most successful concerns. Recently, sales promotion experts rated them as carrying on the best sales promotion campaign. From their experience we can say:

a. Sell aggressively

b. Advertise tremendously (relatively)

c. Use showmanship daringly

d. Be an innovator in your promotional efforts.

3. Use as many ways as you can to gain the good will of customers. Robert F. Chisholm wrote a book entitled

Two choices are open in designing a high-voltage supply for the oscilloscope. If the supply is designed with "B+" grounded and "B—" hot, the grid coupling condenser must have a high-voltage rating, but the deflection plate coupling condensers may be the usual 600 volt paper condensers. The reverse is true if "B—" is grounded and "B+" is hot, but this connection is sometimes preferred as the smaller physical size of the grid coupling condenser makes it easier to keep grid-to-ground capacity of this circuit at a minimum—an important factor in the incoming video voltages.

Incidentally, an unusual power supply circuit will be discussed in the next article, which will describe an actual instrument embodying the design principles discussed herein. This circuit employs a voltage tripling connection supplying 1200 volts to the 3" cathode-ray tube in addition to the lower d.c. circuit voltages, all from a receiver-type power transformer using receiver-type rectifier tubes.

(To be continued)

Failures Don't Just Happen

(*Continued from page* 49)

should get out of what you are in; at least you should not whine if you are not successful.

Four things, at least, must necessarily be done by the small businessman to arrive at success. These are:

1. Know what merchandise customers want and keep it in stock in quantities that permit of the quickest possible turnover. This means marking off a trading area, doing some research in that area and stocking-up with the best known brand names in the respective lines found necessary to carry.

2. He must, as John Allen Murphy pointed out in a series of articles on failing in business in *Sales Management* in 1940, everlastingly sell and sell and sell. Murphy says that experience shows that only 25 per-cent of the concerns in an industry do the necessary selling to remain on a profitable basis. The owners of most concerns do not work hard enough at selling to be successful. Businessmen put

FOOLPROOF SEQUENCE SWITCHING

By THOMAS J. ROSENTHAL, W7IZL

MANY amateurs and experimenters have at different times had reason to use sequence switching; generally bias and filaments are turned on first, then the high voltage. In most such equipment a simple wiring circuit is used so that one switch must be turned on first, but there is no arrangement which will prevent the second switch from being on, thus allowing both circuits to become energized at the same time when the first switch is closed.

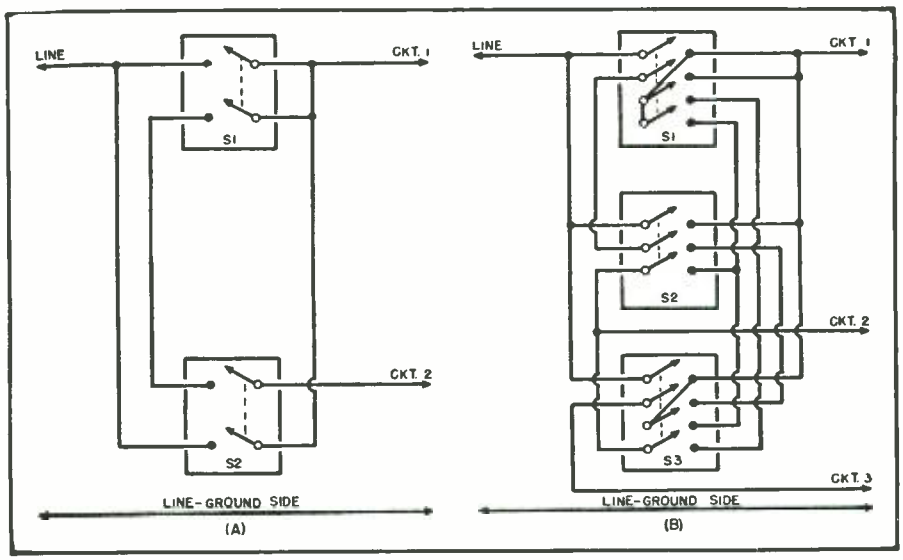
A double interlocking switch arrangement is shown in Fig. 1A which prevents such an occurrence. No matter which switch is closed first, circuit No. 1 is energized first, then when the second switch is closed, circuit No. 2 is energized, and of course no matter which switch is opened first, circuit No. 2 is de-energized first.

A similar arrangement extended for three circuits is shown in Fig. 1B. For sake of clarity, the switch arms are shown in the diagram. S_1 and S_3 are quadruple-pole, single-throw and S_2 is triple-pole, single-throw. With this system, any switch may be closed first and it will actuate circuit No. 1, either of the two remaining switches may then be closed to actuate circuit No. 2, and the third switch will give power to circuit No. 3. Opening any switch will open circuit No. 3 first and a reverse sequence is effected in de-energizing the circuits.

Using either of these circuit arrangements will give maximum protection to any set of circuits and equipment and are worth many times the extra bit of work required in wiring them.

—30—

Fig. 1



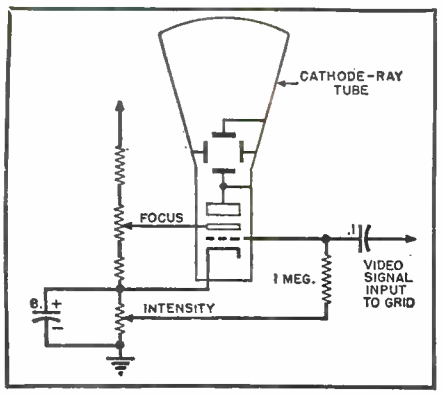
transmitter are separated in the receiver from the actual picture, or "video," information and are utilized to keep the receiver's scanning oscillators in step, or in "sync," with that of the transmitter. The actual video information is delivered to the grid of the cathode-ray tube to cause the beam to increase and decrease in intensity to correspond to the light and dark areas of the actual picture. An oscilloscope suitable for showing actual television pictures must, therefore, be provided with a connection to the grid to receive these television video voltages. Fig. 10 shows the diagram of this connection. The circuit is self-explanatory except to note that the coupling condenser must have a sufficiently high voltage rating to withstand the difference in d.c. voltage existing on each side of it, particularly in oscilloscopes having the cathode and grid at a large negative potential below ground.

Oscilloscope Power Supplies

Even though there are almost as many possible power supply circuits as there are oscilloscopes to choose from, a few generalities applying equally to all are worth noting. As for the power supply feeding the scanning oscillators and amplifiers, its primary requirement is to be very well filtered. In addition, all stages, except the output amplifiers, should have their own individual decoupling filters to prevent circuit interaction.

For the cathode-ray tubes themselves, it is important in the television oscilloscope that the high voltage source provide approximately the maximum voltage at which the tube is rated. This is because of the fact that nearly the entire cathode-ray tube screen is scanned when viewing a television picture, and under these conditions, maximum voltage is necessary to secure sufficient brightness and picture definition. In the usual oscilloscope, only one or several lines are generally viewed instead of a large screen area, and a much lower accelerating anode voltage can thus be tolerated. The high voltage supply must also be well filtered as a very small amount of high-voltage ripple will show up plainly when viewing a television picture.

Fig. 10. Circuit showing one way of connecting video voltages to grid of a CR tube.



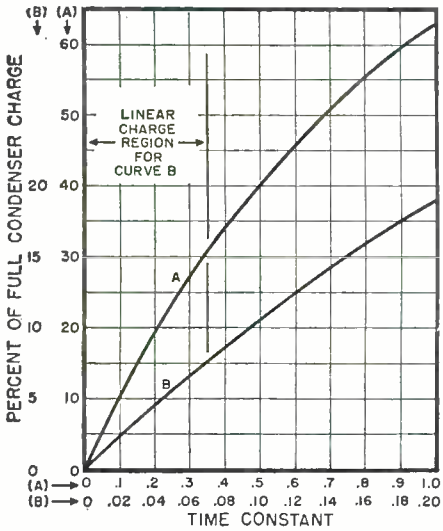


Fig. 9. Curve shows how the voltage charge on a condenser, being charged through a resistance, varies with time.

triode. This circuit will deliver linear saw-tooth oscillations at any frequency from 15 to 20,000 cycles-per-second. The output attenuator, also shown as a part of Fig. 2, is shown in Fig. 8 for the sake of completeness.

Several interesting features are worthy of note. Bias for the tube is secured by a voltage divider between "B+" and ground consisting of a 200,000 ohm resistor from "B+" to cathode and a 3000 ohm variable resistance between cathode and ground. This variable resistance may be an ordinary potentiometer arranged as a screwdriver-type adjustment within the oscilloscope, thus permitting accurate adjustment of the oscillator's ionizing point. The above values are correct if the "B+" voltage exceeds 600 volts. If less than this value, however, the 200,000 ohm resistor should be changed to 100,000 ohms to assure a sufficient range of bias adjustment.

The 5 megohm variable resistance in conjunction with the 800,000 ohm series resistance, provides a frequency adjustment of the oscillator's output for a ratio of slightly greater than 4:1 for each position of the frequency selector switch. Sufficient overlap has been provided between ranges so that charging condensers of standard commercial tolerances may be used and still give complete frequency coverage.

The highest frequency position of the charging condenser selector switch has been left open. The condenser in this position is connected directly between the plate and cathode of the gas triode, omitting even the 500 ohm discharge current-limiting resistor from the circuit. This condenser remains in the circuit at all times, but has very little effect on the circuit performance on the other frequency ranges. By connecting the condenser in this manner, the return trace time of the oscillator is considerably shorter than if the condenser were included directly at the selector switch.

Returning again to the desired linearity of the scanning trace, the following design information may be of interest to those who wish to know the design procedure for a linear scanning oscillator. Fig. 9 is the familiar curve showing how a condenser charges through a resistance. The dotted curve shows the relationship between time and the voltage across the condenser up to one RC time constant (Formula 4). The solid curve shows the same relationship but includes only the first 15% of the dotted curve. An inspection of this solid curve with the assistance of a ruler will show that its linearity is very good up to approximately 7% of RC. In other words, the scanning trace will have good linearity as long as the time for each scanning cycle does not exceed $.07RC$. Putting this in a formula:

$$\text{Time per cycle} = .07\ RC \quad \ldots\ldots (6)$$

where:

Time per cycle is in *seconds*

R is charging resistance in *megohms*

C is charging condenser in *microfarads*

Substituting formula (5) in (6):

$$\frac{1}{f} = .07RC \text{ or } f = \frac{1}{.07RC} \quad \ldots\ldots (7)$$

Since the linearity is good at any value up to $.07RC$, a smaller figure than .07 may be used if desired. However, the amplitude of the saw-tooth voltage decreases as lower values than .07 are used, and the size of the charging condenser is also increased for a given frequency. Further, as previously mentioned, the waveshape from a saw-tooth oscillator may be impaired if the output voltage from it has been adjusted to be too low. It is, therefore, always desirable to design such an oscillator for the maximum possible output, and the values derived from the formula (7) will give the maximum output possible while maintaining the desired linearity.

In using formula (7), all that is necessary is to choose a convenient value of resistance, preferably corresponding to the value when the fine frequency adjustment potentiometer, such as R_1 in Fig. 8, has all its resistance in the circuit. The frequency at which it is desired to have the circuit oscillate is also chosen, and the proper value of the charging condenser, C, then calculated. These values of R and C are then placed in the circuit, and the bias of the oscillator is adjusted until the circuit is oscillating at the chosen frequency. Once adjusted in this manner, the gas triode oscillator is functioning at the frequency equal to $.07RC$, and will continue to do so without further bias adjustment at all normal values for R and C at frequencies as high as 20,000 cycles-per-second.

Video to Grid Connection

In receiving television pictures, the synchronizing pulses sent out by the

zontal scanning oscillator in a television oscilloscope. The scanning linearity of this circuit is excellent over this entire frequency range if the proper circuit constants are used, and the return trace time is less than 15% of each scanning cycle up to the maximum frequency of 20,000 cycles-per-second, which assures completely satisfactory performance on 525 line television pictures. (The standard television picture requires a 15,750 cycle linear horizontal scanning circuit having a return trace time of not over 15%.)

Fig. 7 shows the basic circuit for the gas triode type of scanning circuit. Briefly, its operation is as follows. At the start of a scanning cycle, the condenser, *C*, begins to charge through the resistance, *R*, which is connected to "B+." At this point, because the gas triode has some fixed negative grid bias and because of the small voltage at the plate of the triode, the tube is "cut-off," i.e., no plate current flows. These conditions continue to exist until the charge on the condenser, and the resultant voltage at the triode's plate, reach a certain critical value. At this point, which is determined principally by the amount of negative grid bias, the gas inside the triode suddenly ionizes, causing the tube to conduct. This causes the tube to appear as though a very small resistance were placed across the charging condenser, *C*, and the condenser quickly discharges through this resistance. Discharging the condenser causes the voltage at the plate of the gas triode to be quickly reduced to such a small value that the tube can no longer remain ionized, and the entire process just described is again repeated.

From the preceding brief description, it is evident that the actual scanning is accomplished during the time that the condenser, *C*, is being charged through the resistance, *R*, and the short return trace period occurs when the gas triode, *V*, ionizes and thus discharges the condenser through its own low internal resistance. The frequency at which this scanning process occurs depends on the time-constant of the *RC* combination. The term, "time constant," of an *RC* combination is given in the formula:

$$TC = R \times C \quad \ldots\ldots (4)$$

where:

TC is time in *seconds*

R is resistance in *megohms*

C is capacity in *microfarads*.

From this formula it may be easily seen that as either the value of *R* or *C* is increased, the length of time for each scanning cycle *increases*, corresponding to a *decrease* in scanning frequency, since:

$$\text{Time per cycle} = \frac{1}{\text{frequency}} \quad \ldots\ldots (5)$$

Fig. 8 shows the circuit of a complete saw-tooth scanning oscillator utilizing either the type 884 or 885 gas

f is the upper limit of the desired amplifier frequency bandpass in *cycles-per-second*

C_t is the total amplifier output capacity in *micromicrofarads*

10^{11} is 1 with eleven zeros following it.

Step three gives the value of the "peaking" inductance, L, from the formula:

$$L = C_t \times R^2 \times 5 \times 10^{-10} \ldots\ldots (3)$$

where:

L is the peaking inductance in *millihenries*

C_t is the total amplifier output capacity in *micromicrofarads*

5×10^{-10} is a decimal point followed by nine zeros and a 5.

Returning again to the desired high-frequency response of 200 kc. for an amplifier of this type, it will be found that the gain of a single stage having this wide bandpass is below the desired figure of 150, particularly if cathode degeneration is employed. Thus, another stage of amplification is needed. Since the desirability of the triode cathode follower at the amplifier's input has already been discussed, the remaining triode section in one of the more familiar dual triode tubes, such as the 6SN7, 7F7, etc., is most convenient for the first amplifier stage. Calculations for this first triode amplifier stage are identical to that for the output pentode amplifier with the exception that formula (1) becomes:

$$C_t = C_o + C_w + C_g + C_{gp}(1+G) \ldots (1a)$$

where:

C_g is the grid-to-cathode capacity of the *next* amplifier stage

C_{gp} is the grid-to-plate capacity of the *next* amplifier stage

G is the voltage gain of the *next* amplifier stage.

It is apparent that the proper procedure for designing an oscilloscope deflection amplifier is to begin with the last stage, since its gain and capacities influence the design of the preceding stage. The cathode-ray tube itself, incidentally, affords an excellent means for checking the amplifier's gain. This is done by applying a 60-cycle a.c. voltage to the amplifier's grid having sufficient amplitude to deflect the cathode-ray beam over a large part of the screen diameter. The length of this deflection is measured with a ruler, then the input voltage is removed from the amplifier and applied directly to the cathode-ray tube's deflection plate, and this deflection length is measured. Dividing the first length by the second gives the gain of the amplifier, An a.c. vacuum tube voltmeter may also be used to measure the stage gain conveniently.

Figs. 5A and 5B show possible circuits suitable for use as deflection amplifiers. Fig. 5A is for single-ended deflection, and Fig. 5B is for push-pull deflection. Both amplifiers are suitable for use after the previously-discussed input cathode follower stage, and both will also meet all the requirements previously outlined as desirable if the proper component values are used. These diagrams, incidentally, are not intended to be complete, but are included simply to illustrate two possible circuit arrangements.

Scanning Circuits

As is generally well-known, the scanning (sweep) circuit in an oscilloscope is one which generates a voltage having a saw-tooth waveshape as shown in Fig. 6A. This saw-tooth voltage is usually applied to the input of the deflection amplifier. As a result of this saw-tooth-shaped voltage, a properly-operating scanning oscillator deflects the beam of the cathode-ray tube from left to right or top to bottom on the cathode-ray tube screen at a *uniform* rate of speed, then returns the beam in a relatively short period of time to its original starting position, where the process is repeated again.

