RADIO NEWS

AUGUST
1947
35c

Now in a New and Up-to-Date Catalog Line

CHICAGO TRANSFORMERS and REACTORS

Sealed in Steel

For years, Chicago Transformer has met with outstanding success the varying requirements of the electronics industry for top-quality, custom-built transformers and reactors. Today, C.T. is augmenting this service to the industry with a new catalog line of units, to be manufactured on a standard design basis.

Now, small-quantity purchasers of transformers in the various fields of electronics—broadcast, communications, experimental, amateur, public address, and industrial control—can acquire for their equipment the advantages of progressive, practical C.T. engineering.

Now, large-scale manufacturers of electronic equipment who are in a position to utilize standard components can find in C.T.'s new catalog the transformer ratings and constructions that will fit their latest designs.

Characteristics of this new line are as up-to-date as tomorrow's laboratory project. Ratings have been skillfully selected, by men who know the trends in circuit design, to achieve maximum flexibility of application, close matching with today's preferred types of tubes, and conformance with RMA and FCC standards.

Modern, too, is the type of mounting used. Drawn steel cases and three variations of Chicago Transformer's famous **Sealed in Steel** construction will offer the combined advantages of "steel wall" protection against moisture and corrosion, efficient magnetic shielding, vibration-proof mechanical strength, compactness, and a streamlined appearance that spells "eye appeal" in finished equipment.

For further details, write for catalog

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Plate and Filament Supply Transformers with high voltage secondaries for both capacitor-input and reactor-input systems, and with corresponding filament supplies.

Plate Transformers for use in low to medium high power transmitters.

Filter Reactors accurately matched with the Plate and Filament Supply and Plate Transformers above.

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Bias Transformers—combination plate and filament supply.

Step-Down Transformers for operating radios and appliances on 220 volts, 50/60 cycles, in the export trade.

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Full-Frequency Range, 30 to 15,000 Cycles, provides uniform response over this entire band with ± ½ db up to 10 watts of audio power, within ± 1 db over 10 watts. Standard RMA impedances. Included are Input, Output, Driver, and Modulation Transformers; Modulation Reactors.

Public Address Range, 50 to 10,000 Cycles, frequency response within ± ½ db up to 10 watts of power, within ± 1 db over 10 watts, throughout this range. Secondary impedances match 600 and 150-ohm lines, 16, 8, and 4-ohm reproducing systems. Listed are Driver and Output Transformers.

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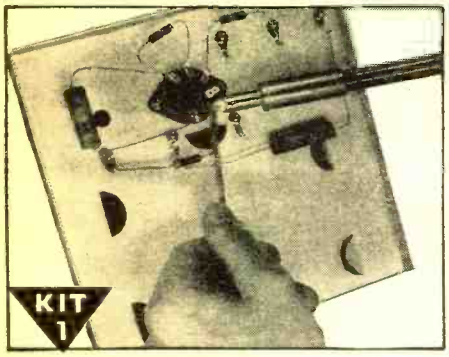

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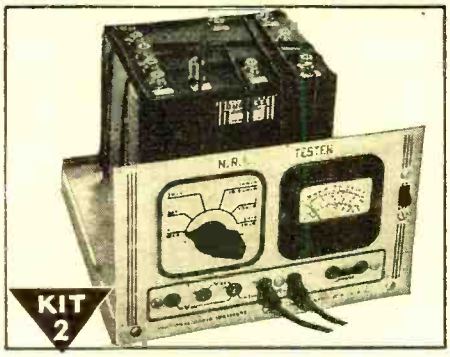
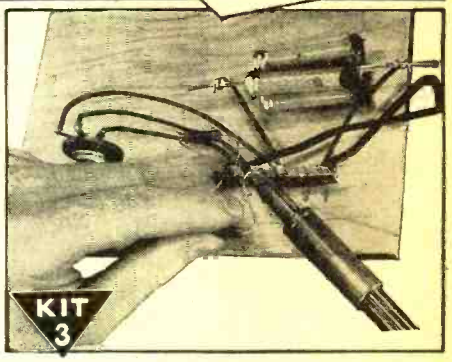
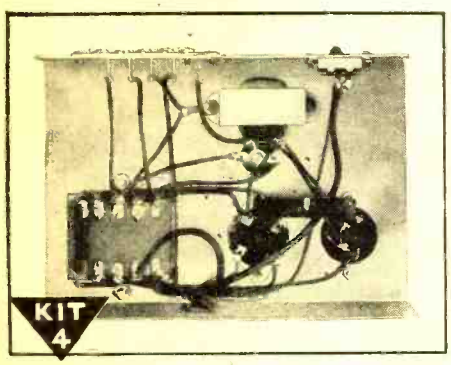


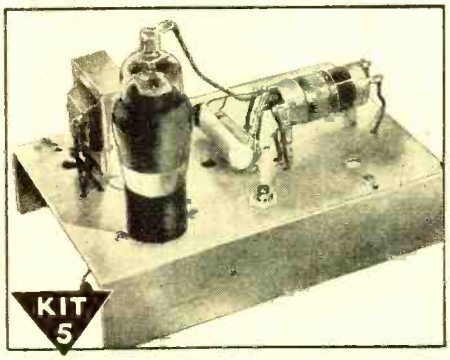
Early in my course I show you how to build this N. R. I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



You get parts to build Radio Circuits; then test them; see how they work, learn how to design special circuits; how to locate and repair circuit defects.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.

You build this Superheterodyne Receiver which brings in local and distant stations—and gives you more experience to help you win success in Radio.

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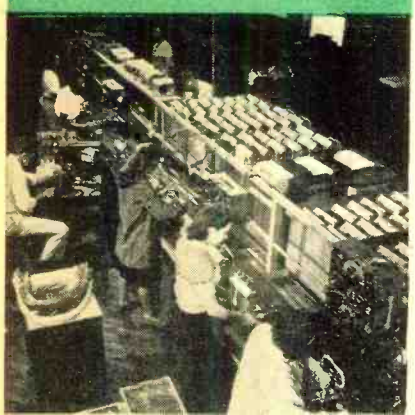

THE COVER: This Templetone Radio Mfg. Corporation assembly line is typical of the activity in radio plants throughout the country. Home receiver production has now reached an all-time high for the industry. Photo by Walter Steinhard.

RADIO NEWS

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AUGUST, 1947

FOR THE SERVICEMAN-DEALER

FOR THE AMATEUR

OF GENERAL INTEREST

DEPARTMENTS

185 North Wabash Ave., Chicago 1, Ill.
VOLUME 38 • NUMBER 2

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GREATER PERFORMANCE
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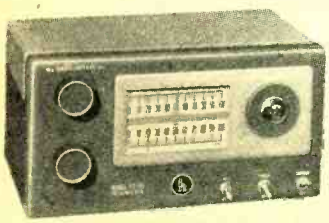

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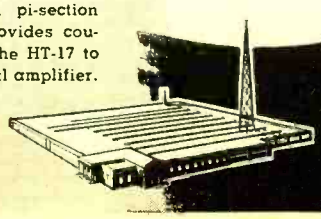

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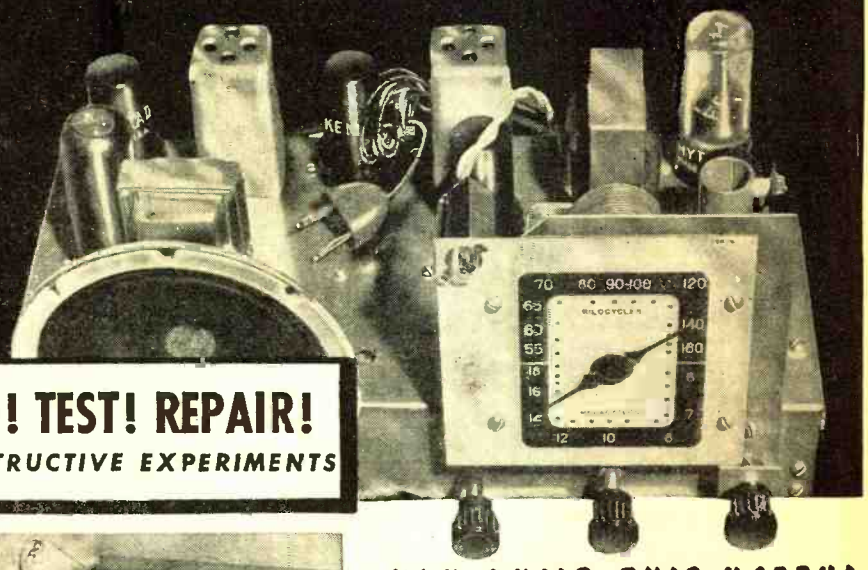

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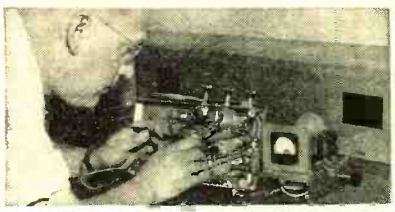

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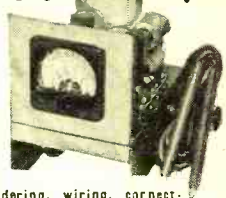

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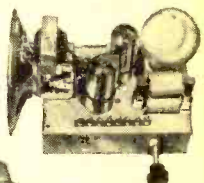

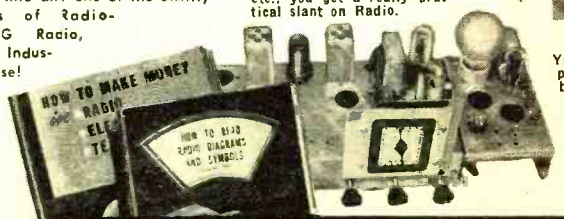

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For the RECORD

BY THE EDITOR

AS WE write this we are on our way back from a circle tour to the West Coast covering, to date, a total of 5000 miles. This trip had a twofold purpose; to contact the members of the radio industry in the various fields, and to conduct tests to determine the effectiveness of narrow-band FM for amateur mobile operation.

Prior to leaving Chicago, the car was equipped with a 28 mc. FM transmitter constructed in the RADIO NEWS lab. In order to make the signal easily readable on the average communications receiver, the total deviation was kept to a maximum of 1200 cycles either side of the center frequency. This corresponds to a deviation ratio of 0.4.

Normal practice in narrow-band FM work is to use a deviation ratio considerably greater than this, usually something over 1. While there are some advantages to a larger deviation ratio, most communications receivers are not capable of accepting a total deviation of more than 4 kc.

The power input to the transmitter was 31 watts, supplied by a surplus dynamotor, mounted in the trunk. Measured output was 22.5 watts, fed to a quarter-wave antenna.

The regular auto radio was used for reception, in conjunction with a converter. Little time was available to work on the car noise, but a series type noise limiter was added to the receiver, and a tuned filter placed in the generator lead.

Time did not permit extensive tests before leaving Chicago, and only a few locals were contacted. It was fully realized that conditions during the summer months were very poor for 28 mc. operation, however, in the West Coast cities, there is a great deal of mobile operation, and this activity is rapidly spreading to other parts of the country.

The home station was equipped with a 100 watt transmitter and the latest in receivers. A three elements fixed beam was mounted on the roof and oriented so the maximum signal was to the west.

Schedules were worked out on the basis of the predictions prepared monthly by the Bureau of Standards. The predictions did not offer much encouragement for contact with the home station, but as the 28 mc. band is not too consistent it was hoped that occasional sporadic openings would permit contact from time to time.

At the time of writing, no contacts have been made with the home station. This in itself is of no importance as no form of transmission, FM or AM, can work when conditions are not right.

Local contacts have been more than satisfactory when the operator on the receiving end tuned his receiver properly. It is surprising how many amateurs do not know how to properly tune an FM station on an AM receiver.

In the process of tuning many narrow-band FM stations, it was found that the best results were obtained by turning off the a.v.c. of the receiver and tuning slightly to the side of the carrier. If the a.v.c. is left on, the gain of the receiver tends to increase as the receiver is detuned from resonance, with the result that the signal is often lost in the resultant noise.

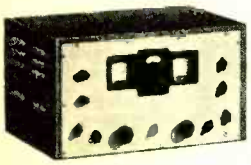
The best answer, of course, is the use of receivers specifically designed for narrow-band FM reception. None of the receivers currently available to the amateur make provision for narrow-band FM reception, although it is our understanding that at least one manufacturer has seen this need and is planning production of a receiver with this provision.

While the results so far have been inconclusive, we feel that narrow-band FM will eventually replace AM for all mobile work. The audio power required is negligible with the result that the power input may be much greater for the same battery drain. The tubes will have greater life as the modulation peaks are missing, with the possibility of running the tubes at their c.w. ratings.

Another great advantage to FM is the improvement in signal-to-noise ratio, permitting the reception of FM signals that would be unreadable on AM. Reduction in interference will also result if the deviation ratio is kept less than 1. The amount of space occupied by a signal modulated by any given audio frequency, is in direct proportion to the deviation, and if this ratio is kept to low values, it is possible for an FM signal to take up considerably less space in the spectrum than the equivalent AM station. Needless to say, this will permit the operation of many more stations in the same band.