Emphasis is placed on the word, *uniform,* above since the uniform rate of speed, or "linearity," of a saw-tooth oscillator output is one of its two most important requirements, the other being the shortness of the return-trace period. In Fig. 6A, the desired linear saw-tooth waveform is shown, and in Fig. 6C, two cycles of a sine wave are shown as they would appear on the cathode-ray tube screen if this linear saw-tooth waveform was applied to the horizontal deflection plates. Fig. 6B shows a non-linear saw-tooth waveform, and Fig. 6D shows how the same two cycles appear unevenly spaced when the horizontal deflection plates are supplied with this non-linear voltage. Were an actual television picture under observation, and such a non-linear sweep being used, the information on the left side of the picture would appear spread out, and that on the right side squeezed up. Thus, the importance of having the scanning process occur at a uniform rate can be readily appreciated, i.e., the scanning portion of the saw-tooth oscillator's cycle *must* be linear and the amplifier following it must introduce no distortion to upset it.

The author has spent considerable time working with the many variations of saw-tooth scanning oscillators, including a number utilizing the multivibrator type circuits. This rather thorough investigation has convinced the author beyond any doubt that the most satisfactory scanning oscillator for oscilloscope use, even in a television oscilloscope, is the familiar gas triode tubes known as type 884 and 885. There are several reasons for this. To begin with, the gas triode saw-tooth oscillator is extremely simple circuit-wise. In addition, it is very easy to get operating properly, requires only one tap switch and one potentiometer control to vary the frequency over its entire range, synchronizes easily and accurately, and above all, gives uniformly satisfactory performance over the wide frequency range of 15 to 20,000 cycles-per-second, as required for the hori-

tions have been written on this subject, only the highlights needed to design a suitable deflection amplifier will be given herein.

Fig. 4 shows the basic circuit of a video-type amplifier. The three dotted condensers represent the capacities which would adversely affect the high-frequency response of an amplifier due to their bypassing effect on these higher frequencies. They may be described in connection with a simple formula which is required in calculating the values for the components of such an amplifier. This formula is:

$C_t = C_o + C_w + C_{dp}$ .....(1)

where:

C_t is the sum of the three "stray" capacities.

C_o is the plate-to-cathode capacity of the amplifier tube.

C_w is the capacity of the output wiring and plate coupling condenser to ground.

C_{dp} is the capacity of one cathode-ray tube deflection plate to ground.

The value of C_o and C_{dp} may be secured from the data in a tube handbook, and the value of C_w estimated to get the value for C_t, but it is preferable to wire this portion of the circuit and measure C_t directly if a suitable instrument is available. Just as in the case of the input grid capacity discussed earlier, these three stray capacities in the output circuit of the amplifier bypass the higher frequencies to ground, and a means for counteracting this effect must be employed to keep the gain of the amplifier constant to the desired high frequency limit.

Actually, two measures are taken to accomplish this purpose. First, the plate load resistance, R, is made considerably smaller than in the case of the usual resistance-coupled audio amplifier. The bypassing effect of the stray capacities across this smaller resistance does not become objectionable until a much higher frequency, thus partially correcting the trouble. Second, a suitable inductance, L, is added in series with the plate load resistance to form a broadly-tuned resonant circuit with the stray capacities at a frequency slightly higher than the upper limit of the desired frequency bandpass. When so chosen, this inductance, L, has an equal and opposite effect to the stray capacities and thus permits the gain of the amplifier to be held constant to the desired high-frequency limit.

Calculating the values for R and L in Fig. 4 is fairly simple. Three steps are required. In the first step, the value for C_t is determined by measurement, or by handbook, and estimation as previously discussed, using formula (1).

The second step is calculating the value of the plate load resistance, R, from the formula:

$$R = \frac{1.59 \times 10^{11}}{f \times C_t} \quad \text{.....(2)}$$

where:

R is the plate load resistance in *ohms*

New FM Receiver

(*Continued from page* 53)

in poor alignment in one stage being compensated for by shifted alignment in another stage, thus peaking the i.f. characteristic unsymmetrically and no one stage by itself satisfies the condition for wide-band passage. Therefore, the best practice is to align each stage individually, and satisfy the requirement of phase as well as amplitude linearity for each stage as shown in Fig. 7. The output of the signal generator, whose frequency is set at the i.f. mid-frequency of 10.7 megacycles, is connected to the grid of the last i.f. amplifier tube, V_4. The transformer trimmers are so adjusted that the desired characteristic is obtained by observing the deflection of the limiter microammeter. The resulting characteristic should be as shown in Fig. 7, the two peaks appearing at about 75 kc. on either side of the i.f. frequency of 10.7 mc. The characteristic should be as "flat" as possible, which condition may be obtained by adjusting the damping resistors of the i.f. transformers. Upon successful alignment of T_3, the output of the signal generator is connected to the grid of V_3 and the transformer T_2 is aligned in a similar manner. The output of the signal generator is reduced in strength, of course, since the addition of a stage of amplification has been effected by the change. Finally, the signal is applied to the grid of the high frequency converter, V_2, and the alignment of transformer T_1 performed. It should be noted that due to the low impedance of the coil, L_1, in the grid circuit of the converter,

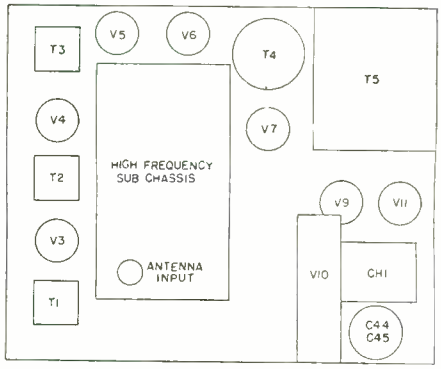
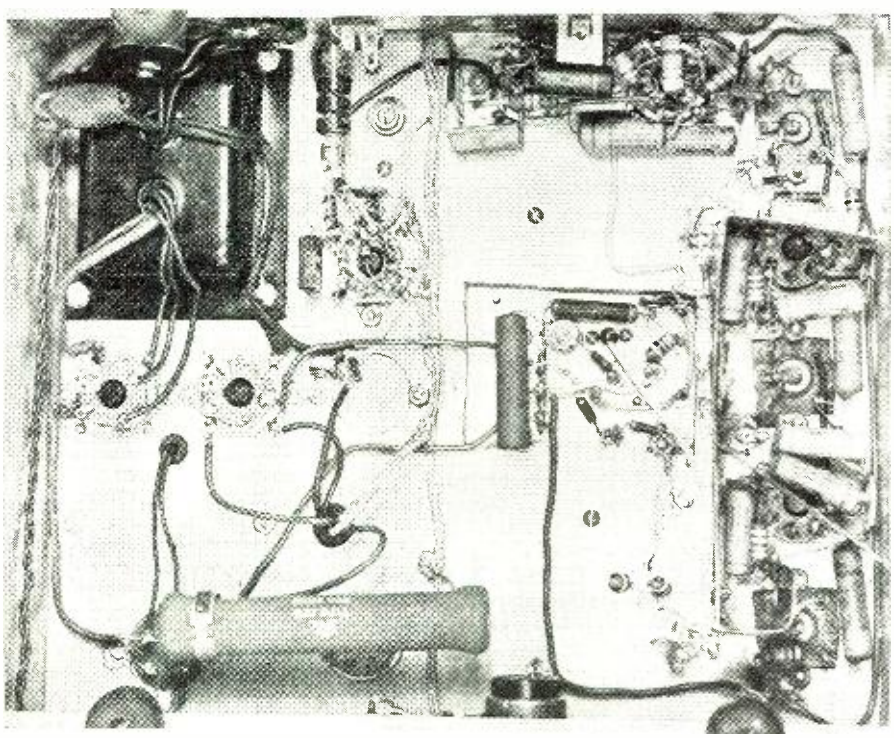


Fig. 5. Layout of receiver chassis showing location of various components.

a high resistance of, say, 100,000 ohms should be substituted for this coil, before the test is attempted.

In the alignment of the high frequency stage, customary practice is followed, the same as would be used in any other superheterodyne input circuit. A signal generator covering the FM band is connected to the antenna input terminals across L_1. Here, again, since the i.f. amplifiers have been properly aligned, the magnitude of the limiter input current is used as a guide for alignment. The signal generator is set at the high side of the band, say 105 mc., and the tuning dial, which drives C_2, C_{10}, and C_{12}, rotated until the microammeter indicates a maximum value. Then the oscillator trimmer, C_{13}, is adjusted for a still higher maximum reading and finally C_1 and C_9 are adjusted for the highest reading of the limiter grid meter. The receiver dial, at this point, is marked with the corresponding indication of the signal generator. Tracking is then checked by noting the readings

Fig. 6. Under-chassis of FM receiver features neat wiring and uncluttered appearance.



range of 40 to 9000 cycles. Wire spools of quarter, half, and full hour duration may be used. This portable unit permits dubbing in, correcting, or adding any form of sound to the original recording.

The "Musicord" provides the fun of making professional sounding records at home with the use of the *Hoffman* magnetic cutting head. A monitoring circuit allows you to listen to the program at the same time it is being recorded.

Many other models are also described and further information may be obtained from the *Hoffman Radio Corp.,* Los Angeles, California.

CABINET EXHAUST FAN

The Rotron Division has recently released a catalogue sheet on an exhaust fan for flushing the air of instrument cabinets and radio transmitter cubicles. This versatile unit covers all requirements up to such high back-pressures as where a centrifugal-type fan should be used. The ball bearing motor, which is totally enclosed, can be mounted with propeller vertically-up or vertically-down or horizontal.

The propeller operates in a Venturi ring, which has been designed to obtain full benefit of the pressure-building capacity of the blades. The shape of the ring assures efficient operation for both directions of flow. A number of propellers of different pitch and opposite direction of flow are available, so that the air can either be sucked into the cabinet, or pushed out.

The motor has two accurately aligned "precision" type ball bearings with felt seals. Its diecast casing is finned for maximum heat dissipation. The motor conforms to all NEMA standards for this class. Further information on this unit will be furnished by the *Rotron Division,* 180 Weeden Street, Pawtucket, R. I. Ask for data sheets RP-22 and RM-15.

'SMALL BUSINESS' SERVICE

Of interest to both new and established retailers in the radio-appliance field is the booklet "The Home Appliance Business" published by the *Bank of America.*

If you have your own home appliance store or if you are thinking of buying or opening one, this information digest will interest you. It won't tell you how to run your business, but it may give you something to think about.

"Before the war the appliance business was very competitive and dealers sent out salesmen and arranged for demonstrations but with the war came scarcity and high prices . . . Today with changing conditions prewar competition is on the way back, that's why it's going to pay you to look ahead with market changes in mind."

For a copy of this publication write to *Small Business Advisory Service, Bank of America,* 300 Montgomery Street, San Francisco 20, California.

-30-

L_1—2 t. #16 en. wire, ½" diam., self-supporting
L_2—4 t. #16 en. wire, ½" diam, self-supporting
L_3—1¾ t. #20 en. wire, ½" diam. polystyrene form
L_4—2¼ t. #20 en. wire, ½" diam. polystyrene form
L_5—1½ t. #20 en. wire, ½" diam. polystyrene form
L_6—3 t. #20 en. wire, ½" diam. polystyrene form
Note: Maintain ⅛" spacing between turns of all coils
Primaries and secondaries of all coils should be spaced ⅛" apart.

Table 1. Coil winding data.

adjusting the input trimmer condenser of the transformer T_4.

With alignment completed, the receiver is ready for connection to an antenna system and an audio amplifier. The quality of reception depends heavily upon the design of these two additional circuits; both must be constructed with the utmost of care, for the receiver will respond with no better quality than has been incorporated in the design of these units.

-30-

NBFM Transmitter

(*Continued from page* 58)

ble) may be substituted for the 6L6 with higher plate voltage and output being possible. The 829B would have to have a separate power supply, but its screen could be run from the exciter unit's supply.

With the voltages shown on the schematic for the 6L6, a 25 watt lamp coupled to the 6L6 lights to ⅔ brilliance on 20 meters and ⅓ brilliance on ten meters. This exciter may be used as a composite transmitter on all bands or to excite a pentode amplifier. The unit should be link-coupled to the next stake. The author has been using the exciter with 20 watts input on 10 meters with a 3-element beam for several months. Some of the amateurs contacted found it hard to believe 20 watts input could push their S-meter so hard. Distant amateurs didn't recognize the NBFM until it was mentioned.

-30-

Television Scope

(*Continued from page* 66)

as might possibly seem logical, the variable control is, instead, placed in the grid circuit, and for the following reason. When the control is in the cathode circuit, as in Fig. 3B, plate current flows through the control causing a fixed d.c. voltage drop across it. This d.c. voltage will charge the grid coupling condenser to whatever voltage appears at the point where the arm of the control is set. Thus, when the arm of the control is altered, the d.c. voltage across the condenser also changes, causing a momentary shift in the pattern position either horizontally or vertically as the adjustment is made. This becomes a considerable annoyance when attempting to make a fine adjustment of a pattern, and the scheme in Fig. 3A was thus adopted. The rather unusual values of the coupling condenser and the gain control potentiometer in Fig. 3A are necessary in order to eliminate the undesirable effects of the tube input capacity, previously described. With the values shown, the various stray capacities have no detectable effect at any frequency up to 200 kc.

The amplifier proper must be designed to go with the type of cathode-ray tube being used At present, the tendency in oscilloscope design is toward the use of push-pull deflection, i.e., a push-pull output amplifier is used to supply deflection voltage to both horizontal and both vertical deflection plates. Tubes suited for this type of deflection are the 2AP1, 3BP1, 5BP1, etc. The two principal advantages for this type of circuit lie in the fact that the output amplifier may be operated at a lower value of "B+" voltage in order to secure the desired screen deflection, and the defocusing of the cathode-ray tube spot is also minimized. These advantages are somewhat cancelled, however, by the extra tubes and circuit components required. In the case of larger tubes, the extra complexity is often justified since very large deflection voltages are needed, but in the case of the smaller tubes, particularly the 2" and 3" screen sizes, the author has always favored the "single-ended" type of deflection because of its simplicity. Single-ended deflection re-

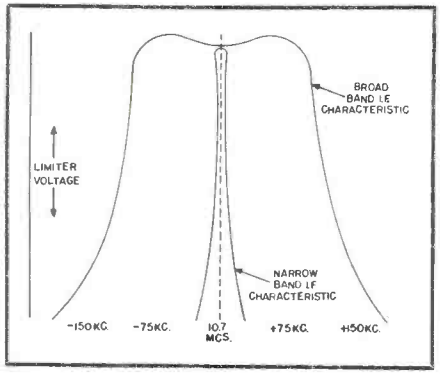


Fig. 7. Comparison of narrow-band (AM) and broad-band FM i.f. characteristics.

of the microammeter when both the settings of the signal generator and the receiver tuner are varied over the entire FM band. If the input signal is maintained constant, the microammeter should read essentially the same magnitude over the entire band, for proper tracking. If the tracking is not satisfactory, the trimmers should be adjusted, following the same practice as is employed in AM receiver alignment. Throughout the tracking procedure, the frequency of the signal generator should be noted and recorded on the receiver tuning dial in pencil and later inked in.

The discriminator circuit is adjusted next by varying the capacitances of the discriminator transformer, T_4. This can best be done by connecting a high resistance voltmeter across the cathode end of R_{30} and ground and noting its reading as the applied intermediate frequency of 10.7 mc. is varied back and forth over this mid-frequency. The discriminator characteristic, as shown in Fig. 8, should be the resulting variation of discriminator voltage with change in frequency. Zero voltage at exactly 10.7 mc. is obtained by adjusting the output trimmer condenser of the transformer, T_4,—the condenser that is connected across the plates of the tube, V_7. Equal and opposite discriminator voltages are obtained by

Fig. 8. Discriminator characteristic.

English or Spanish editions and may be obtained by writing *Sibley Machine & Foundry Corp.*, 206 East Tutt St., South Bend 23, Indiana, mentioning RADIO NEWS.

MULTIPLE ARM RELAYS

A new line of sensitive relays has been announced by *Signal Engineering & Mfg. Co.*, in their bulletin No. 50-72. This line consists of a new series of small, rugged, general purpose multiple arm relays adaptable to a wide variety of circuit arrangements.

Three styles of assembly are featured in these new relays; the octal socket with removable dust cover, the octal socket and hermetically sealed cover, and the header type container which is hermetically sealed.

The basic design consists of a relay mounted on an octal socket with the relay armature and the contact arms in a vertical position to the relay base, allowing the required mounting area to be held to a minimum. The armature is so proportioned that it is substantially balanced with respect to its axis of rotation, allowing the relay to be mounted in any position without affecting its normal action. Shock or vibration is minimized by the use of a balanced armature which might cause false opening or closing of the contacts.

Signal Engineering & Mfg. Co., 154 West 14th St., New York 11, New York, will furnish a copy of bulletin No. 50-72 on request.

NEOPRENE NOTEBOOK

The "Neoprene Notebook," recently published by *E. I. du Pont de Nemours & Co., (Inc.)*, contains articles on synthetic rubber. This booklet also contains information on laboratory results and industrial applications for Neoprene products.