If a receiver is used that is specifically designed for FM reception, interference from AM signals is reduced or eliminated. This feature is of particular value in mobile work where the noise level is exceedingly high. This noise, being of the amplitude type, is absent in a good FM receiver. . . . . O. R.

With a Modern Communications Receiver!



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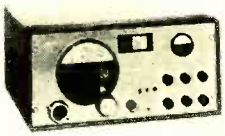

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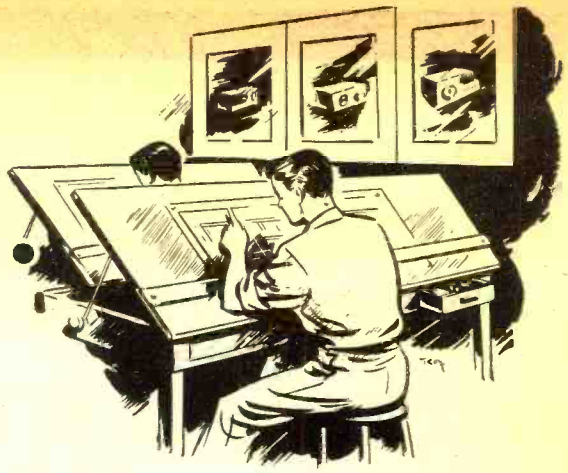

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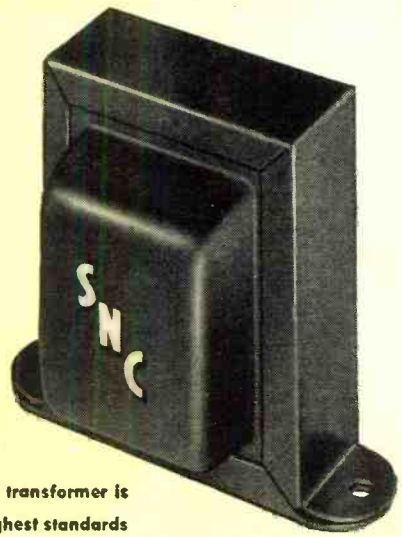

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. . . cuts "down-time" to a minimum

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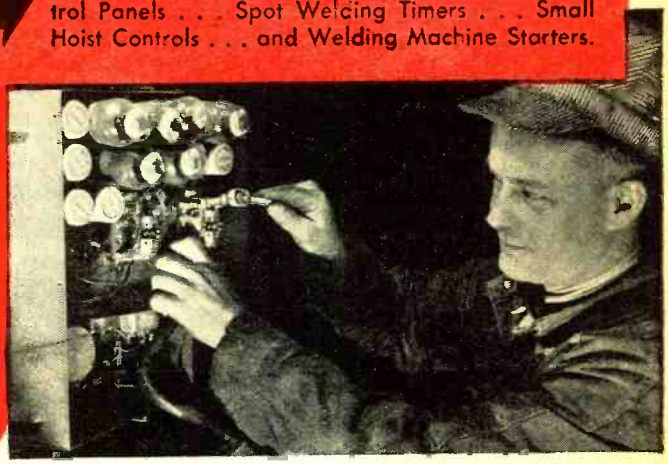
at the right time



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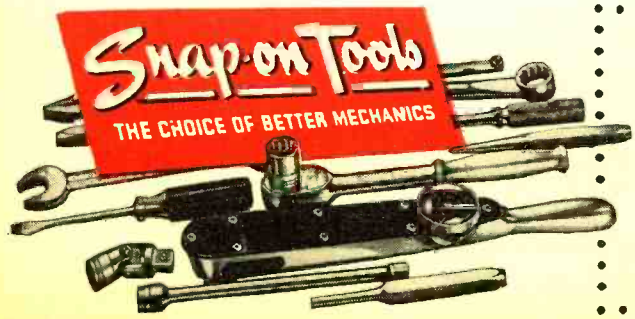

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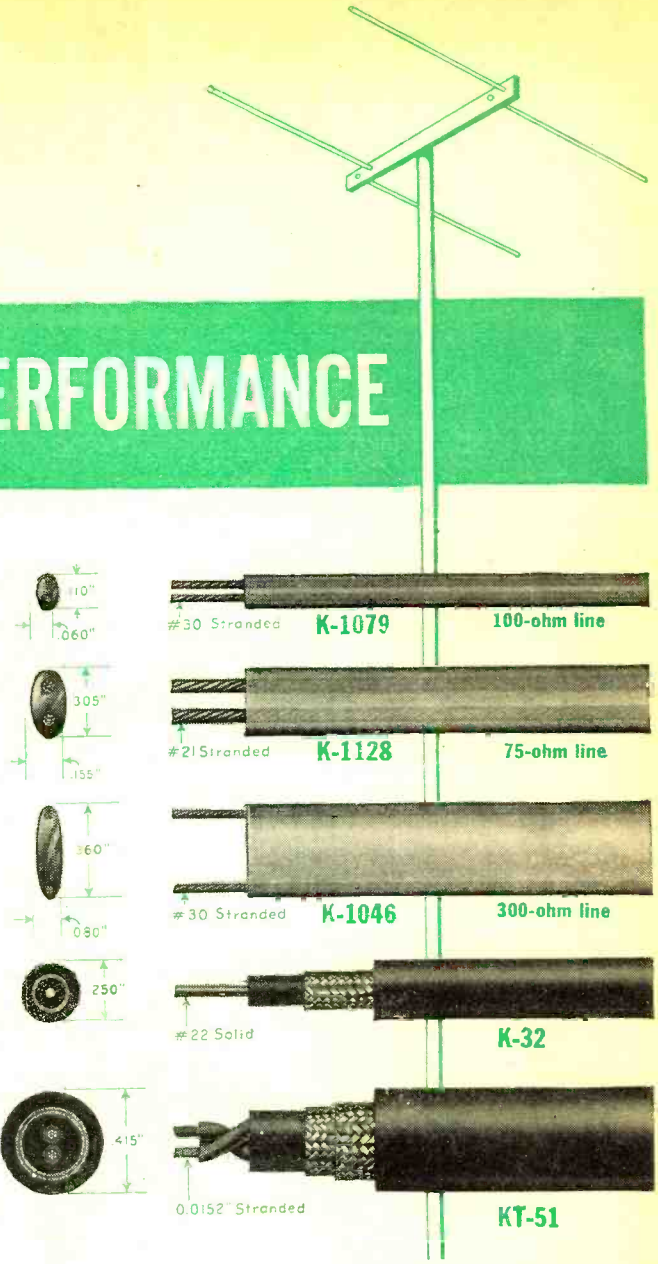

IN THE FIVE ITEMS listed here, there's a high-frequency cable for practically every antenna application. The K-1128 75-ohm line, for transmitter use—the K-1079 and K-1046 lines for general FM and Television service. The smooth oval cross-section of these 75, 100, and 300-ohm lines prevents the accumulation of foreign matter, thereby maintaining stable capacity characteristics. The K-32 and KT-51 coaxial cables offer peak performance for applications where locally-induced interference is severe.

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Type Number	Characteristic Impedance Ohms	Velocity of Propagation (in percent)	Capacitance Per Ft. mmf	Attenuation, Db per 100 Ft. Frequency in Megacycles				
				1.0	1.7	30	100	300
K-1079	100	71	15.5	.6	.75	2.8	5.2	8.8
K-1128	75	71	19.5	.3	.4	2.0	4.0	7.3
K-1046	300	300	4.0	.38	.57	.85	2.0	—
K-32	73	66	22	—	—	2.0	3.8	7.0
KT-51	95	66	16	—	—	1.8	3.8	7.5

•Reg. U. S. Pat. Off.

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D6-251	.000250	1.25*
D6-501	.000500	1.25*
D6-751	.000750	1.25*
D6-102	.001000	1.25*
D6-202	.002000	1.25*
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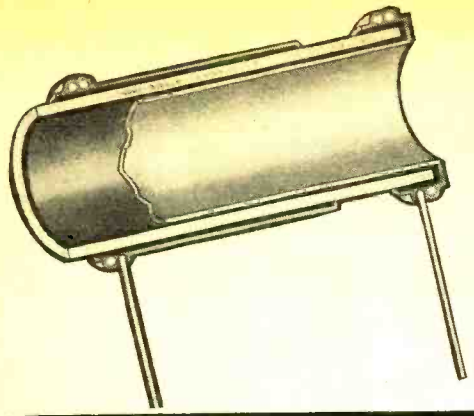
Rating: 600 WVDC — 1000 V. flash tested. Individually color coded, inspected and insulated.



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"HI-KAP" FEATURES	DESCRIPTION	ADVANTAGES
1. Impervious to moisture	Ceramic-X is non-hygroscopic. Moisture absorption is .007% or less.	No deterioration, no shorting. Longer life even under the most adverse conditions.
2. Low mass weight 3. Small size 4. High capacity	Av. Wt. / Dimensions / Values .029 oz. — D—.315" L—.540" — .00005—.00025 mfd. .044 oz. — D—.315" L—.830" — .0005 mfd. .050 oz. — D—.340" L—1" — .000750—.005 mfd. .082 oz. — D—.400" L—1.305" — .01 mfd. Rating: 600 WVDC — 1000 VDC flash test.	For unit size and weight, Centralab BC "Hi-Kaps", made with Ceramic-X, are the only capacitors on the market which provide these voltage ratings.
5. Special insulation	Wax impregnated, lacquered, dipped in special phenolic resin, cured and wax impregnated.	Prevents any possibility of shorting to adjacent leads, chassis or components.
6. Convenient side leads	Heavy #22 gauge tinned copper.	Permit rapid, close-coupled connections. No tricky bending or fitting required.
7. Low power factor	Initial — .6%. After 100 hours, 95% humidity test — 3.0%.	More efficient circuit operation, fewer failures.
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Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

WITH THE RECENT Radio Manufacturers Association convention in Chicago now history, next big national appearance for which the entire industry is now pointing is National Radio Week, October 26-November 1. RMA will coordinate its activities with the National Association of Broadcasters, the Frequency Modulation Association, the Television Broadcasters Association and all other interested groups to make the week outstanding in radio annals. Emphasis will be given to the rapid growth in broadcasting facilities since the end of the war, especially in the FM field. Another point that will be emphasized: You can get a million dollars in radio entertainment for the price of a receiver. RMA is already busy preparing material for radio dealers and stations, with suggestions for cooperative local promotion programs. W. B. McGill of Westinghouse Radio Stations, Inc., Philadelphia, is chairman of RMA's committee on Radio Week. John M. Cutler, station WSB, Atlanta, is heading up the parallel committee with NAB.

THE RMA CHICAGO MEETING, incidentally, made history on a number of scores. The twenty-third, it was also the largest, brought out some thousands of the industry's leaders. Consensus was that more was accomplished at the intensive business sessions than ever before. And it was generally agreed that the banquet, addressed by Brig. Gen. David Sarnoff, president of the *Radio Corporation of America,* hit an all-time high . . . Credit for the success of the convention is shared by retiring RMA president R. C. Cosgrove and convention committee chairman Leslie F. Muter.

MAX F. BALCOM, Vice-President and Treasurer of *Sylvania Electric Products Inc.* was named President of the Radio Manufacturers Association for the coming year at the Chicago business session of the organization. He succeeds Ray C. Cosgrove of *Crosley* who completed his third term as RMA president.

Serving with Mr. Balcom will be R. E. Carlson, Vice-President, *Tung-Sol Lamp Works, Inc.* and W. J. Barkley, Executive Vice-President, *Collins Radio Company* as the newly elected Vice-Presidents. Paul V. Galvin, President, *Motorola, Inc.;* J. J. Kahn, President, *Standard Transformer Corp.;* and Allen Shoup, President, *Sound, Inc.* were reelected as RMA Vice-Presidents. Leslie F. Muter, President, *The Muter Company* was reelected Treasurer for his thirteenth year.

Four new RMA Directors and two new Division chairmen were elected by by the respective RMA divisions. The new Directors are: H. L. Hoffman, President, *Hoffman Radio Corporation,* and Harry C. Sparks, President of the *Sparks-Withington Company,* representing the Set Division; E. N. Wendell, Executive Vice-President, *Federal Telephone & Radio Corporation,* and W. A. McDonald, President, *Hazeltine Electronics Corporation,* representing the Transmitter Division. The new Division Chairmen are E. E. Carlson for the Tube Division and F. D. Wilson, General Sales Manager, *Operadio Manufacturing Corporation,* for the Amplifier Division.