Included in this notebook are abstracts from a report entitled "The Effect of Fuels Containing Aromatic Hydrocarbons on Neoprene Hose." Copies of the complete report may also be obtained from the *Rubber Chemicals Division, E. I. du Pont de Nemours & Co., (Inc.)*, Wilmington 98, Delaware.

TRANSMITTING TUBES

United Electronics Company is now offering a new 12-page catalogue, which provides a positive means for identifying transmitting tubes of latest design from war surplus.

This pamphlet presents a description of *United* electronic tubes and vacuum capacitors for radio transmission, sound amplification, and diathermy. All internal types embody the new *United* isolated getter trap which is a capsule-like device which forms a gas absorbing reservoir in which the metallic gettering substance is confined. This frees the new tubes from the mirror-like coating inside the bulb.

Contained in this pamphlet are photographs of tubes and vacuum capacitors, with many different types of charts and tables. This catalogue, No. 1-GPW-7 is obtainable upon request by writing direct to the *United Electronics Company*, 42 Spring Street, Newark 2, New Jersey.

NEW SERVICE AID

The Friend's Record Changer Parts Company has released a sheet on its new service aid, the "Bend-R-Tool." This tool is a practical tool for bending and straightening levers in record changers.

With this tool it is possible to reach levers and parts in the changer that are inaccessible with pliers, thus making it unnecessary to lower the sub frame or main cam gear.

Further information on this tool may be obtained from *Friend's Record Changer Parts Company*, 9 North Seventh Street, Philadelphia 6, Pennsylvania by asking for sheet No. 917.

ALLIED CATALOGUE

The new 1948 catalogue called "Everything in Radio and Electronics" has been released by *Allied Radio Corporation*. This buying guide lists more than 10,000 items in its 172 pages. Complete listings of radio and electronic parts, test equipment, batteries, public address systems, radios, recording equipment, diagrams, and a wide variety of other items is to be found.

Feature items include a new low-cost television receiver, a television kit with a 12 inch viewing tube, new communications receiver, a new FM-AM console and table model radio receivers, and two chassis for custom installations.

The public address section covers equipment for sound systems from 7 to 60 watts, the latest intercom units, microphones and pickups, speakers and baffles, phono motors, cables and connectors.

A large radio amateur section includes parts and accessories to meet the requirements of all veteran and fledgling "hams." For builders and experimenters there are a wide variety of kits from the simple "one-tuber" to a 22 tube television kit, plus diagrams, accessories, and the tools and supplies necessary for the builder.

All items are arranged in clearly defined sections and are carefully indexed for speedy reference. The catalogue is available free, on request, by writing to *Allied Radio Corporation*, 833 West Jackson Boulevard, Chicago 7, Illinois.

HOFFMAN BROCHURE

Hoffman Radio Corp., recently published a 16-page brochure featuring their new line of radios and recorders.

The booklet is well illustrated with photos and descriptions of their 1948 models including the new *Hoffman* "Wirecord," a professional home recorder, and the "Musicord," a disc recorder.

The "Wirecord" is a high fidelity recorder that reproduces the full tonal

work book covering all available material, along with complete instructions on how to tie-in with FM stations. A folio of spot announcements for both AM and FM station use is provided, plus material for general publicity use.

A dealer window display is also furnished, including window streamers, window spots, and easel cards on the *Westinghouse* rainbow-tone FM. In addition, mats and proof sheets for a full page newspaper ad to be run in cooperation with the station, one for an individual dealer tie-in and three for the company's new FM receivers are provided along with 100 sixteen-page consumer brochures explaining FM and showing pictures of all *Westinghouse* FM models.

Stations installing *Westinghouse* transmitters will be provided with similar packets entitled "How to Sell Your FM Station to the Public." This material will tie-in *Westinghouse* radios and radio dealers, thereby providing a complete tool chest for FM promotion.

NEW JONES CATALOGUE

The recently published *Howard B. Jones* catalogue covering electrical connecting devices of various types, has been designed to be of maximum service to the user.

This thirty-two page catalogue includes specifications, illustrations, and suggestions for inspection, installation, etc. Each product is illustrated and, in addition, diagrammatic sketches and cutaway photographs are included for many of the items.

Copies of Catalogue #16 may be secured upon request to *Howard B. Jones Division, Cinch Manufacturing Corporation,* 2460 W. George Street, Chicago 18, Illinois.

SIBLEY DRILLING MACHINE

The *Sibley Machine & Foundry Corp.* have just issued a new catalogue, No. 67, describing their modern designed Model C-20 drilling machine.

This model is sensitive enough to handle the smaller size drills with hand feed, yet has ample power to drill 1½ inches in mild steel, or its equivalent in other metals.

The rigidity of the stationary head assures accuracy in precision work. Exact table alignment can be obtained by boring the table arm after assembly with the same spindle furnished on the machine. Table surface is held at right angles to the spindle to seven thousandths in six inches. Oil grooves in the rectangular table permit the use of a coolant. The precision ground spindle is equipped with two ball thrust bearings, with spindle speeds ranging from 65 r.p.m. to 1360 r.p.m.

The geared power feed operates in an oil reservoir and provides feeds of .003", .006", and .010" per spindle revolution. Selection of feed is made by simply turning the dial indicator.

This catalogue is available in either

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

TWO-WAY SPEAKER SYSTEMS

The *Colortone Company* of South Bend, Indiana have released a folder on their new 1948 line of two-way speakers.

These speaker systems are designed for sound-on-film reproduction and high quality public address systems. They employ high and low frequency speaker units and are suitable for professional uses such as playback of transcription records, auditorium entertainment, electronic organ music, and public address installation. Incorporated is a type N-300 frequency crossover network necessary for operating two-way speaker systems.

Both the high and low frequency speakers employ 25 watt permanent magnet speaker units with a combined frequency range of 50 to 9000 cycles. These speaker systems are furnished with a low and high frequency speaker unit, low frequency reflex cabinet, high frequency projector horn, crossover network, and the necessary hardware for mounting the assemblies. Side wings, which will increase the forward projection of the bass frequencies are offered in three sizes.

Further information will be furnished by the *Colortone Company,* South Bend 15, Indiana.

PACKAGED A.C. GENERATORS

"How to Apply 'Packaged' A-C Generators" is the title of a booklet recently published by the *Electric Machinery Mfg. Company.*

The "Packaged" generator consists of three main parts; a revolving-field a.c. generator, which is driven by the engine and which generates the a.c. electric power; the direct current exciter, which is connected directly to the generator shaft and furnishes excitation for the generator field winding; and the generator control cabinet. This cabinet, mounted on the generator, encloses the meter for reading the voltage, current, and "Regulectric" circuit.

These three components are manufactured and assembled at the factory so that when the generator arrives it is ready to be connected to the engine and have the line connected. No switchboard is necessary with these units.

Protective enclosures keep drip and dirt out of the generator. Voltage selection is obtained with a built-in voltage regulator that requires no maintenance or attention.

Further information on this generator line is included in the "E-M Synchronizer," Vol. 8, No. 3a, which is available from *Electric Machinery Mfg. Company,* 821 Second Avenue S.E., Minneapolis 14, Minn.

DIE-LESS DUPLICATING

A new edition of the 40-page *Di-Acro* catalogue has just been released by the *O'Neil-Irwin Manufacturing Company* of Lake City, Minnesota. This booklet contains illustrations and specifications on all *Di-Acro* precision machines which are now available in six different types and 18 different sizes.

These machines accurately duplicate parts making it unnecessary to make numerous dies. A simple adjustment on the *Di-Acro* machines allows changes to be made right on the job. This equipment can be readily adjusted to cover an unlimited range of duplicating requirements in a wide variety of materials, thereby making these precision machines valuable for the fabrication of a few experimental pieces or quantity production runs.

This catalogue is available from *O'Neil-Irwin Manufacturing Company,* Lake City, Minnesota.

POINT-TO-POINT COMMUNICATION

A booklet describing new point-to-point radio communication equipment is now being offered by *Westinghouse Electric Corporation.*

This 8-page booklet shows how *Westinghouse* type MV equipment can meet all radio communication demands by offering several types of service from one transmitter; on-off telegraphy, frequency shift keying, facsimile, m.c.w., and radio-telephony.

Typical applications for this equipment are ship-to-shore, between airports, and industrial communication systems such as mining, lumbering, and construction.

A center spread chart illustrates the inherent "building block" design, by which only those units needed to perform specific tasks need be incorporated in any final assembly. Copies of this booklet (B-3945) can be obtained from *Westinghouse Electric Corporation,* P.O. Box 868, Pittsburgh 30, Pa.

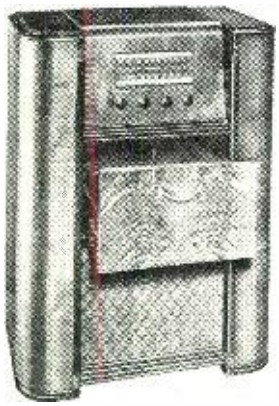
FM PROMOTION KIT

The Home Radio Division of *Westinghouse Electric Corporation* has prepared a complete promotion kit to give adequate material for FM promotion for *Westinghouse* distributors.

The package includes all necessary tools to meet the urgent demand for retail promotion to help build FM station audiences for new or existing stations. Materials consist of a complete

complete bands—both broadcast and overseas.

Prices and additional details on this



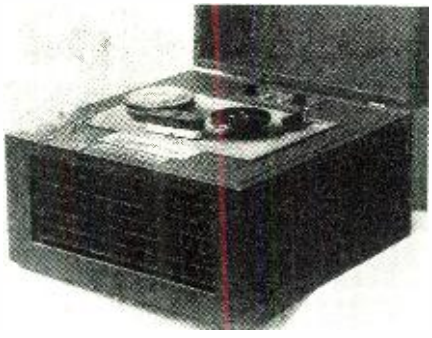
unit will be supplied on request by *Crosley Division, Avco Manufacturing Corporation,* Cincinnati, Ohio.

WIRE RECORDER

National Polytronics, Inc. has announced its entry into the wire recorder field with the Model 5-A unit.

This utility-type, ten-minute recorder comes complete with self-contained amplifier and microphone. The wire used for recording may be reused thousands of times as the machine automatically erases previous material when new recordings are made. Editing can be accomplished on this machine by either erasing unwanted portions or cutting the wire and tying with a square knot.

Designed to be marketed in the low price field, *National Polytronics, Inc.,*



2430 Atlantic Avenue, Brooklyn, New York will supply prices and additional information on this wire recorder to those requesting this data. —30—

"Psst! Better play with the toys for a while. We can figure out the max. plate rating later!"

The full-vision, straight-line dial is illuminated by two pilot lights.

The Model 77U is 10½" x 17¾" x 18¾". Engineering features include an improved automatic record changer, a "Silent Sapphire" pickup, a.v.c., and built-in "Magic Loop" antenna. The receiver uses six tubes and one rectifier.

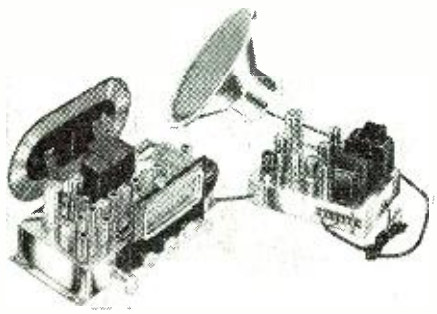
The *RCA Victor Division* of *Radio Corporation of America* will supply full information on the Model 77U upon request.

CUSTOM RECEIVER

Freedom from drift and the elimination of any need for a tuning indicator are two features being claimed by *The Radio Craftsmen, Inc.* for its new Model 1-2-3 receiving unit.

The new model incorporates an AM-FM tuner, a high-fidelity amplifier, and a 12" speaker, the whole unit being designed for custom installations.

The FM circuit of the tuner automatically compensates for drift and keeps the set in perfect tune by means of a.f.c. Besides offering flexibility in mounting arrangements, the new Model 1-2-3 has self-contained internally-switched inputs for phonograph, recorder, television sound, or microphone and multiple outputs to adapt to many sizes and quantities of speakers, or transmission line.



For further information and descriptive literature, write *The Radio Craftsmen, Inc.*, 1341 South Michigan Avenue, Chicago 5, Illinois.

ZENITH CONSOLE

Zenith Radio Corporation of Chicago has announced a new console radio which provides AM and FM reception as well as an automatic phonograph.

Named "The Regent," this new combination features the company's "Cobra" tone arm and "Intermix" record changer, two-band Armstrong FM, as well as AM reception. The "Radiorgan" tone control enables the listener to select any one of 64 tonal effects. A 12 inch speaker is used in this receiver. The silent-speed "Intermix" record changer automatically changes twelve 10 and 12 inch records intermixed, twelve 12" or fourteen 10" records. Storage space for record albums is also furnished.

"The Regent" is housed in a simply designed cabinet which is finished in selected American walnut veneers. The radio tilts out to a convenient, waist-high tuning position and the phonograph slides forward as the door is opened.

Additional information on this combination radio may be secured from *Zenith Radio Corporation*, 6001 West Dickens Avenue, Chicago 39, Illinois.

LOW PRICED CONSOLE

Shipment has started on *General Electric Company's* new low price radio-phonograph console, the Model 119.

The new receiver is supplied in both mahogany and walnut cabinets and is designed to provide ample space for record storage. A full lift-top covers the phonograph with its automatic record changer and the radio controls. The receiver is equipped with a 12 inch Alnico V magnet loudspeaker and has a built-in "Beamascope" antenna.

Further information on the Model 119 may be secured from the *Receiver Division, General Electric Company*, Syracuse, New York.

CROSLEY CONSOLE

A new, low-priced radio-phonograph combination, the Model 68 CR, has been announced by the *Crosley Division* of the *Avco Manufacturing Corporation*.

The new receiver features the *Crosley* "floating jewel" tone system and is housed in an American walnut cabinet measuring 36" x 27" x 14¾".

A fast, jam-proof automatic record changer plays twelve 10" or ten 12" records. The chassis is equipped with a 10" electrodynamic speaker, has continuous tone control, automatic sensitivity control, and covers two

plification for interference immunity in the picture and an r.f. stage for less interference.

The top, front, and back are removable so that the chassis may be serviced without taking it out of the cabinet. The circuits of the set are fused for safety.

Those wishing additional details on this unit should write to *United States Television Mfg. Corp.*, 3 West 61 Street, New York 23, New York.

"TELEVISION OPTIONAL"

A revolutionary idea in home receiver merchandising has been introduced by *Admiral Corporation* of Chicago.

The innovation, called "television optional," offers matching television consoles, radio-phonograph combinations, and record cabinets, which may be bought separately and matched at any time.

This new method of merchandising offers several advantages; the family of moderate income can plan on both a radio-phonograph and a television set and buy them one at a time to distribute the over-all cost and still have matched units; the family which

has been hesitating about buying a three-way set for fear of obsolescence can now protect its investment by buying the units separately, the radio-phonograph and the TV receiver may be used together, separately, or even in different rooms; as the units are styled to fit the sectional trend in furniture design, they will fit many decorative schemes.

Additional details on this new "television optional" line will be supplied by *Admiral Corporation*, Chicago, Illinois to those requesting them.

TABLE MODEL COMBINATION

A new table model radio-phonograph combination, the Model 77U, featuring the largest speaker ever employed in a comparable *RCA Victor* instrument and 50 per-cent more power output than is usual in such an instrument, has been announced by *Radio Corporation of America*.

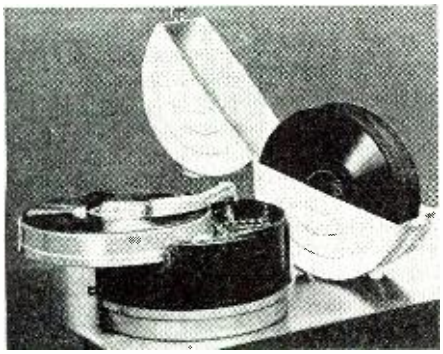
The veneered cabinet, available in walnut or mahogany finish, is of streamlined modern design and features a cut-back lid fitted with a satin-finish, brass-plated handle for convenient lifting. The tuning and control knobs for the phonograph and standard broadcast radio units are located on the outside of the cabinet.

NEW RECEIVERS for Spring Market

PORTABLE PHONOGRAPH

Audar, Inc. has just added an all-plastic portable phonograph to its line of "Telvar" home instruments.

Known as the "Carousel," this unit is available in six color combinations



and features storage space for 10 records in a removable bottom section. The top, when removed, becomes the turntable on which either 10 or 12 inch records may be played. The unit weighs seven pounds complete.

The tone arm uses a P-89 high-fidelity crystal cartridge generating 3 volts at 1000 cycles. The unit uses a standard phonograph motor to power the turntable. The chassis is shock mounted on rubber pads to eliminate tube vibration and *Sylvania* loctals are incorporated to avoid loosening of the tubes during carrying.

Audar, Inc. of Argos, Indiana will supply full details on the "Carousel" upon request.