Directors reelected for three year terms include: Set Division, E. Alschuler, President, *Sentinel Radio Corporation;* G. M. Gardner, President, *Wells-Gardner;* Joseph Gerl, President, *Sonora Radio & Television Corporation*; Ray H. Manson, President, *Stromberg-Carlson Company*; and Harold C. Mattes, Executive Vice-President, *Belmont Radio Corporation.* Tube Division, E. E. Carlson, Vice-President, *Tung-Sol Lamp Works, Inc.*; Transmitter Division, H. J. Hoffman, Vice-President, *Machlett Laboratories, Inc.*; Ray F. Sparrow, Vice-President, *P. R. Mallory & Co., Inc.*; R. C. Sprague, President, *Sprague Electric Company*; and Allen Shoup, President, *Sound, Inc.*

Bond Geddes was renamed Executive Vice-President and Secretary of RMA and John W. Van Allen of Buffalo, New York was reappointed General Counsel.

GETTING BACK to Radio Week, the industry will not be alone in celebrating. Retailers, department stores, music and furniture stores will be among the many who will participate. Among those who have offered fullest cooperation are William A. Mills, executive secretary of the National Association of Music Merchants; James P. Oliver, of the National Retail Furniture Association, and Howard P. Abrahams, of the National Retail Dry Goods Association. All three associations are now working on plans to

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SPOT RADIO NEWS

furnish their members with promotion kits, posters, streamers and other material prepared by RMA and NAB.

WATCH FOR RADIO to go back to school in a big way when the fall semester begins. Straw-in-the-wind—and also history-making—is a report now being rushed for early fall publication giving basic standards for school sound recording and playback equipment. The report is the result of work by an RMA committee and the U.S. Office of Education. It will be published by RMA and will supplement the "School Sound Systems" brochure by RMA published last fall and widely distributed by the Office of Education. Previews of the report indicate that scores of devices developed during the war will be enlisted for educational purposes under expert guidance. Recording by engraved discs will be only one of the available methods. Magnetic wire and tape, and embossed tape and discs, not to mention photographic processes, will be covered in detail in the report, together with advice on operation and application to the educational field. The report will also summarize present thinking of foremost radio manufacturers and educators specializing in audio education. Expected to be the masterpiece in its field, credit for the report's creation goes to scores of experts in both the industry and in education. Among these are Lee McCanne of RMA and vice president of the *Stromberg-Carlson Co.*, Rochester, N. Y. Dr. R. R. Lowdermilk, radio education specialist of the Office of Education, and C. F. Gill, of RMA and the *General Electric Co.*, Syracuse, N. Y.

IN A STATEMENT made in Washington recently by Paul Mowrey, head of American Broadcasting Company's television activities, he told students at American University that job possibilities in television are "sensational." Best reason he gave was mathematical: It takes 77 persons to handle a television show which four or less could handle for radio. But don't plan to go to work tomorrow—Mowrey added that the television employment market would not boom in a big way for perhaps another eighteen months.

TELEVISION and a number of other radio services are suffering from acute growing pains concerning which much will be heard at the Federal Communications Commission for some time to come, if recent informal meetings at FCC are any indication. Current television troubles are three—the high cost of piping programs from one center to another, interference from local radio services in the same channels, and need for more channels.

HIGH INTERCITY TRANSMISSION costs were revealed publicly for the first time before FCC by the

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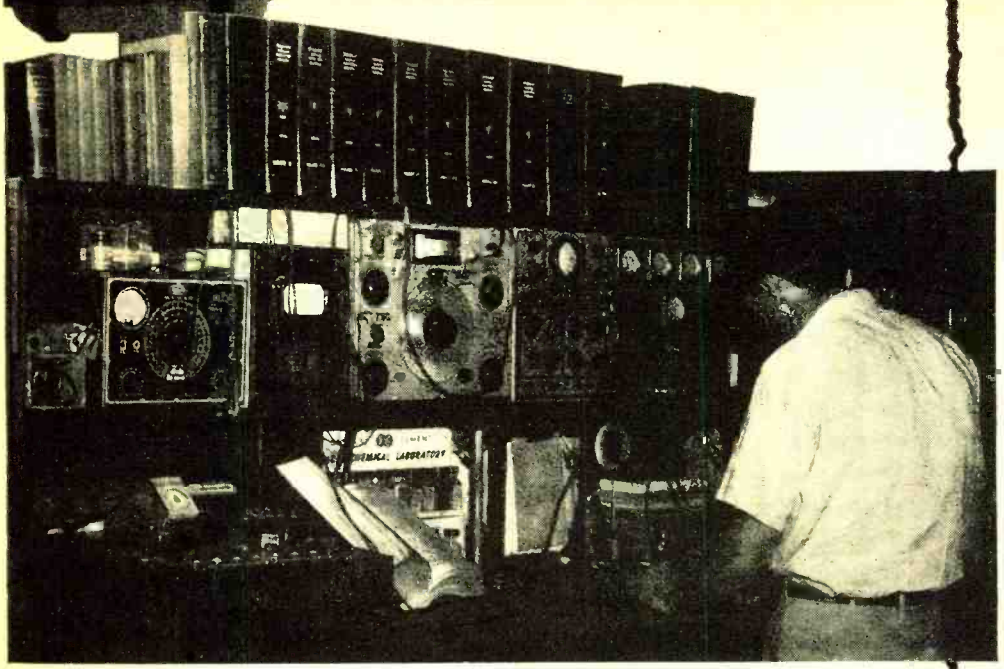

Couch has all fifteen RIDER MANUALS

W. J. Couch & Company of Tullahoma, Tenn., was recently featured in a national radio publication because of the completeness of its servicing equipment. In the Couch shop, as in thousands of other successful servicing establishments, you'll find all fifteen Rider Manuals in daily use. From no other single source is such data available.

Comprehensive servicing information is essential to shops called upon to service all makes and all types of radio receivers—of all ages. That's why the first fourteen volumes of Rider Manual are so time-savingly valuable to the average shop. These volumes alone cover the years when 82% of the sets now in American homes were issued. (From 1920 to April 1942 inclusive.)

And, the information on these receivers is the OFFICIAL, AUTHORIZED servicing data direct from the service departments of the manufacturers who made the sets. *No one knows better than the manufacturer what procedures are best for his product. That is the foundation on which Rider Manuals are built.*

Volume XV, covering sets issued during 1946, plus some unpublished pre-war models, is the result of "Seventeen Years of Continuing Service to the Radio Servicing Industry". It is full of exclusive features. For example, the 520 "clarified-schematics", which break down composite diagrams of complicated multiband receivers into *individual* schematics of each circuit as it exists with each turn of wave band or equipment switch.

With each Volume XV is the 200-page "How It Works" book, a guide to the theory of operation of new technical features in latest receivers. Volume XV also has all popular "Ham" communication receivers, Scott receivers, Magnavox RA combinations and record player combinations. These you find only in Rider Publications.

Rider Manuals are an investment which keeps pouring out profits for you. Those who bought Volume I, 17 years ago, are still benefitting from it. Be sure your shop has the Sign of Succeesful Servicing—all fifteen Rider Manuals.

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Export Division,
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13 E. 40th St., New York City
Cable ARLAB

American Telephone & Telegraph Company, operators of the only available video cables—virtually a monopoly. Monthly rates were quoted at $40 per circuit mile for eight consecutive hours daily, plus $2 for each additional consecutive hour. Figure mileage on a coast-to-coast hook-up basis, and you're spending folding money, to put it mildly. *AT&T* said rates should come down appreciably with more use of the circuits and established that cost of putting in the circuits was extremely high. Short of a lot of customers, however, they did not see how they could reduce charges. A hinted alternative at the informal FCC meeting was that an independent competitive network be set up and many television broadcasters seemed interested. But to do that would take time, and all are eager to get going on hook-ups as soon as possible. *AT&T* is equally eager to extend its circuits nationwide.

TELEVISION INTERFERENCE is coming mostly from mobile and special service units and often plays hob with telecasts. Exhibited at the FCC meeting was a telecast over WDTT, Washington, from somewhere in the northeast of the city, which faded repeatedly owing to interference. Mobile and special service unit folks are just as unhappy about the situation as the television people—they complain of interference from telecasts. Solutions are difficult to find. Some of the experts recommended that television and the competing services should all "move upstairs," as should FM, to make more room for everybody. Whether FCC will take action toward such moves seems doubtful, at least for the present. The moves would not only result in loud bleats from one and all, but might throw a sizable monkey wrench into the work now progressing toward establishing channels in the international field.

TELEVISION has a familiar solution for its problems—as who hasn't—more channels. At the moment, best estimate of the television experts is that ten new channels, giving them a total of 23, would do them nicely. That's the opinion of Thomas Goldsmith, Jr., of the *DuMont Laboratories,* Passaic, N. J., owner of the world's most powerful television station, WABD. Reporting that *DuMont* has already made and sold some 8000 receivers, Mr. Goldsmith feels that a minimum of three television stations should be available in any area with a potential receiver population of 50,000 persons or more. The ten new channels he requests fall between 108 and 174 mc.—now occupied by aviation, some amateurs, some mobile units. He points out that these channels were originally proposed when the present thirteen channels were assigned. If assigned, it would mean that television could use the spectrum between 44 mc. and 216 mc. except for small regions retained for FM, amateurs, and miscellaneous services. Speaking for aviation interests, E. K. Morse of *Aeronautical Radio, Inc.,* pointed out that changing frequencies at this time or in the future would strike a severe blow to aircraft operations, especially in the transport field, where units costing around $10,000 are being installed in each plane.

WHAT ALL THIS will add up to is trouble any way you figure it. Radio is expanding so rapidly in all departments that it is going to be difficult in the extreme to give every service enough to meet minimum needs, much less maximum wants. It's going to be tough for the various services and it's going to be tough, indeed, for FCC. As everybody agreed at the close of the informal summer meetings of the Commission, there are going to have to be a lot more meetings, more expert testimony—and lots of compromises.

ONE THING that came out of the FCC summer hearing—however expensive, the *Bell System's* intercity television network is already a reality and is expanding by leaps and bounds. "Manufacturing capacity and output of coaxial cable and associated equipment have been stepped up," says George Gillman, *AT&T* engineer, "construction forces have been expanded, and the program has taken definite shape. As of October 1, 1946, about 2700 route miles of coaxial cable were in the ground. Today this figure has increased to about 4000 miles and the going rate of installation is nearly 3000 sheath miles of cable per year." Plans call for continuing at this rate for the next few years. By the end of 1949, some 11,000 miles of cable will be in, according to the plans. What this means in intercity television service is that the New York-Boston link will be ready for testing by fall. New York-Chicago link is scheduled to go into operation some time during 1949. New York-Washington has already been operating more than a year experimentally. Philadelphia and Baltimore will be added to this hook-up in the near future, with Richmond, Va., being added by next summer. Similarly, intermediate cities will be hooked up with the New York-Chicago cable when completed. A Los Angeles-San Francisco hook-up is expected by early 1949, a complete national network by 1950-51.

RADAR WENT SAILING down the Potomac the other day under the auspices of Capt. W. R. Griswold of the *Sperry Gyroscope Company's* ship "Wanderer" with results wonderful to behold. Capt. Griswold, a veteran of the wartime merchant marine, could tell where he was, where he was going and what was in his way—all by electronic means. He does his navigating by reading a 12-inch viewing scope which picks out landmarks, buoys,

(*Continued on page* 104)

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9. Complete Reference Table for Quickly Locating Receiver Troubles.

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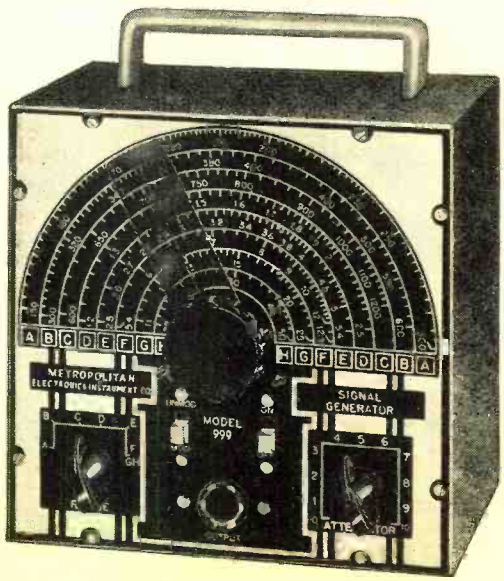

Hand-rubbed oak portable cabinet complete with cover, self-contained battery, test leads and instructions. Measures 4"x6½"x7".
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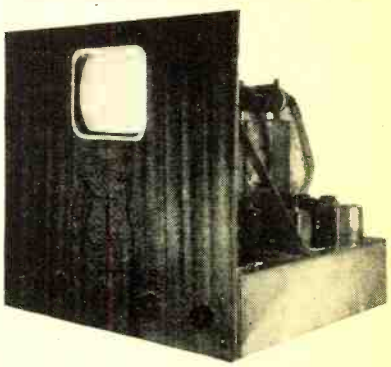