MEISSNER RECEPTOR

Meissner Manufacturing Division of *Maguire Industries, Inc.* is currently introducing the Model 8C FM receptor.

According to the company, a simple connection to any present AM radio will permit full-scale fidelity FM reception. Special features of the Model 8C include coverage of the new

FM band from 88 to 108 mc; audio fidelity, flat within plus or minus 2 db. from 50 to 15,000 c.p.s.; audio output, 3 volts r.m.s. at minimum usable signal input, 30% modulation, output voltages as high as 15 volts r.m.s. obtained without distortion; power supply, 105 to 125 volts, 50 or 60 cycles, power consumption 35 watts; and a tube complement consisting of two type 6AG5, two type 6BA6, two type 6C4, one type 6AL5, and one type 6X5GT/G tubes.

For further information on the Model 8C write direct to the *Meissner Manufacturing Division* of *Maguire Industries, Inc.,* Mt. Carmel, Illinois.

CROSLEY COMBINATION

Crosley's deluxe "Spectator," which was introduced recently to the trade, features a "Swing-a-View" picture tube which swivels over a 60 degree arc.

This all-purpose instrument provides FM, AM, and short-wave reception in addition to the automatic phonograph and television. The "Swing-a-View" picture tube mounting enables viewers to angle the screen so that they

may watch the picture directly from any point in the room within a 60 degree arc in front of the receiver.

When not in use, the picture tube swivels into a position crosswise in the cabinet and may be concealed by panels which match the mahogany cabinet.

The receiver uses seven radio tubes plus one rectifier and 23 television tubes including the 10 inch cathode-ray picture tube, plus three rectifiers. The set measures 44½" x 37½" x 18" and has storage space for records.

Further data on the "Spectator" may be secured from the *Crosley Division, Avco Manufacturing Corporation,* Cincinnati, Ohio.

G.E. TABLE TELEVISION

A compact table model television receiver, incorporating both AM and FM radio, is now in production at the *General Electric Company* plant.

Known as the Model 803, this receiver has a 10 inch direct view tube and provides reception on all 13 television channels. A separate circuit for each channel is incorporated to provide the best possible reception by merely turning the selector to the channel number on which the desired station operates.

The unit also includes the company's automatic clarifier which is said to virtually eliminate fuzzy edges

and reduce the effects of interference.

A built-in "Beamascope" is provided for AM broadcast reception. For television and FM reception convenient terminals are provided for attachment to a dipole antenna. The cabinet of genuine Honduran mahogany is designed for the home or commercial establishment where space is a consideration.

The *Receiver Division, General Electric Company,* Syracuse, New York, will supply additional details on request.

UST'S TABLE MODEL

United States Television Mfg. Corp. has entered the table model TV set field with a new 10 inch direct view unit capable of yielding a picture approximately 9 x 7 inches.

Housed in a cabinet of modern design the new receiver features four controls placed vertically for increased eye-appeal and ease of operation. The cabinet measures 22½" x 19" x 14½".

The set has a crystal picture detector which adds to picture detail. The automatic picture synchronizing controls make for easier selection in the set which has a thirteen channel tuner.

Four stages of picture i.f. amplifi-

cation and two stages of sound i.f. amplification have been incorporated along with two stages of video i.f. am-

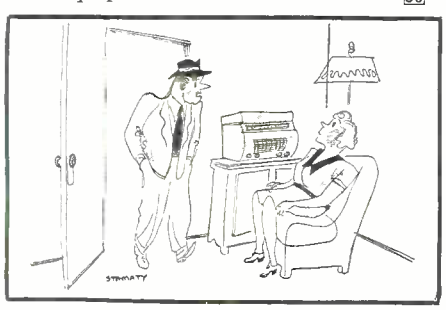
and reradiate a certain amount of the distributed energy, and are, therefore, actually spoilers in the radiated field of the antenna.

Because it is necessary to place the parasitic dipoles in two positions, they may be turned 90 degrees against a spring by gears connecting to the antenna drive motor. The spring returns them to the non-radiating position when the power is turned off.

The antenna is mounted directly below the chassis containing the transmitter-receiver components, and is supported by a fork-type casting. Since the transmitter is fixed and the antenna rotates, a rotating joint has been arranged to transfer the energy from the magnetron transmitter to the antenna, with no change in the transmission characteristics. The antenna is driven by a 400-cycle induction motor which operates at a normal speed of 7200 r.p.m., and which is reduced by a gear train to a normal antenna rotation of 30 r.p.m.

Since not everyone in the aviation industry thinks alike it is possible that the transport industry may require modifications of this equipment, one of which might be the substitution of a 5-inch indicator, due to severe cockpit space limitations. This modification is easily accomplished and, in fact, the equipment can be operated with such an indicator, with an external control box located for easy access by the pilot. It is also probable that many of the later design aircraft are better suited to a nose installation, rather than to tolerate the drag occasioned by a belly installation, even though the nose installation reduces the radar coverage in the aft direction. The physical size of this particular unit would prohibit its installation in most of the nose areas available, but suitable modifications can be made to accomplish this. The equipment is normally able to operate with two indicators and a third could be provided, should it be required, for navigator's use.

Combining the several achievements in a single lightweight assembly has been no easy task. Now that the services have underwritten its early development, I believe the design can be produced within the economic range of the air transport industry. Coming tests by the storm-searchers, radio experts, and transport fliers should demonstrate the value of such many-in-one equipment. —30—



"What a gyp! They used different questions on the repeat broadcast to the West Coast!"

the mixer unit so that the receiver is isolated from the transmitter, meaning that a common antenna-waveguide assembly is used for both transmission and reception.

Signals and other radar indications appear on a circular tube face in the conventional PPI pattern such that the zero azimuth position on top of the tube represents straight ahead, and the other azimuth positions are calibrated in a 360-degree interval around the top. Since the antenna rotates constantly, it furnishes a complete azimuth picture at all times, which continues to change as the aircraft moves. The various functions of the equipment are obtained by combinations of changes to the radar characteristics, particularly the transmitting characteristics. For instance, in switching from "search" to "weather," the transmitter pulse is lengthened by a factor of approximately three. In switching from "search" to "beacon," the transmitter pulse is likewise increased, and at the same time, the transmitted antenna pattern as well as the received antenna pattern is changed from a narrow vertical beam to a broad vertical beam, and the receiver frequency is shifted approximately 50 megacycles.

The antenna system consists of an 18-inch diameter parabolic reflector with a double dipole radiator located at the focal point of the parabola and fed from a standard X-band waveguide. In addition, a double parasitic dipole is located on top of the antenna feed, and immediately behind the normal dipole radiators. This parasitic dipole is arranged in such a manner that it can be actuated so that its dipoles are parallel to, and therefore parasitic to the radiating dipoles. The parasitic dipoles are free to rotate 90 degrees, so that they are then 90 degrees with respect to the radiating dipoles and their effect is negligible. It is by the use of such an arrangement at the frequency of 9375 megacycles that it is possible to focus nearly all the energy radiated into a very narrow beam. The beam will be approximately six degrees wide in the horizontal and vertical dimensions at the half-power points. This energy, by reason of the dipoles' horizontal position, is horizontally polarized—the most effective type of polarization on search type radar for use in detecting land and sea targets. It is also necessary that the energy be horizontally polarized for beacon operation, as the beacon antennas themselves are horizontally polarized.

When the parasitic dipole arrangement is used, a certain amount of the radiated energy is deflected downward toward the earth's surface so that there is, in effect, what amounts to a cosecant-square pattern of radiated energy. The parasitic dipoles are tilted slightly with respect to the axis so that they can radiate in a downward direction. Being located in the path of the energy being reflected to the parabolic reflector, they absorb

obtained on the equal energy path, it then becomes possible to see only those objects projecting into the flight path of the aircraft.

The third position is for "beacon operation" and it provides for the interrogation of ground radar beacons. These ground radar beacons have been established by the Army, Navy, and Coast Guard at various well-known geographical locations. It is possible for the radar to interrogate them so that they in turn show a signal on the indicator, which is suitably coded to indicate the beacon station identification and at the same time provide an accurate measure of azimuth and range to the particular beacon. Thus, precise navigation is possible through beacon operation.

The fourth position is for use in obtaining "weather information." Probably one of the most valuable assets of the transport radar is its ability to observe weather phenomena. By utilizing a pencil type of beam and tipping the antenna upwards to eliminate any reflection from the ground, it is possible to search the sky for heavy rain-bearing clouds, thunderstorms, and areas of super-cooled water. These manifest themselves by peculiar displays on the indicator which are easily recognized by an observer with practice. It is thus possible for transport aircraft to avoid such areas of possible danger. It is also possible, by mapping such areas by radar, to pick the narrowest or "softest" spot, if indeed it is not possible to avoid the weather altogether. Also, by searching in layers in a vertical direction, it is quite possible to find layers where a minimum of weather disturbances prevail so that flight altitudes may be changed to take advantage of such a situation.

The other controls to be operated by the pilot are (3) a receiver sensitivity control which, as its name implies, governs the sensitivity and hence the signal indication on the indicator. An intensity control (4) is used for governing the intensity of the display on the indicator tube primarily for adjustment under different cockpit lighting conditions. Lastly, there is a (5) trim control, which provides arbitrary displacement of the center of stabilization on the pitch axis over a range of plus or minus 7½ degrees.

Operation of APS-42 is similar to all centimeter type radar equipment, in that it transmits a high power pulse of very short duration through a waveguide assembly to an antenna which focuses the energy to a very narrow beam and rotates the beam in azimuth. Timing of the transmitted pulse is very precise, and the time required for the transmitted pulse to be sent out and reflected from a target is so measured by the equipment that the distances are recorded with good accuracy. Received echoes are picked up by the same antenna assembly, and fed into the same waveguide assembly, separation taking place at

channels. However, two separate transmitters and transmitting antennas must then be used.

It is strongly suggested that the model sailboat enthusiast ally himself with some competent radio amateur rather than try to build his own control equipment, for though the radio gear is simple as radio gear goes, still the experience factor in the building and "de-bugging" stages of the project will count for a lot of wasted time and sleepless nights.

-30-

APS-42 Radar

(*Continued from page 45*)

approximately 6 degrees in width in the vertical direction. The beam is useful for detecting any obstacle, either other aircraft in flight or high ground obstacles, such as a mountain range projecting into the path of the aircraft in flight. By eliminating the reflections from the ground in the vicinity of the aircraft, such as are

GROUNDED-GRID AMPLIFIERS

By MILTON S. KIVER

IT is well-known by radio engineers that the simple triode tube is, in many instances, preferable to a pentode in the r.f. amplifier stage of a high-frequency receiver. This is due to its lower noise factor. In a sensitive receiver, tube and circuit noise assume greatest importance in the r.f. amplifier and mixer stages. Noise is generated in a tube because the electron current flow is not a continuous fluid but composed of a large number of separate, individual electron particles. At any one instant, more electrons are impinging on the plate than at some other moment. Over any time interval, the current is steady, but instantaneously it fluctuates quite rapidly. These instantaneous fluctuations represent the noise component. In a resistor (or other conductor) there is a random motion of electrons which also results in noise voltages. Both together are generally around 15 microvolts or less. This seemingly minute voltage is important at the front end of the receiver because the incoming signal strength may not be much greater. Hence, the tube generating the least amount of noise is desirable and the triode, in this respect is 3 to 5 times better than a pentode. However, triodes have a marked tendency to oscillate. Neutralization is not desirable because it requires the addition of several components and can, at times, be critical in adjustment.

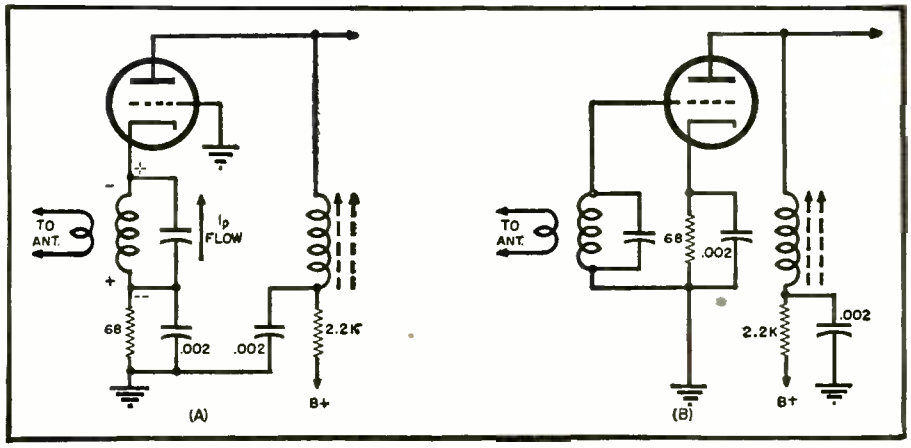
Recently, an arrangement known as the grounded-grid amplifier has permitted the use of triode r.f. amplifiers with good results. The grounded-grid amplifier is contrasted with the conventional amplifier in Fig. 1. Note that the grid of the tube is at r.f. ground potential and that the signal is fed to the cathode. The tube still functions as an amplifier because the flow of plate current is controlled by the grid-to-cathode potential. Instead of varying the grid potential and maintaing the cathode fixed, the grid is fixed and the cathode potential is varied. The net result is still the same. In addition, the grid, being grounded, acts as a shield between the input and output circuits, thereby preventing the feedback of energy which is so essential to the development of oscillations.

The grounded-grid amplifier also offers low input impedance, enabling the amplifier to match the antenna transmission line impedance. The low impedance provides a broader bandpass characteristic which is particularly essential to 6 mc. television signals.

A disadvantage of a grounded-grid amplifier is the inherent degeneration which is present in the circuit. When the input signal drives the cathode increasingly negative, the effect is the same as though the cathode had remained fixed and the grid was made positive.

The plate current flow increases, producing a larger current flow through the cathode circuit. A larger voltage drop is developed across the circuit in the cathode leg with a polarity as shown by the dotted lines in Fig. 1A. The result, therefore, is to produce a voltage drop which opposes the driving voltage of the signal and this opposition reduces the effect of the signal. This is detrimental to the reception of lower than normal signals. -30-

Fig. 1. A comparison between the grounded-grid (A) and conventional r.f. amplifier (B).



1 Watertight metal box
1 Pittman d.c. motor (or equivalent)
1 100 tooth, 48 pitch, single thread bronze worm gear with worm to match (Boston Gear G-1023)
1 30 tooth, 48 pitch, single thread bronze worm gear with worm to match (Boston Gear G-1019)
2 Microswitches
No attempt was made to control the boom or vane gear as applied to this type of boat.

Parts list for rudder control mechanism.

lay chatter at the 600 c.p.s. superregenerative quench frequency, and is quite normal. Turn the transmitter on, and vary C_2 of the receiver until the plate current takes a radical dip. Tune for minimum plate current. Repeat for the other receiver, using the other transmitter channel. It is always a good idea to walk the transmitter off 25 or 50 feet and run through a few operations before actually putting the ship in the water.

Now, just a few words about controlling the boat. In "coming about," apply full rudder until the limit switch stops the rudder in a full rudder position. The boat then heads up into the wind. Then, just as the wind carries the mainsheet boom across, use opposite rudder control to bring the rudder amidships again. After a few hours' operation the "feel" of the control will allow the operator to time his control operations nearly perfectly. However, it has been found convenient to put on some sort of rudder position indicator. This consists of some easily seen mass hung on a six inch arm to move along with the rudder. Experimentally, we used first a wad of white cotton, and then a small chromium plated vane. A ping pong ball would be ideal. With the boat under sail on a specified course, the operator will quickly recognize his greatest fault—that of over-controlling. Very short pulses of control time then suffice to keep the boat headed on course.

Variations

A considerable saving in weight is possible by the use of the new mercuric oxide batteries which should be available in quantity very soon. Also by increasing R_3, R_1 to 50,000 ohms, the smaller size 67½ volt "B" battery can replace the larger 45 volt size. Prospective builders of this equipment should also look into the possibility of using the new ultra-small and rechargeable wet cells. Also some small electric motors by *Pittman* are made for 6 volt operation.

The possibility of using two channels at once should not be overlooked. Referring to the receiver circuit diagram, (Fig. 2) it will be seen that if both receivers are operating at once, the motor circuit will not be energized. Thus, if a third sensitive relay be placed in the "B+" line, and it is adjusted to open at 1.5 ma. or less, this relay will operate *only* when both receivers are signalled, but not when either one alone is. Thus, this third relay affords a third control operation through the use of only two

0930; letter was signed by Fu Hwa Hau, director of the Chinese Army Radio Service; QRA is Radio Station XMPA, Chinese Army Radio Service, 10 Snake Mountain, Hanchungmen, Nanking, China. This station is heard with fair signals some early mornings in East.

XLRA, Hankow, China, operating on 11.500 at 1800-1920, 2330-0100, 0500-1030, has news at 0900 (relayed from XGOY), and signs off with National Anthem. Will verify all *correct* reports; QRA is Hankow Broadcasting Station, No. 168 Sheng-Li Street, Hankow, China. (Kary, Pa.)

Hanoi, 11.910, French Indo-China, is heard in Australia at 0645 with news in French and Chinese, then music. (Sanderson)

Oy. Yleisradio Ab., Helsinki, Finland, informs me that they "are just building up a new transmitter which may be one among the strongest of the world." It is presumed this will be a 100-kw. outlet.

Radio Monte Carlo, 6.13, Monaco, has been heard in New York with good level at 0130 opening; fair to poor at 0330 sign-off. (Beck)

The Director of Transmissions of Indo-China, Hotel Des Postes, Saigon, French Indo-China, has informed Major, Western Australia, that *Radio France, Hanoi,* 1 kw., 6.048, operates 1700-1930, 2230-0015, 0400-0830; *Radio Cambodge,* Pnom Penh, 1 kw., 6.035, operated 1800-1915, 2300-0015, 0500-0700. Stated *Radio France* ceased operation on its 9.520 channel in September and that *early this year would be on 6.190.*

CHNX, 6.130, Halifax, Nova Scotia (Canada) has been off the air for repairs but by this time should be back on regular schedule, listed by the station 0700-0015 (sign-on Sundays is 0900); if officials meant "local" time, then this schedule would be 1 hour *ahead* of EST.

Munich, Germany, relays programs from the United States over Munich I, 6.100, 1415-1700; Munich III, 6.170, 1300-1400; Munich II, 7.290, 1115-1700, and Munich IV, 9.540, 1115-1700 (all beamed on East Europe).

KRHO, Honolulu, is now using 11.890 to relay programs from the United States at 0230-0345 (carries United Nations programs beamed to China). The 9.650 channel is beamed to Philippines and South East Asia, 0400-1005.

"Voice of America relaying from Manila" is scheduled on 15.330 at 0230-0345 (except Mondays), beamed to India and Pakistan with United Nations programs; on 11.890 is beamed to Far East at 0400-1005.

ZQP, Lusaka, Northern Rhodesia, is scheduled on 9.710, 7.220, 3.914, weekdays 1000-1200; Sundays 0400-0530, 1030-1130; uses some *English;* has had very good signals this winter on 9.710 in California. (Dilg) I have heard this station here in East only once—on a Sunday at 1030 opening, very weak and with bad CWQRM; faded out within 15 minutes.

—30—

Model Sailboat
(Continued from page 41)

danger of getting outside of it. Incidentally, the usual FCC regulations hold in this type of service; a licensed radio amateur *must* be present during operation.

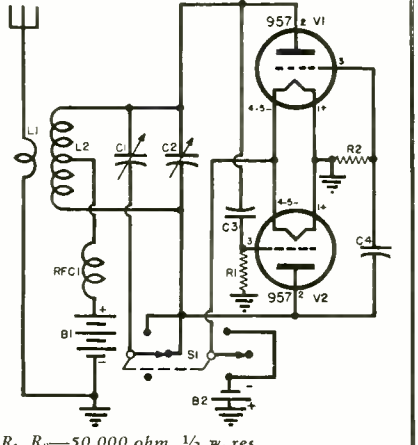
Operation

Receiving antennas are formed from an insulated portion of the mainmast stays. The total length of the receiver antennas should be 46" from the small rods coming up from each receiver through the hatch cover. *Fahnestock* clips may be used to connect the antennas to the rods.

The sensitive relays will probably need some adjustment. The back contact should be set originally for about .025" clearance between the relay armature and the winding core face. Then adjust the fore contact clearance for about .003" or the thickness of a piece of paper when the relay is open. Then, with the receiver in operation, vary the adjusting spring tension so that the fore contact closes at 1.4 ma. The plate current of the receiver may be conveniently varied for this test by means of the plate resistors, R_1, R_2. If the relay drops out at less than 1 ma. plate current, the relay contacts are set too wide. Optimum adjustment of the relay will yield a pull-in current of 1.4 ma., and a drop-out current of 1.1-1.2 ma.

After the preliminary adjustment of the relays, the plate current on each receiver should be set for 1.5 ma. (3 ma. total "B" battery drain). With no signal, a slight ragged-sounding audio note of about 600 c.p.s. will be heard from each relay. This is re-

Fig. 8. Schematic diagram of transmitter—a simple push-pull oscillator.



R_1, R_2—50,000 ohm, ½ w. res.
C_1—15 μμfd. air trimmer
C_2—35 μμfd. air trimmer
C_3, C_4—5 μμfd. ceramicon
L_1—1½ t. (otherwise same as L_2)
L_2—6 t. #14 copper wire, c.t., 7/16" i.d., spaced wire diam.
RFC_1—46" length, #36 d.s.c. wire wound on 1 megohm, ½ w. res.
B_1—Two midget 67½ volt "B" batteries
B_2—Two 1½ volt flashlight cells in parallel
S_1—2-pole, 3-pos. rotary sw.
V_1, V_2—957 tube

that country; still relays important Spanish broadcasts of interest, such as international matches and the like. Frequencies available are 7.080 and 14.278, although the 14.278 outlet has not been reported as having been heard; schedule given as 0800-1100, 1400-1700."

Recently, Cairo has been using SUP3, 19.765, instead of the usual 20.136 channel to New York. A recent "good three-way deal" one morning was logged while WQV, New York, was receiving pictures from GLU, 19.045, actually being relayed from Bombay, India, via London; the originating station, VW6A, in Bombay, 17.950, was picked up with very low level, but readable. PJY-19 is a new Curacao point-to-point outlet on 19.455, used to New York. (Arthur, W. Va.)

An ISW monitor in Seattle, Washington, reports that recently at night (PST), he heard a station on about 9.600 announcing as WVTM, "an all-Navy net," at Clark Field, Manila, Philippines; he says he understands this station was being reopened after having been closed for repairs during the war. (Has anyone else heard this one?—K.R.B.)

CR6RB, Radio Club de Benguela, Angola, signs on at 1230, off at 1400 on 9.165; CR6RF, 7.084, is in parallel. A station heard on approximately 9.230, in Portuguese, announces as "Radio Clube da Huilla," heard around 1300-1330; Huilla is in southern Angola, about 100 miles inland on the railway line from the port of Moasamedes. (Laubscher, South Africa)

I have received vague reports that "Radio Malaya," Singapore, is using 6.120 for relays of the (*English*) Home Service prior to 0600.

A *new* German point-to-point outlet, DFA7, Frankfurt, 7.460, is reported by Arthur, West Virginia; heard working WQM, poor level; apparently is alternate for DFA, 15.550.

Radio Martinique verified promptly via airmail from Boite Postale 136, Fort-de-France, Martinique. (Southall, Pa.)

Rabat, French Morocco, 16.666, is excellent level (in French) in Newfoundland at 0745-0815. (Peddle)

Jack Carter, Washington state, received a verie card printed on a filing card, from WLKS, Kure, Japan, station of the British Forces of Occupation; bore a Royal Crown in blue over "WLKS" in red letters and with operating data on each side of call letters; gave schedule 0630-2230 (presumably Japanese time, or 1630-0830 EST); power was listed 1 kw., frequency as 6.105.

XMPA, The Military Radio Service Station of the Chinese National Defense Department in China, at Nanking, 12.220, recently wrote Kary, Pa., that the station uses 1000 watts and a transmitter manufactured by the Central Radio Company of China, erected in Chungking and moved to Nanking three years later; gave frequency as 12.220 (24.50 m.) and a schedule of 1800-1900, 2300-0100, 0430-

is not known; may be an Underground outlet.

A station has been heard on approximately 12.1 to around 2115 with a woman speaking in what appears to be Chinese. (Foerster, Illinois) Kary, Pa., reported a Chinese-speaking station on 12.1 some time ago, early evenings (EST). (Does anyone have additional information on this station? —K.R.B.)

Bob Park, Vancouver, reports a mysterious European again—heard on Wednesday night, on 6.345, tuned in at 0245 on a special test transmission using frequent announcements in five languages (including *English,* French, and Spanish); could not get the call or location, due to weak signal and QRN. This may be HEI2 on 6.345, Park comments; was requesting reports from listeners and used excellent (Oxford) *English.* (Could this be the *Radio Venetzia Julia* station reported by Peddle, Newfoundland? —K.R.B.)

A Swedish monitor reports a Chinese-speaking station on approximately 9.640, heard to sign-off at 1000; call may possibly be XGBN, he says.

* * *

Last Minute Tips

Be on the lookout for s.w. outlets from Pakistan—due to open this summer. The Pakistan short wave station will likely be 100 kw. in strength.

SHF-1X, aboard the Swedish oceanographic ship, "Albattros," has been heard in Melbourne, Australia, on 28.450 during the evenings (in Australia), from around Hawaii. (Hutchins, Radio Australia)

Pearce, England, sends us this data about *"Radio Africa,"* 1 kw.; "was used by Spain during her occupation of Tangier as an official Spanish outlet, having been originally set up by

AMERICAN AIRLINES SEEKING RADIOMEN

AMERICAN Airlines' newly opened school for would-be aviation radiomen is now accepting applications from servicemen under thirty-five years of age who have had at least two years' experience in operating a radio service shop, have worked for an established radio dealer for that period, or have had Signal Corps experience approximating one and a half years of actual service.

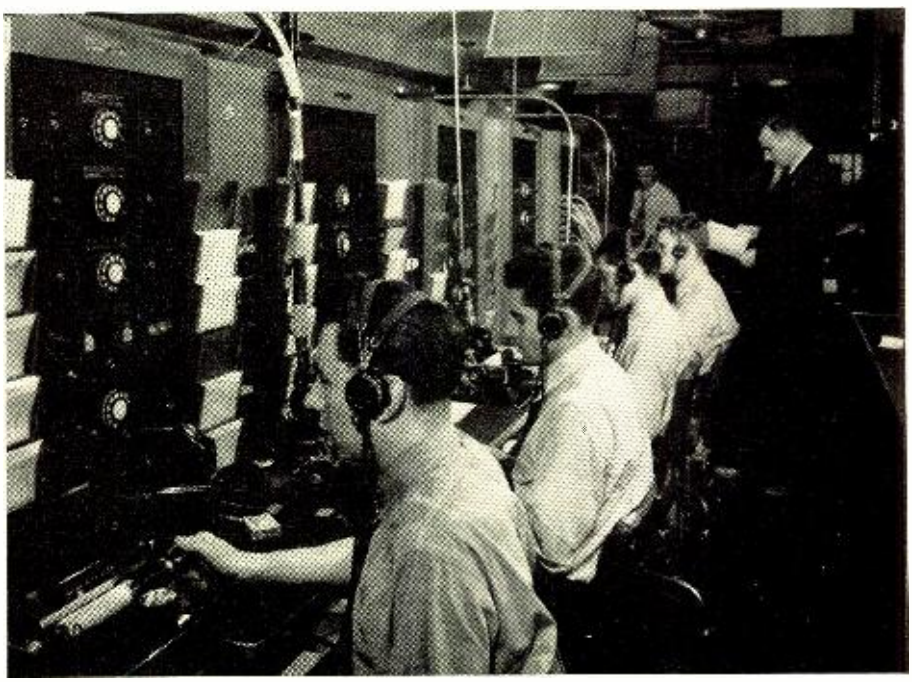
The school, which is located in Newark, New Jersey, will handle thirty-five men at a time with classes starting every three months. The company plans to be able to absorb from seventy to one-hundred such trainees yearly in their own aviation radio program.

A six months' course of instruction will include radar, facsimile, aircraft video, radio beacon and tower installation, and domestic as well as "Clippership" and overseas aircraft radio installations. Courses will cover both practical and theoretical principles in equal proportions.

Classes will run from 8 a.m. to 6 p.m. daily and room and board will be furnished in addition to a salary of $120.00 per month during the training period. Those passing the course with satisfactory ratings will be assigned to duty as radio operators aboard aircraft, as airfield radio employees, etc. After such placement, radiomen will be placed on regular assignments at specified salaries.

Inquiries about the new training program should be addressed to N. V. Gates, Director, American Airlines Radio School, Newark, New Jersey. The company is particularly interested in servicemen who are seeking employment overseas. Class members are not required to agree to work for American as a prerequisite for admission although it is assumed that the majority of the students will accept employment with the company. —30—

One of American Airlines' training classes for aviation radiomen.



a verie from "Hunan Damas" in 47 days, report was sent in French with IRC; QRA is Republique Syrienne, Direction Generale des Postes, Telegraphes et Telephones, Damas (Damascus), Syria (Syrie).

Tangiers—Radio International verified with nice folder-type card; listed power as 1 kw.; uses 10 kw. on 1238 kcs.; schedule is 0800-1100, 1400-1900; frequency is 6.200; QRA is 34, Goya St., Tangier, International Zone, Morocco. (Kary, Pa.)

Trinidad—VP4RD, Port-of-Spain, some time ago was using 6.080 (may be as high as 6.085) at 1700-2200; badly QRM'd. Has not been reported on 49 meters more recently—so may be using 9.625 again (evenings) as it does mornings. (Stark)

U. S. S. R.—Komsomolsk, 9.565, is heard in New York 1600-1730 in Chinese; the Home Service is heard there after 1945 on 15.30 and 11.875, after 2200 on 11.89, after 2300 on 11.74, 9.54, 7.30, 6.14, and 6.02 (Kiev) (Beck)

Gillett, Australia, says Moscow's 6.18 outlet is heard in *English* to 0730, fair signal; also on 6.090, signing off at 0945, to return again at 1000.

A powerful new Soviet outlet is reported on 6.090 at 1000 in Persian, and at 1100 in Arabic. (Radio Australia)

Moss, Canada, reports that "despite many reports that Russian stations sign off with the 'Internationale,' this is not the case; the 'Internationale' was abandoned completely by the Soviets as of March 13, 1944, in favor of the new anthem, 'Republic of the Free'; it is with this new anthem that Soviet stations now leave the air."

Vatican—HVJ was heard recently on a *new* frequency of 7.670 with a special broadcast. (Beck, N. Y.) The 9.66 outlet is heard in Philadelphia with fair signal at 1315 with news. (Southall) The 15.095 channel is very good level in 1000 news.

Venezuela—YV5RY, Caracas, has moved to 4.725 from 3.380; YV2RM, 3.550, San Cristobal, is a *new* station heard evenings to 2130 sign-off; YV6RH, 3.450, Barcelona, is heard evenings to 2130 also.

Yemen—Radio Australia's North African correspondent reports a station on 7.385 in this small kingdom of Southern Arabia, just north of Aden; transmitter is at capital city of Sanaa; is heard in North Africa with programs in Arabic; closes down around 1215 after a newscast which begins at 1200; according to announcements, begins at 0830—but must have an irregular schedule since it has been heard signing on much *later* than 0830; *may be off Fridays.*

Yugoslavia—Radio Belgrade, 6.100, has news 1530 daily. (Pearce, England)

Unidentified—Kary, Pa., reports a station on 10.615, woman heard briefly in French at 1345, then station faded out; presumably is Madagascar which is scheduled to 1400 sign-off. Peddle, Newfoundland, reports *Radio Venetzia Julia* on approximately 6.43; location

2345-0130 transmission. (Balbi) BBC news is scheduled for 0100. Normal operating times of the SABC network, according to latest schedules received direct via airmail from Johannesburg, are weekdays 2345-0130, 0315-0710, 0900-1605; Sundays 0055-0115, 0400-1605.

ZRB, Pretoria, the South African Air Force Station, is now using 6.210 in parallel with 9.110; former is to cover "skip" about 300 miles from Pretoria; has been heard irregularly so may not be on regular schedule with this channel yet; normal schedule on 9.110 is around 0030-1100 (may be off Sat. and Sun.); has weather report about every two hours, and fills in gaps with recorded programs and relays from SABC; the 7.445 outlet has not been reported lately but may be used in summer. Announces, "This is Radio ZRB, the S. A. Air Force station, located near Pretoria"; sometimes gives location as Waterkloof Aerodrome. (Laubscher, South Africa)

Spain—Kenneth M. Dobeson, England, of La Sociedad Espanola de Radiodifusion, informs me that future developments in Spanish radio include four 100 kw. short-wave transmitters now being built in Spain. Further details will be sent as available. He lists these schedules for present Spanish s.w. outlets:

Radio Nacional de Espana, 9.369, Madrid, 1300 French, 1330 German; 1350 Italian; 1405 Portuguese; 1420 Russian; 1500 *English;* 1530 Arabic; 1545 Spanish; 1600 closedown; 1845-2200 in Spanish to Latin America (news in Spanish 1915, 2100). Radio Falange de Alicante, 7.940, 1.2 kw., 0700-0900, 1400-1800. Radio Tenerife, Canary Islands, EAJ-43, 7.558, 0700-0900, 1230-1800. Radio SEU, Madrid, EBV-10, 7.190, 1 kw., 0930-1300, 1500-1830. Radio Falange de Oviedo, F.E.T.-22, 7.130, 250 w., 0730-0900, 1345-1830. Radio Falange de Cordoba, F.E.T.-15, 7.042, 200 w., 1400-1600. Radio Mediterraneo de Valencia, 7.035, 100 w., 0700-1000, 1400-1830. Radio Nacional de Espana, Malaga, EAJ-9, 7.024, 200 w., 0830-1000, 1500-1900. Radio Nacional-Sindicalista de Valladolid, F.E.T.-1, 7.006, 0730-0900, 1500-1800. Radio Nacional de Espana, Cuenca, EAJ-7, 6.318, 200 w., 0800-1000, 1400-1900. Radio Tetuan, Spanish Morocco, 6.067, 0230-0300, 0830-1000, 1330-1800 (uses Spanish, Arabic, French). Mr. Dobeson explains that at various times news bulletins and special programs are relayed by some or all Spanish s.w. outlets with the announcement, "Radio Nacional de Espana, Madrid," giving a misleading impression; main times are 0830-0845 and 1545-1600 when news in Spanish is rebroadcast by all Spanish stations on the air at those times, and at 1800-1810 by all "Radio Nacional de Espana" outlets on medium-waves and by Cuenca and Malaga on short-wave.