A complete television kit using a seven-inch tube which gives a 26-square-inch picture. This kit has everything, all power transformers, chokes, I.F.'s—R.F.'s, condensers, resistors, mounting brackets, nuts, front panel and a complete punched chassis, plus simple to understand schematic diagrams. This receiver is a well engineered piece of equipment having three stages of video I.F. amplification which are slug tuned for maximum gain and efficiency. Only five controls are on the front panel giving simplicity of operation. The instructions are written in an easy step-by-step system enabling accurate construction. Alignment procedure without the use of expensive test equipment is given in detail.
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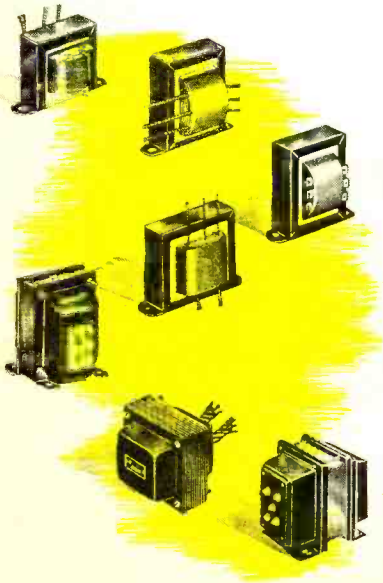

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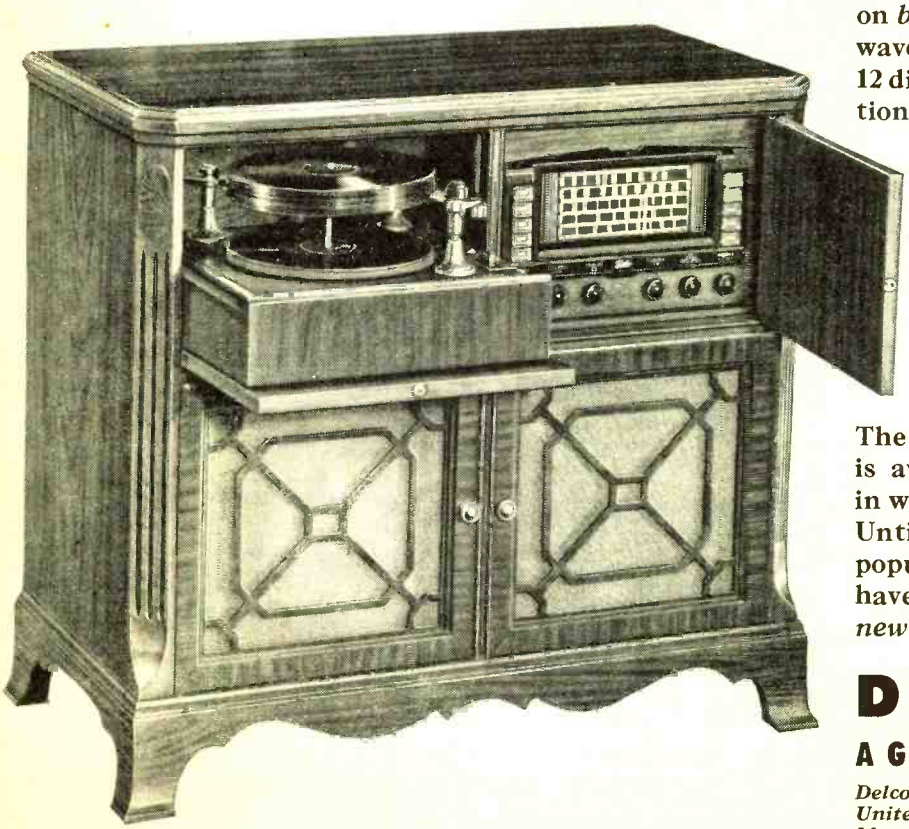

LOOK at it as a piece of furniture and you'll see that the new Delco Radio Combination is outstanding in the field. The grace and distinction of its 18th-Century design . . . the superlative materials and workmanship . . . make it a handsome addition to the finest home.

Listen to it as a musical instrument and you'll find that the new Delco Radio Combination lives up to all the promise of its appearance. It brings a new richness and clarity of tone to both recordings and radio broadcasts.

This new Combination has 14 tubes plus rectifier . . . automatic tuning on *both* AM and FM . . . three short-wave bands . . . a 15-inch speaker . . . 12 different bass and treble combinations . . . and advanced engineering throughout. The record player handles fourteen 10-inch or ten 12-inch records, and shuts off automatically after the last record plays. A special lightweight tone arm with *jeweled-point* pick-up makes recordings sound better and last longer.

The new Delco Radio Combination is available in two models: R-1251 in walnut, and R-1252 in mahogany. Until you've seen them and the other popular Delco radio models, you haven't seen *the best of all that's new in radio!*