Surinam—PZC (or PZX5), approximately 15.402, Paramaribo, has replaced PZR, 10.970; relays Dutch news from PCJ (Hilversum, Holland) at 1830-1845. (Balbi)

Sweden—Foerster, Illinois, reports that Sweden is to have two of its medium-wave transmitters (Gotenborg and Sundsvall) reconstructed, and that a new short-wave transmitter (probably Horby) is expected to be put in use some time this year.

Switzerland—Berne has been using 11.815 (good signal) to North America for transmissions beginning at 1730 and 2030, respectively; in latter period, 9.535 and 6.165 have been in parallel, all closing down at 2230.

Syria—Radio Damascus, 12.000, is heard in England signing at 1100, fades out before closedown; still all native except occasional Western recordings. (Pearce) Closedown is probably 1500. Block, Belgium, received

When James Caesar Petrillo permitted himself to be televised without protest during hearings before the House Labor Committee, he violated one of his own edicts. Petrillo has laid down a flat ban against any member of his union appearing on television. He is shown at right with television camera lens trained on him.

Forces Broadcasting Service, Jerusalem, stated they were closing down in January; however, this will bear checking as this station has been reported as still operating more recently.

Panama—George Williams, Panama City, long associated with broadcasting on the Isthmus, has informed Kary, Pa., that he has purchased a new transmitter in Colon for HP5J, soon to operate on 9.690; no further details were given.

Philippines—Schedules for the Commonwealth outlets are—KZRH, 9.640, Manila, 1700-1100; KZPI, 9.505, KZOK, 9.695, both Manila, 1630-1105 (according to latest schedules, KZOK is no longer an "all-nighter"); KZFM, temporarily using 11.900, Manila, reported at 1630-1830 and 0400-1105 (may not be complete schedule); "Voice of America," lately moved to 11.89 from 11.84, Manila, takes relays from the U. S. (in *English,* Korean, Chinese, Indonesian, Dutch, French, Annamese, Siamese) at 0400-1005; KZRC, 6.140, Cebu, 0400-1100; KZBU, 6.100, Cebu, *new,* 250 w., 0400-1105. KZRC is operated by owners of KZRH; KZBU is operated by the KZPI-KZOK company.

Poland—Warsaw seems to have settled down on about 6.215; news 1350-1610 (will be one hour *earlier* in summer).

Portuguese Guinea—Radio Bissau has been heard widely this winter with powerful signals in Eastern U. S. on measured 7.948; schedule appears to be 1628-1731; on with Portuguese guitar music, off with "Heroes do Mar," the Portuguese National Anthem; announces slogan of "Aqui Bissau, Estacion de ondas curtas, Emissora Regional," but also at times says "Emissora dos Reynes." Recently gave calls (in *English*) to Kary, Pa., said was operating in the 42-meter band; then in Portuguese gave call of CQM-4. Announcement of 42 meters would mean the 6.993 outlet, but a check of that frequency revealed nothing. Lists do not show Bissau on 7.948 but Berne lists do give CQM-4 on 3.973; thus, the 7.948 frequency may be a harmonic; Kary says it is definitely *not* an image. Bissau was reported some time ago by Peddle, Newfoundland, as heard on about the same schedule around 8.159 to 8.170.

Rumania—Bucharest, 9.25, has news daily 1215. (Pearce, England)

Siam—According to Malayan sources, Bangkok programs include 0500-0630 on 5.994, news 0515, 0615, talk (in *English* also) at 0545; 0700-0920 on 6.130 and 825 kcs., Home Service in Siamese; 0500-0645 on 4.754, 7.025, and 1000 kcs., Home Service in Siamese; stations on 5.994, 6.130, 825 kcs. are operated by the Siamese Publicity Dept., while those on 4.754, 7.025, 1000 kcs. are operated by the Posts and Telegraphs Dept.; callsign on 825 kcs. is HSPJ; call on 5.994 is HSPP; call for the 6.130 outlet is believed to be HS8PJ; other calls are not known. (Hutchins, Radio Australia)

South Africa—Cape Town is again using 5.877, replacing 9.608, in the

Madagascar—*Radio Tananarive* is heard during last half-hour of the transmission closing at 1400 on 6.065 and 10.615; former outlet best; French news from 1345 to closedown. (Peddle, Newfoundland)

Malaya—The British Far Eastern Broadcasting Service, Singapore, is now using 11.770 instead of 11.735. (URDXC) The frequency has been measured 11.766.5. (Kary, Pa.)

Current schedules for programs of BFEBS are—Orange Network, 11.77, 6.77, 0030-0130, 0300-0430, 0530-1200 (at 0430-0530 these frequencies carry the Purple Network); Purple Network, 15.300, 21.720, 0030-0130; 15.300, 0300-1200; 21.720, 0300-0530; 9.690, 0530-1200. (Cushen, N. Z.) BFEBS is anxious for reports on reception of the *new* 21.720 outlet. (Pearce, England)

Kuala Lumpur is noted on *new* frequency of 6.050; heard in native to 0800, announces "Radio Malaya, Kuala Lumpur," and then takes *English* programs. (Cushen, N. Z.) Frequency may be as high as 6.055. (Balbi, Calif.)

Mozambique—Lourenco Marques has same Portuguese language program on 9.650 and about 4.825 at 1330; *English* programs are still carried on 4.925. (Gillett, Australia) The 4.825 outlet is heard in England daily from around 1300 with Portuguese programs; CR7BJ, 9.645, is heard there daily with good signal to 1500 sign-off; on Thursdays runs to 1530 with messages in Portuguese for Portugal and Angola; may be off Sundays. (Pearce)

New Zealand—By this time regular transmissions should have been started by the New Zealand-Broadcasting Service; frequencies most likely to be used are 9.54, 11.78, 15.28 (which were used in tests during early winter). James Shelley, director, has informed me that "we are pleased to receive IRC's if DX-ers are writing in asking for verification." Reports on tests were most gratifying, he adds. QRA is New Zealand-Broadcasting Service, 36, The Terrace, Wellington, C. 1, New Zealand.

Nicaragua—YNDG, Leon, has been using *English* occasionally during programs recently; frequency seems to have shifted to about 7.651, signs off around 2200. (Arthur, W. Va.)

Norway—Oslo's outlet (LLG) on 9.61 is definitely beamed to North America daily 2000-2100; still asks for reports to Norwegian State Broadcasting, Oslo Studio, Oslo, Norway. Announces in Norwegian and *English*. (Kary, Pa.) The 6.195 outlet (in parallel) is just readable in West Virginia, through bad QRM. (Arthur)

The Norwegian outlets on 6.185 and 9.540 now have increased power to 100 kw. (Holmberg, Sweden) The 9.610 outlet is heard with such good level in Eastern U. S. that some DX-ers believe it is also now 100 kw.

Friis, Denmark, reports Oslo is now on 11.855 (probably 11.850) at 0600-0730. (Kary, Pa.)

Palestine—Cushen, N. Z., reports

International Short-Wave

(*Continued from page* 156)

daily. (Radio Australia) (Has anyone in the U. S. picked up the 1730-1930 radiation?—K.R.B.)

Korea—The Korean Broadcasting System frequency has been measured at 7.933; is still heard well in East to 0830 sign-off; probably runs from around 0530; 2.510 may be in parallel. Cushen, New Zealand, reports XLKA at Seoul has replaced JODK on 2.510, heard 0400-0845, good signal. Reports on callsigns the new Korean stations are using are conflicting, some give "X," some "H," and still others "J" as the initial letter.

The Korean outlet on 4.400 has a good signal in Vancouver, British Columbia, 0300-1030 or 1100. (Park)

Lebanon—Radio Beirut is now on (measured) 8.017 from 8.033. (UREXC) Appears to have altered schedules; *English* programs now end at 1100, has Arabic programs to 1515, then French to 1630 (*new* sign-off); leaves the air with a French march (*not* "La Marseillaise," as formerly). (Pearce, England) Is audible some days in East near close-down, but through heavy QRM.

Libya—Sanderson, Australia, has received word from the Forces' Broadcasting Station, Benghazi, Cyrenica, M.E.L.F., that its tests on 11.850 had to be discontinued for the present, but that it hopes to be on the air soon with a regular schedule; when testing was *actually* on 11.820 although announced 11.850; watch for this one around 0500-0615, 0900-1100, 1300-1600, 1815-2100 (which were times reported testing).

Luxembourg—Announced schedule of *Radio Luxembourg* is 0600-0800, 15.350; 1130-1800, 6.090, according to Swedish sources. However, is heard in Eastern U. S. as late as 0830 when it either leaves the air or fades out, best 0700-0800. (Kary, Southall, Pa.)

(*Continued on page* 170)

The particular chassis shown is a pre-punched used receiver chassis. Layout and construction may be changed to suit the individual cabinet, chassis, and parts available without affecting the operation of this unit. The main consideration in this change would be for short and isolated grid leads to the amplifier and "eye" tubes to prevent induced hum in the amplifier.

—30—

HIGH FREQUENCY RECEPTION IN STRONG NOISE FIELDS

By I. M. BICKFORD

ONE of the poorest short-wave locations that can be envisioned is that area known as midtown Manhattan. Tall buildings with their partial shielding effect on radio impulses and the constant interference caused by ignition systems on cars are bad enough. The worst offender, however, is noise generated locally in the building in which radio signals are being received. If this building happens to be a newspaper office where the peak of activity is reached in the early evening hours and continues until around 4 a.m., the chances of getting consistent copy from any but the most powerful of signals is remote.

To operate a radio circuit from a city location it is usually necessary to "pipe" the signals in from a remote receiving station via leased telephone lines, and that is what is done by all commercial communication central offices.

However, there are many conditions which render the use of piped-in signals either too costly, or due to the variations in frequency at the point of origin, particularly in the case of expeditions using old type equipment with no crystal control, it is desirable or necessary to have the operator copy with one hand on the tuning dial.

This type of "slug-it-out" radio reception is now almost a thing of the past, but the high noise level in city buildings still prevents clear commercial reception by recorder tape machine, which would otherwise be possible if the locally generated noise could be eliminated, or at least cut down substantially. (Diversity reception notwithstanding.)

After many years of such "slug-it-out" reception on the third floor of one of the above-mentioned midtown Manhattan buildings, this writer, after many fruitless experiments in an endeavor to decrease the noise, finally hit the jackpot in getting clear signals through the "hell-hash," with the result that the transmission lines to the doublets atop the building no longer had a complete or partial antenna effect, and the doublets became directional again, instead of acting like electronic umbrellas, with everything electrical pelting them.

The reasoning behind this experiment was this: The chief source of noise pick-up in the receiver (locally generated noise in the building, that is) occurred in the ground or cathode side of the receiver proper. This included the power lines feeding the tubes, and even the metal shielding of the receiver itself, all such elements, of course, being in an intense field of noise in the building (elevator clicks, electrical presses, and their associated electrical equipment).

The centertap on the receiver's input coil meant nothing. The r.f. choking of the power leads had little effect, even when tuned against the received frequency. The noise still poured in. Static shielding between the input coils was ineffective.

The conclusion was reached that since the cathode side, including the set's shielding, was acting as an antenna, with the transmission line to the doublet as its counterpoise, that in order to neutralize the transmission line as a counterpoise, an "artificial" centertap would have to be placed external to the receiver, and out of capacity relation to the set's shield.

Such an "artificial centertap" was made by using two surge resistors (Fig. 1) in each side of the transmission line in close proximity to the receiver's input terminals. One of these resistors (non-inductive) was fixed, and of about 300 ohms while the other resistor was variable, and was adjusted so that the reflections in one side of the line matched and balanced those in the other side of the transmission line.

It was found that two variable condensers, one in each transmission wire, would also function, but that they were more susceptible to external pick-up.

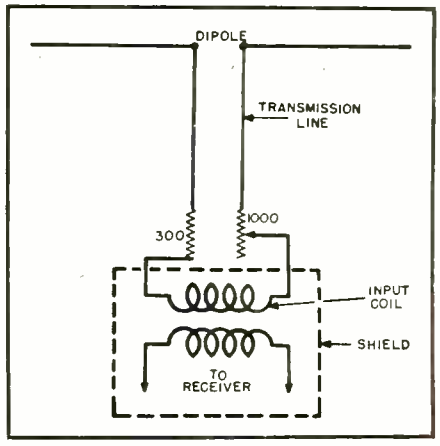
When suitable adjustment was made on the variable resistor a critical point was reached where the noise disappeared, the local noise that is, leaving only the static and other noise picked up by the dipole itself, such as ignition noises, signs, etc. But the continuous "mush" and roar had disappeared and the signals uncovered were surprising.

Tape recording was made of signals which previously had to be untangled by ear reception at great effort. Since this experiment was made during the war, it uncovered for monitoring, many useful interceptions.

For the variable resistor, a 1000 ohm graphite unit was used, as it was easily available and the balance point at its low end was not over critical. Each separate antenna requires its own individual balance, but the balance remains the same for all frequencies being received.

—30—

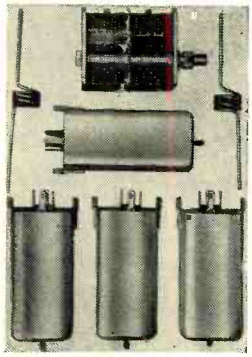
Fig. 1.



TELEVISION KIT BUILDER
WRITE FOR SENSATIONAL
Offer of RCA Television Parts

CATHODE RAY TUBE, No. 7EP4	$18.95
CATHODE RAY TUBE, No. 7DP4	19.50
FOLDED DIPOLE ANTENNA, list price $14.50	7.25
COAXIAL CABLE, 72 ohms, per 100 feet	6.95
COAXIAL CABLE, 72 ohms, per 500 feet	32.10
TWIN LEAD-IN WIRE, 300 ohms, per 100 feet	1.95
TWIN LEAD-IN WIRE, 300 ohms, per 1000 feet	17.50
VIEWTONE POWER TRANSFORMER	11.75
ELECTROLYTIC CONDENSER, .05—3000 V.	.69

FM TUNER OR FM RADIO



FM Condenser & Coil Kit—(88 to 108 Mc)

- Variable Condenser
- Discriminator Coil
- Oscillator Coil
- Two I.F. Coils
- Limiter Coil
- Antenna Coil
- Schematic Diagram
- Instructions

$4.95

This kit contains the vital parts needed to build an FM Tuner or Radio and for modernizing Pre-War FM Sets; all other parts needed are standard.

RADIO TUBES
KNOWN BRANDS—BULK

	Each
80, 5U4G, 5Y3GT, 5Y4GT	$ .42
35W4, 25Z6GT, 35Z5	.45
6J5, 6SA7, 6SK7, 6SQ7	.49
12AT6, 12BA6, 12BE6, 12SQ7	.49
12SA7, 12SK7, 12SH7, 12SR7	.49
6H6, 6J7, 6K7, 6Q7, 6SN7	.55
43, 6A7, 6A8, 6V6, 25L6	.65
0Z4, 6X5, 7A8, 7B7, 7N7	.65
1A5, 1A7GT, 1H5GT, 1N5GT	.74
1S4, 1R5, 1S5, 1T4, 3Q4, 3Q5	.79
14A7, 14Q7, 14B6, 1LN5	.95
6AC7, 6L6G, 25A6G, 35Y4	.95
1LA6, 70L7GT, 117L7GT, 117N7GT1	.35

CONDENSERS

	Per Hundred
100—Assorted, .001 to .02	$3.95
100—.001—600 V.	3.95
100—.002—600 V.	3.95
100—.006—600 V.	4.40
100—.01 —600 V.	4.40
100—.05 —600 V.	4.95
100—.1 —600 V.	7.20

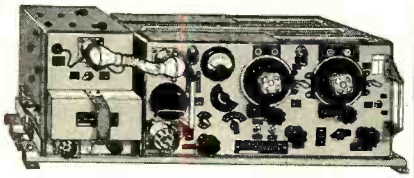
ELECTROLYTICS

	Each
16 —150 V.	$ .24
20 —150 V.	.26
20-20—150 V.	.29
30 —150 V.	.32
50 —150 V.	.35
8 —450 V.	.27
10 —450 V.	.32
16 —450 V.	.36
16-16—450 V.	.59
20 —450 V.	.39
30 —450 V.	.47
40 —450 V.	.54

G.I. AUTOMATIC RECORD CHANGER	$13.50
WEBSTER NO. 50, AUTOMATIC RECORD CHANGER	22.75
WEBSTER NO. 56, AUTOMATIC RECORD CHANGER	26.50
BROOKS INVERTER, 50 Watts, 110 Volts, D.C. to A.C.	8.95
ELECTRIC SOLDERING IRON, 60 Watts, list price $2.95	1.59
ELECTRIC SOLDERING IRON, 100 Watts, list price $3.85	2.37
ELECTRIC SOLDERING IRON, 150 Watts, list price $5.95	3.57
SELENIUM RECTIFIER, 100 ma.	.95
CRYSTAL CARTRIDGE, Astatic L-70	1.55
CRYSTAL CARTRIDGE, Astatic L-72	1.65
CRYSTAL CARTRIDGE, Astatic L-75	1.25
VOLUME CONTROLS, ½, 1 or 2 meg. with switches	.39
OUTPUT TRANSFORMER, match 50L6	.39
A.C.-D.C. Choke	.39
TOGGLE SWITCH, SPST	.15
TOGGLE SWITCH, DPST	.25
TOGGLE SWITCH, DPDT	.40
AUTO RADIO VIBRATOR, 4 prong, non synchronous	1.19
AUTO WHIP ANTENNA, 2 post, 3 section	2.25
I.F. COIL, 456KC	.39
OSCILLATOR COIL, 456KC	.19
VARIABLE CONDENSER, 420/162 mmfd	.68
VARIABLE CONDENSER, FM (88 to 108 mc)	.75
RESISTANCE CORDS, 135, 150, 180, 200, 235, 290 ohms	.49
RADIO CHASSIS, punched for 6 tubes or less	.19
LOOP ANTENNAS, oval, assorted sizes	.39
ELECTRIC PHONOGRAPH MOTOR, complete with 9" turntable	2.95
4" PM SPEAKER, ALNICO No. 5 magnet	1.19
5" PM SPEAKER, ALNICO No. 5 magnet	1.39
LINE CORD, 6 feet	.14
CRYSTAL PICK-UP ARM, includes all hardware	1.95
COMPLETE INTER-COMM. SYSTEM (3 tubes) master & station	17.97
100—ASSORTED KNOBS, screw and push on types	4.95
100—ASSORTED SOCKETS	4.95
100—ASSORTED PILOT LIGHTS	4.95
100—ASSORTED RESISTORS	1.50

BROOKS RADIO DISTR. CORP., 80 VESEY ST., DEPT. B, NEW YORK 7, N. Y.

SPRING SPECIALS



SCOOP: The famous B 19; Mark II; 40 & 80' meter transmitter-receiver with tubes; dynamotor power supply instruction manual. 12 ft. ant. and base. V.H.F. antenna and base, dummy ant., mounts. 1 headset, microphone, key, junction boxes and interconnecting cables. N-1.....$29.95

B-19 MARK II complete tank installation with all spares. Packed for export. Instruction manual, etc. N-1 .....$44.95

Headset & Microphone used with Mark II. N-1. $1.95.

SCR522 SPECIALS
Two meter transmitter-receiver with tubes. U-1. $17.95; U-2. $14.95.
Dynamotor — SCR522. N-1 $3.95; Plugs for SCR522 N-1, $4.00 per set.
BC602 Control Box. N-1.....$1.00

BC1206-C SETCHELL CARLSON BEACON RECEIVER 28 volts D.C. 195-420 KC. 5 tubes, N-1 .....$4.95

BC733D Aircraft Glidepath Receiver N-1...$19.95 (Approved by C.A.A.)

T-17 MIKE N-1. $1.95; **TS-13 Handsets** U-1.$2.50

APS-15 3CM Radar Transmitter complete with Magnet, magnetron Kylstron and other tubes. Used $14.95

BC464 TARGET RECEIVER and selector for 5 channel remote control with battery container and ant. 68-73 MC. N-1.....$14.95

SCR284A, 3800-5800 kc.—Complete set, N-1.$69.50
PE104A 6-12 volt vibrapack, N-1 $5.95; U-1 $4.95
GN45A Handcrank Generator and stand. N-1.$4.95
BC357J Beacon Receiver, 75 MC. tubes N-1.$3.45
GENERAL ELECTRIC BATTERY CHARGER: Tungar 6RB6B17. 12 battery, 12 amp.; 24 battery, 6 amp. N-1 .....$67.50
TRANSFORMER 600-0-600 @ 300 MA 17 V @ 1 amp. N-1 .....$5.95

SCOOP: MN26 RADIO COMPASS RECEIVER with tubes 150-1500 KC U-1.....$18.95
U-2 .....$14.95

SIGNAL BOX KITE, Postpaid, N-1.....$2.50
TRIMM commercial 17,000 ohm headset, N-1.$4.25
HS-23 8,000 ohm headset N-1 $1.29; U-2.....89c
HS-33 600 ohm headset NEW.....$1.50
CODE: N-1 New
U-N Used, like new
U-1, Used, excellent condition
U-2 Used, minor scratches
U-3 Used

EE-8 TELEPHONE field sets with handset and ringer N-1. $15.00 ea., $28.00 pr.; U-2 $10.00 ea., $18.00 pr.; U-3 $7.00 ea., $13.00 pr.

TUBE SPECIALS

5PB1	$1.15	5BP4	$2.50
3AP1	2.25	4E27	6.00
872A	1.75	304TL	1.75
2X2	.75	EF50	.90
316	.90	9002	.75
726	4.95	211	1.00
75TL	2.50	717-A	.69

GIBSON GIRL SCR578B transmitter for sending distress signals from boats. Trans., complete with balloon, hydrogen gen., kite and inst. manuals. N-1 .....$25.00

EXTENSION CORDS, PL55 plug incl. N-1..$ .40
HS-30 Ear plug headset N-1. $ .95; U-1.....$ .50
MATCHING TRANSFORMER, HS-30.....$ .50
115 V.A.C., ¼ h.p. motor with 250 V 600 MA amplidyne generator. N-1. .....$24.50
200FD Johnson var. cond. dual N-1.....$1.19

APN-1 ALTIMETER INDICATOR — basic movement 0-1 m.a. 5 m.a. shunt 270° scale. An excellent basic G.E. movement for constructing your own meters. N-1.....$1.95
METER RECTIFIER, full wave midget Selenium, 10 volts, 30 MA. N-1.....$ .29

A.C.-D.C. BUZZER, N-1 .....$ .89
PL-55 PLUG, N-1 $ .29; 4 for.....$1.00
AN-160 ANTENNA, N-1. 2,000-6,000 KC; 9 insulators and jumpers 100 ft. long.....$1.00
.01-300 V. mica Cap.—Ideal by-pass cond. N-1.

PHOTOCON SALES
1062 N. Allen Avenue PASADENA 7, CALIF.

$ .25; 7 for $1.00; per 100.....$6.00
SCR-274 Remote tuning head, 3 crank $1.50. 2 crank $1.00
AS-89/ART Ant. System, N-1.....$2.95

PE-103A DYNAMOTOR N-1 .....$9.95
CD-501A CABLE for PE-103A-BC654A N-1 .....$1.95
LS-7 SPEAKER, N-1 .....$4.95
Frame for mobile mounting BC654A-PE-103A $4.95
ANTENNA, 8 sec, 24 ft. for BC654A. Base N-1 .....$7.95

TRANSTAT 10 amp. 0-135 V. panel mtg. N-1 .....$29.50
INTERPHONE AMPLIFIER BC709. Ideal for aircraft, booster for telephones, etc. 1 tube, batt operated, N-1 .....$5.00
TSC-9 COLLINS TRANSMITTER/RECVR. 110 V. A.C. Power Supply, Cables U-1.....$109.00
THROAT MIKE $ .50; **HAND KEY**, N-1. $ .50; U-1 .....$ .25

BC-348 MNTG. BASE Postpaid.....$2.50
BC-348 OUTLET PLUG Postpaid.....80
BC-348 MNTG. BASE & OUTLET PLUG 3.00

LIONEL SPEED KEY, N-1.....$5.95

Crank for 274-N Receivers.....$ .60

SOUND POWERED chest set. N-1. $3.95 ea.; pair $7.50
SOUND POWERED HANDSET, TS-10, N-1. $15.00 ea.; per pair.....$25.00
PHOTOFLASH CAPACITOR, 23 mfd., 2000 V; N-1 .....$10.00
FL-8 Range Filter. $1.95; With cord and plugs $2.50
ANTENNA knife switch, S.P.D.T. $1.00; Ant. knife switch, D.P.D.T. $2.00
SOLA CONSTANT voltage Transformer, 80 V.A., 60 cycle, 115 V.A.C. $13.50

APN-4 CATHODE RAY INDICATOR, TUBES N-1 .....$24.50
APN-4 Receiver, tubes N-1.....$17.50

PEERLESS A-4233Q Line matching transformer 50/125/200/250/500 ohms, N-1 .....$1.50

TERMS: F.O.F. Pasadena unless postpaid. No C.O.D.'s under $5.00. 25% deposit on ALL orders. All C.O.D.'s shipped by Rail Express. Send full price with order and we will ship by fast truck, transportation collect. Minimum order $2.00. Californians include 2½ sales tax.

Test Instrument

(*Continued from page 55*)

another hi-gain voltage amplifier stage is added. To the extreme right of the panel is the external speaker jack. A 6½" internal speaker is connected by a closed circuit jack to the amplifier output until an external speaker is plugged in. The external jack is used for testing speakers as well as for connecting a larger speaker to the amplifier for p.a. work. The tone control is located just to the left of the speaker jack.

The 6E5 electron-ray indicator tube, visible at the upper right of center of Fig. 1, is the visual indicator of the strength of the signal made audible by the loudspeaker. It is more than this, however, since by its switch S_1 (located to the upper left of center) it may be shifted to indicate input voltage from the signal tracer probe or output voltage from the tracer amplifier. The first and third positions of the switch provide this visible voltage indication without having the signal go through the final amplifier. This is necessary since some signals measured would be so strong for a given setting of the gain control that the audible signal would blast the speaker out of its cabinet. Position #2 applies plate voltage to the inverter stage making the amplifier operative for audible as well as visual indications. The input potentiometer R_1 is intentionally provided with a linear curve rather than the usual logarithmic audio volume control curve. Thus, the user, knowing that the 6E5 electron-ray tube shadow will fully close when 3.5 volts of d.c. is applied to its grid, is potentially provided with a d.c. voltmeter. The potentiometer scale is graduated 0 to 10. A calibration curve may be made of d.c. volts versus gain figures so the approximate voltage may be read at setting of the control. Used as a d.c. voltmeter the input resistance is that of R_1 shunted by R_2 or 333,000 to 500,000 ohms. Exactly the same process may be used to estimate a.c. voltage to quite good accuracy, but using the crystal diode to rectify the a.c. so it will properly actuate the 6E5. The input resistance will approximate 500,000 ohms on a.c. Again it is no great problem to prepare a calibration curve for the particular diode probe by applying differing a.c. voltages to it from a potentiometer connected across a 60 cycle a.c. line (instead of a d.c. voltage source as for d.c. calibration) and so determine the values of a.c. voltage necessary to just close the "eye" at the 10 successive "gain" knob settings.

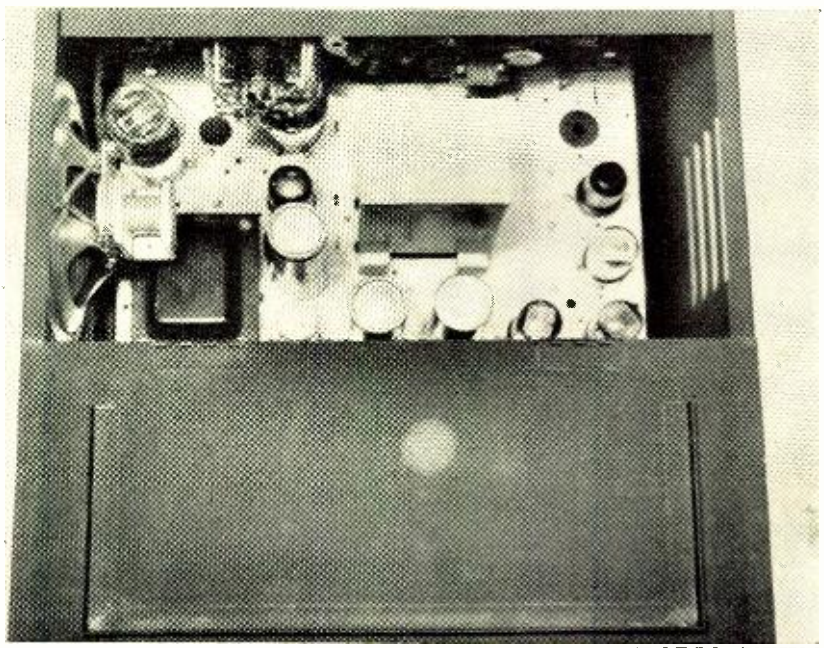
This voltmeter will determine presence or absence of a.c. and d.c. operating voltages, as well as to trace signals in equipment being tested. The d.c. plate, screen, cathode, and grid voltages and polarity can be observed using it as a d.c. voltmeter.

The a.v.c., a.f.c. and other d.c. control voltages, as well as a.c. operating voltages in power, as well as signal circuits may be observed using it as an a.c. voltmeter.

The signal tracer probe shown in Fig. 1 consists of a radar type fixed crystal diode detector 1N34 with condenser C_{12} and anti-loading series input resistor R_{2s}. This is all housed in a ⅜ inch diameter bakelite tube, 6 inches long. A 3 foot, shielded flexible cable extending from this prod is provided with a shielded phone plug for insertion in the amplifier input jack. With this insulated probe, any r.f., i.f. and a.f. signal source points may be easily reached in any operating receiver or amplifier.

Fig. 3 illustrates the general parts layout and simplicity of construction.

Fig. 3. Top view of completed home-built servicing test instrument.



should talk clearly and intelligently about terminology that has now entered the public domain. If we let ourselves get confused, can we wonder that the public becomes confused?

Another point for the industry is to emphasize improvement in such basic factors in fidelity as the microphone, the phonograph pickup, the amplifier, and the loudspeaker. One way to raise standards of performance is to adopt realistic methods of testing audio equipment. One glaring shortcoming in our testing methods is in connection with amplifiers. While the key importance of the amplifier is recognized as a factor in high fidelity, methods of testing amplifiers are woefully inadequate.

The single frequency distortion test is now supplemented by the dual signal test and the intermodulation distortion is measured with the amplifier feeding its power into a fixed resistance load. Yet, none of these test methods comprehends intermodulation distortion with the wide variations in load impedance due to the loudspeaker and its environment. Harmonic generation, transient distortion, and intermodulation distortion rise rapidly as a mismatch occurs between the voice coil of the loudspeaker and the plates of the tubes. In addition, a severe fatigue problem develops unless the reproduction of transients is clean and no loudspeaker hangover effects are noticed.

A voice coil in motion, as is well known, reflects a very complex impedance to the amplifier. If amplifiers generally were tested while connected with a loudspeaker, we would have a more realistic appraisal of amplifier performance.

—30—

PARTS SHOW CONFAB

WAYS and means of conducting the annual Radio Parts and Electronic Equipment Conference and Show in the best interests of all groups and organizations within the industry was the subject of discussion at a recent meeting attended by leading trade press editors and publishers meeting with the Show Committee.

Charles Golenpaul, Show Corporation president, presided at the first industry press conference which was attended by Oliver Read, RADIO NEWS; S. R. Cowan, Radio Service Dealer; Nancy Mainpaugh, Radio & Electronic Jobber News; Milton B. Sleeper, FM & Television; Paul S. Weil, Communications; Sidney Gernsback, Radio Craft; Alex H. Kolbe and Nat Boolhack, Radio & Appliance Journal; Stuart J. Osten, Boland & Boyce; Mal Parks, Parts Jobber; Frank D. Thompson, Electrical Equipment; Wallace D. Morris, Radio & Television Weekly; and Rose Buss Koragren, Electronic News and TV. The Show Corporation was represented by Charles Golenpaul, Show president; Jerome J. Kahn, vice-president; William O. Schoning, treasurer; Kenneth C. Prince, general manager and general counsel; L. B. Calamaras, NEDA executive secretary; and S. I. Neiman, Show public relations counsel. —30—

Just keep in mind two things; (1) the banker is very anxious to be your partner in the development of your business for the simple reason that that is the business out of which he pays his living expenses just as yours is the business with which you pay yours. The other point is equally important, that is, (2) no business can develop without proper banking connections. The advice and personal and financial assistance that is available through your banker is the cheapest thing you can buy, providing you build your credit in a businesslike manner, use it intelligently, and treat it fairly; it will pay you dividends!