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CALIFORNIA: Fresno, Jack C. Arbuckle, Martin Distributing. Long Beach, Fred S. Dean Radio Electric Co., Scott Radio Supply. Los Angeles, Henry Radio Shop, Hollywood Radio Supply Co., Kierulff & Co., Pacific Radio Exchange, Inc., Radio Equipment Distributors, Radio Specialties. Oakland, Electric Supply. Pasadena, Dow Radio Supply Co. Sacramento, E. M. Kemp Co. San Diego, Western Radio & Television Supply Co. San Francisco, Offenbach-Reimus, Zack Radio. San Jose, Frank Quement. Santa Ana, Radio & Television Equipment. Santa Barbara, Channel Radio Supply.
COLORADO: Colorado Springs, Murray Radio Co. Denver, Radio Products Sales, Western Electronic Lab. Co.
CONNECTICUT: Hartford, Hatry & Young, Inc., R. G. Sceli & Co. New Haven, Congress Radio.
D. C., Washington: Capitol Radio Wholesalers, Kenyon Radio Supply, Sun Radio Service.
FLORIDA: Miami, Electronic Supply, Walder Radio. Pensacola, Grice Radio, Gulf Radio, Pensacola Appliance. St. Petersburg, Cooper Radio, Welch Radio Supply.
GEORGIA: Atlanta, Concord Radio, Southeastern Radio Parts, Yancey Co., Inc. Columbus, Radio Sales & Service Co.
IDAHO: Boise, Craddock's Radio Supply.
ILLINOIS: Chicago, Allied Radio, Concord Radio, Newark Electric. Peoria, Klaus Radio & Electric. Rock Island, Tri-City Radio Supply.
INDIANA: Indianapolis, Radio Distributing Co. South Bend, Radio Distributing Co.
IOWA: Des Moines, G. W. Onthank Co.
KANSAS: Topeka, Overton Electric Co.
KENTUCKY: Lexington, Radio Equipment. Owensboro, Central Electronic.
MARYLAND: Baltimore, Kann-Ellert Electronics, Wholesale Radio Parts.
MASSACHUSETTS: Boston, DeMambro Radio Supply. Radio Shack. Worcester, Radio Maintenance Supply Co.
MICHIGAN: Detroit, M. N. Duffy & Co., Radio Electronic Supply, Radio Supply & Engineering Co., Inc. Grand Rapids, Wholesale Radio Co. Lansing, Budd's Music House. Muskegon, Industrial Electric Supply. Pontiac, Electronic Supply.
MINNESOTA: Duluth, Lew Bonn Co. Minneapolis, Lew Bonn Co., Northwest Radio Electric Supply.
MISSISSIPPI: Greenville, Goyer Supply Co. Jackson, Cabell Electric, Ellington Radio, Inc.
MISSOURI: Joplin, 4-State Radio & Supply. Springfield, Harry Reid Radio Supply. St. Louis, Radonics.
NEBRASKA: Omaha, Omaha Appliance, Radio Equipment Co.
NEW JERSEY: Trenton, Allen & Hurley.
NEW YORK: Albany, Fort Orange Radio Distributing, E. E. Taylor Co. Buffalo, Bars Radio & Electronic Parts Co., Buffalo Radio Supply Co., Genesee Radio & Parts. Radio Equipment. Jamaica, Norman Radio Distributors. Middletown, L. & S. Radio Sales. New York City, Fordham Supply Co., Newark Electric Co., Terminal Radio Corp. Niagara Falls, Niagara Radio. Poughkeepsie, Chief Electronics. Rochester, Masline Radio & Electronic Equipment, Rochester Radio Supply. Syracuse, Broome Distributing, Stewart W. Smith. Troy, Trojan Radio. Utica, Vaeth Electric Co. White Plains, Westchester Electronic Supply Co.
NORTH CAROLINA: Fayetteville, Dugan's Radio Supply Co., Eastern Radio Supply. Winston-Salem, Lambeth Electric Supply.
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OKLAHOMA: Enid, Radio-Electronics. Oklahoma City, Radio Supply Co.
OREGON: Portland, Bargelt Supply, Harper-Meggee, Lou Johnson Co., United Radio Supply.
PENNSYLVANIA: Altoona, Kennedy's Radio Supply. Erie, Warren Radio. Philadelphia, Almo Radio, M. & H. Sporting Goods, Radio Electric Service, Sanders Electronics, Eugene G. Wile. Pittsburgh, Radio Parts Co., Tydings Co. Reading, George D. Barbey Co. Scranton, Scranton Radio and Television Supply. Wilkes-Barre, General Radio. York, C. R. Minnich.
RHODE ISLAND: Providence, DeMambro Radio Supply.
SOUTH CAROLINA: Anderson, Electronic Supply. Columbia, Dixie Radio Supply Co.
TENNESSEE: Memphis, Bluff City Distributing.
TEXAS: Beaumont, Montague Radio Dist. Co. Corpus Christi, Wicks-De Vilbiss. Dallas, Wilkinson Brothers. El Paso, Midland Specialty. Houston, R. C. Fall. Lubbock, R & R Parts & Supply Co. San Antonio, Modern Radio Supply, Olsen Radio Supply.
UTAH: Salt Lake City, Radio Supply Co., Standard Supply,
VIRGINIA: Norfolk, Radio Parts Distributing, Radio Supply.
WASHINGTON: Everett, Pringle Radio Wholesale Co. Seattle, General Radio, Inc., Harper-Meggee, Radio Products Sales, Seattle Radio. Spokane, Harper-Meggee, Northwest Electronics.
WEST VIRGINIA: Charleston, Hicks Radio Supply. Wheeling, General Distributors, Wheeling Radio Supply.
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Radio's outstanding practical text. How-to-build-it descriptions of dozens of tested-and-tried types of transmitting, receiving and test equipment. Supplemented by basic electrical and radio theory in the simplest possible language for those without mathematical or technical training.

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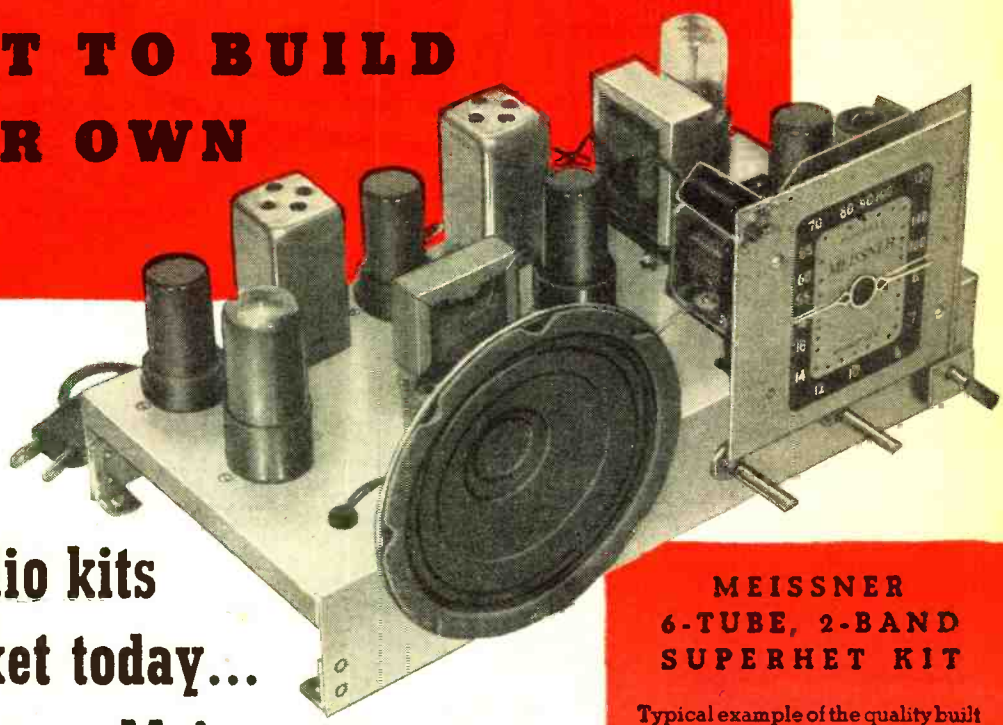

There are no finer radio kits on the market today... than these new Meissners

The finest quality components, careful circuit designs for sure, efficient operation, plus unusual ease of assembly, all make these new Meissner Kits the outstanding buy for those interested in constructing their own sets.

Kits include all parts, tubes and speaker . . . everything except cabinet. A screwdriver, pliers and soldering iron are all that is required to assemble any Meissner Kit into a complete radio. See this complete line today or write for new free catalog to