—30—

High Fidelity

(*Continued from page* 43)

Under these circumstances, the reproduction system must take the blame. Tone quality—the product of a perfect balance of vibrations between the fundamental and its harmonics or overtones of a note—must have been disturbed by additional tones generated or induced by the amplifier-speaker system, upsetting the perfect balance achieved at the point of origin.

The preference for a boom bass tone, or the so-called "juke-box bass," stems in part from the public's tendency to turn down their tone control knobs to eliminate the higher frequency sounds, which have been distorted by faulty amplification. Peculiarities in tone quality are most noticeable in wider range systems as this is where distortion has run riot on so many sets in recent years.

Popular writers are damning the public's taste by very glibly referring to listener preference tests, which indicate 5000 cycle reproduction to be much more popular, even among musicians, than 10,000 cycle reproduction. So-called experts have tossed around the findings of the *Chinn and Eisenberg* study with an amazing lack of understanding of basic audio principles. Our popular sound experts would do well to brush up a little on fundamentals and also to look at the conclusions reached by *Dr. Harry F. Olson,* who in tests with a "live" orchestra, found "it is entirely evident that users prefer full frequency range when dealing with a system with no distortion."

This significant conclusion underscores this suggestion: If we are going to furnish the public wide frequency range, let us also provide high fidelity. Then the public will hear what is really being originated. If the public then does not like the tone quality, the pressure of opinion will be felt by the performing artists and the various groups employing sound reproducing systems, such as the broadcasting industry, record manufacturers, and the motion picture industry.

In the electronic industry and the audio engineering profession, we

LEEDS
The Home of RADIO

In Our 25th Year

Quality -- Price -- Dependability

CS—DIFFERENTIAL RELAY

Dual coil with armature pivoted between calls. All contacts normally open. Operates 220-250 Volts. 8000 Ohms each coil, contacts S.P.D.T. Controls rated 2 amps. at 110 VAC. Ideally suited for balanced or bridge type circuits where limited current or power is available. Will withstand 12 G Vibration up to 60 cycles at 35000 feet altitude.

Special low price..... **95c**

POWER TRANSFORMER

655-0-655 volts @ 320 mil. 110 volt AC primary. Thordarson power transformer, fully shielded. Net weight approx. 17 lbs.
Special **$4.95**

FILAMENT TRANSFORMERS

6.3 volts @ 6 amps. A swell buy..... **$1.50**
10 volts @ 8 amps. 7500V Insulation..... **3.84**

OIL FILLED CONDENSERS

1 Mfd.	600 VDC	$0.35
2 Mfd.	600 VDC	.35
10 Mfd.	600 VDC	.98
2 Mfd.	1000 VDC	.69
7 Mfd.	330 VAC	1.25
0.1 Mfd.	7500 VDC	1.50
2x.1 Mfd.	7000 VDC	2.00
.02 Mfd.	8000 VDC	.98
SPECIAL—16 Mfd.	400 VDC W.E.	.98
1 Mfd.	5000 VDC Solar	2.95

MICA CONDENSERS

.01—600V Postage Stamp — **Each 5c**
.01-.3—2000V Postage Stamp
.006—600V Postage Stamp — **100 for $4.75**

DYNAMOTOR 5047

D.C. input 27.0 volts at 1.75 amps.
D.C. output 285 volts at .075 amps.
Continuous Duty Rating. Brand New. **95c** each

5 BPI CATHODE RAY TUBES

5" Green Screen. Brand New in original cartons. You'll want a few at this low price **$1.45**
832 Tubes. Brand New Guaranteed. Special **$2.15**

STEEL CHASSIS

10 x 17 x 3	$1.38	11 x 17 x 3	$1.86
5 x 10 x 3	.87	13 x 17 x 3	2.22
7 x 13 x 2	.96	7 x 7 x 2	.63
10 x 14 x 3	1.35	4 x 17 x 3	.99

STEEL CANS AND BOXES

4 x 4 x 2	$0.68	12 x 7 x 6	$1.68
4 x 5 x 3	.78	15 x 9 x 7	2.35
6 x 6 x 6	.99	11 x 12 x 8	2.25

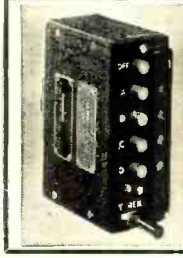
1/8 INCH STEEL PANELS

5¼ x 19	$0.87	10½ x 19	$1.22
7 x 19	.96	12¼ x 19	1.46
8¾ x 19	1.10	14 x 19	1.62

1/8 INCH ALUMINUM PANELS

5¼ x 19	$1.74	8¾ x 19	$2.25
7 x 19	1.84	10¼ x 19	2.87

All above Black Crackle finish. Grey panels to order.



ATTENTION ! ! !

All SCR-522 Owners:

Remote Control Boxes for SCR 522's, Brand New in Original Packing; Consists of 5 push button switches, 5 Western Electric Pilot Assemblies, with Pilot Bulbs and Dimmer, and lever Switch all finished in Black Crackle. Order yours today for only each **$1.25**

Antenna Plug 46-PS-1 for 522A ..... Each **15c**

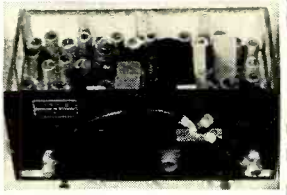
Wire Wound Potentiometer

100,000 ohm. precision made G.R. type, 25 watt, 6" diameter. Brand new. **$1.95**

Heineman Circuit Breakers 3 & 5 amp. sizes.... **95c**

RADIO TRANSMITTER & RECEIVER APS 13

Tunes 410/420 megacycles: light weight airborne Radar. 17 tubes, including 5/6J6: 9/6AG5: 2/D21: 1/VR105 and 30 megacycle I.F. strip with schematic. All for **$11.95**



ITEMS YOU MAY BE LOOKING FOR

In 23A X-Tal Diodes 35c each, 3 for **$1.00**
Mike to Grid Ouncer Transformer 25:1 Ratio Low to High Imp. 35c each, 10 for..... **$2.95**
Arc-5 Silver Plated Banana Plugs per doz. **10c**
De Jur Wire Wound Pot 20,000 Ohm. 12 watts.. **49c**
Meissner Shielded 2.5 MA RF Choke..... **19c**
RS-8 Octal Sockets low loss Bakelite..... **8c**
1/100 amp. instrument fuses 8AG size per 12... **50c**

DM-43A DYNAMOTOR

Manufactured by G.E. New, input 24v @ 23 amps. 7500 RPM; output 515/1030/2/8 v. @ 215/260 milliamps; filtered. SPECIAL **$2.95**

METERS

0-1 Ma DC 2" Round Metal Case Gruen **$1.95**

RESISTORS

100 watt—Ferrule Type—25,000, 30,000, 40,000, 50,000, 100,000 ohms ..... Each **25c**

FULL WAVE BRIDGE RECTIFIERS

Type B: Up to 144 VAC in, up to 96 VDC out @ 1.2 amp. Signal Corps. #9D0612B **$2.50**

Type A: Up to 54 VAC in, up to 39 VDC out @ 1.2 amps. Signal Corps. #4D0238 ..... **$1.50**

If not rated 25% with order, balance C.O.D. All prices F.O.B. our warehouse New York. No order under $2.00. We ship to any part of the globe.

LEEDS RADIO CO.

Dept. RN4
75 VESEY STREET
COrtlandt 7-2612 New York City 7

Why Leading Electronic Engineers Use ADC TRANSFORMERS For Unusual Applications

ADC engineers interpret and build transformers to fit your specific requirements:

- Frequency response
- Input and output impedances
- Power requirements
- Vacuum tubes to be used
- Mounting or casing requirements
- Operating conditions

When you need special transformer designs, send us your specifications. ADC has thousands of special transformer designs on file.

Transformer Engineering—ADC engineers design special transformers for leading electronics manufacturers. Write us your specifications when special transformer design is needed.

SEND FOR FREE CATALOG TODAY
Have the **ADC** catalog in your reference file.

PROMPT DELIVERY FROM STOCK OF ALL CATALOG ITEMS

AUDIO DEVELOPMENT

Audio Development Co.

2833-13th Avenue So., Minneapolis, Minn.

Audio Develops the Finest

experience against the banker's loans without any equity. You cannot expect too much consideration on a deal of this kind because the woods are also full of bankers who are no longer in the banking business, who have been willing to furnish your capital needs as well as your financing needs—all of them.

Once you have secured your basic capital funds, it is necessary that you husband those resources. There is only one way to properly take care of your assets to intelligently keep yourself in constant position to answer the necessary questions precedent to bank financing, and that is to keep an intelligent set of books—records that tell you what you are doing, promptly and in one syllable words. The importance of accounting in any business and especially in a service business cannot be overestimated. It is so important that many automobile manufacturers furnish a complete set of bookkeeping forms for their dealers and will go so far as to cancel dealerships of those who refuse to keep books in accordance with their specified formulas.

This cannot be overemphasized because your business will not progress and your merchandise cannot be properly served or properly valued unless you know, month by month, what it costs you to do business and whether you are making money or losing money, and whether your original investment is appreciating or depreciating. If I were to make a suggestion which is gratuitous and, as such, not particularly acceptable, I would suggest that your association adopt a standard accounting system so far as possible and make it available to those members of yours who are not sufficiently experienced or equipped with personnel to select and set up their own bookkeeping system.

To get back to our original premise as to how to build your credit, how to use your credit and how to treat your credit, I think that if you will ask the above questions of yourself about your own business, the way to build your credit will answer itself.

You should use your credit only for essential and sound purposes. The use of credit is so important that I can safely say that the soundness of a loan is based to an unusual degree on the soundness of the purpose for which the loan is made. Your short term credit should be used only for short periods for purposes such as building up a receivable, the liquidation of which will pay the loan at maturity. For instance, it is sound from a business sense to purchase merchandise with borrowed money in September and October which will be sold during the Christmas season, so that the bank can be paid off and your profit can be pocketed by the year end. Such credit should not be used for the purpose of capital requirements and long term investments.

Long term credit should be used for the purpose of equipment purchases and installation of other facilities which will improve your operation or expand your ability to do business. These funds should never be borrowed for a short term, but should be repaid over a longer period, and instead of being payable in 90 to 120 days, should be liquidated monthly while you are presumably profiting by the use of the increased facility.

There is a third use for bank credit, and that is in connection with the sale of consumer goods on the installment plan. This is really not a credit to you but is a credit to your customers and enables you to increase your sales. In this instance, you should make your connection with a bank which is experienced in the business of consumer credit to be sure that you are selling to the proper people and to insure that your customers will be handled with the proper courtesy and at proper cost to them.

You should make your selection of a banker early. You should let him handle your checking account and use whatever facilities of the bank, such as savings, safe deposit boxes, etc., that you need. This gives your banker a chance to become acquainted with you and enables him to give you much better service should your need for borrowing arise.

This last point comes under the heading of how to treat your credit. You can't expect to walk in cold to a banker who has never seen you before and ask him to determine in a few minutes whether you are a good credit risk. People are funny that way, but time and again I have seen folks come in at noon of the final day to pay their taxes and become quite disturbed because the banker who never saw them before was unable to approve their loan for the payment of those taxes in order to save them the penalty, within the next 15 or 20 minutes. In this case, the banks never heard of you before, although you knew at least a year before that you would have to pay those taxes, and you must have known at least a couple of days before that you would not have the money with which to pay them, unless you borrowed it.

Emergencies arise in practically every business, and the time to prepare for an emergency is well in advance of the occurrence. The average bank credit should not be one of emergencies, but should be well thought out by both the borrower and the lender, so that the soundness of the venture both from the standpoint of the borrower and of the lender may be established.

One more point that is obvious but might well be made in connection with the treatment of your banking relations is to keep your commitments to your banker. Of course, there will be times when what you plan does not occur. However, when that happens, see him in advance, tell him your story and give him a chance to worry with you about the liquidation of your account. If he knows what's going on, he can worry much more intelligently, and there is nothing so comforting as to have someone else help you worry.

Money—How to Get It

(*Continued from page 42*)

Will you pay?—Based on the information he has asked of you under question (1), he will determine your chances of staying in business. This is important in determining whether you will stay in business long enough to pay him back. He will try to determine whether you pay your bills promptly or not, what your personal reputation is outside of your business, and from that determine whether your intentions are honest or not. You will note from the questions so far that some of the questions which your banker asks you, which seem silly and irrelevant, are all couched with the intention of giving him a composite picture of you as a business man.

Can he make you pay?—This question sounds pretty harsh, and you are thinking that no banker should lend you money if he has to look forward to forcing repayment. You are absolutely correct in this thought, and no good banker would lend money under such circumstances. However, don't forget that he is lending you funds entrusted to him, and he must ask himself whether you are ultimately collectible, if conditions arise over which you or he has no control, which interfere with your repayment. In answering this question, he looks at your investment in your business, the soundness of your assets, the condition and quality of your equipment, and he looks at the soundness and satisfaction of your customers. (You will note, parenthetically, that all three of these questions are based substantially on what your customers and your suppliers think of you. The importance of public relations to a service business cannot be over-emphasized, but that is another subject.)

It goes without saying that a banker cannot be too enthusiastic about lending you money unless you have some cash in your business invested in substantial assets. The woods are full of people who are anxious to match their

(*Continued on page 162*)

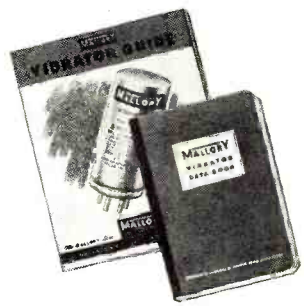
MALLORY VIBRATORS
start like the proverbial bat

Mallory Vibrator contact materials are specially alloyed to resist oxidation. The design of the contact arms and their carefully controlled timing provide self-cleaning contacts. That's why you can count on Mallory Vibrators for sure starting.

The precision with which related parts are balanced assures accurate output and dependable service over a long life.

These are some of the reasons why more Mallory Vibrators are used for original equipment than all other makes combined. These same reasons make Mallory the best replacement line for you to handle.

In addition to assured quality, Mallory offers the most complete line in the business. Mallory standardization permits 12 basic vibrators to meet 90% of your replacement requirements. But a complete line of 52 vibrators is available to meet virtually every vibrator need.



The Mallory Replacement Vibrator Guide is free. The Vibrator Data Book is $1.00—from your distributor or by mail.

THE MALLORY "GOOD SERVICE FOR GOOD BUSINESS" PLAN

will increase business and profits in your shop.

A unique follow-up file makes it easy to keep customers.

You tie in with Mallory acceptance to develop new business—ask your distributor about it.

MORE MALLORY VIBRATORS ARE IN USE THAN ALL OTHER MAKES COMBINED

P.R. MALLORY & CO. Inc.

MALLORY

CAPACITORS . . . CONTROLS . . . VIBRATORS . . .
SWITCHES . . . RESISTORS . . . RECTIFIERS . . .
VIBRAPACK* POWER SUPPLIES . . . FILTERS

*Reg. U.S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

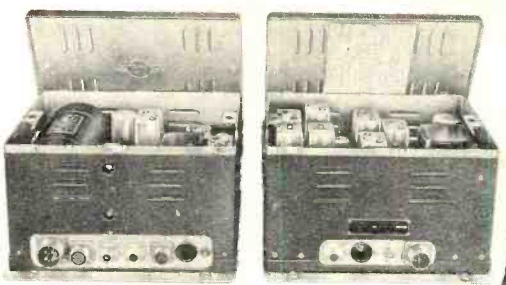
Link FM Sets . . .
Sylvania Lock-In Tubes . . .
handle emergency calls rapidly and smoothly for Morro Limousine

2-way radio permits drivers to notify central office of completion of trip.

Office can immediately advise driver of other calls in the same neighborhood.

WITH 10 of its 14 limousines equipped with 2-way Link FM, Morro Limousine Service is always ready—24 hours a day—to respond promptly to emergency calls for home-to-hospital transportation—anywhere in the entire Borough of Brooklyn. Cars are strategically located throughout the borough, to reach any point in the shortest possible time.

Since quick, *unfailing* service is the essence of Morro Limousine's business, Link Radio Corporation turns to Sylvania Lock-In Tubes to prevent communications interruptions. These tubes stay firmly in place in their sockets . . . have no soldered joints, few welded ones. Elements can't warp or weave. Connections are short and direct . . . getter located on top. Loss and leakage are reduced. See Sylvania Distributors or write Radio Tube Division, Emporium, Pa.



Transmitting and Receiving Units used by Morro Limousine Service, manufactured by Link Radio Corporation, New York.

The famous Lock-In Tube's superiority makes it the ideal choice for equipment on the road, in the air, on the rails, marine radar, FM and television.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS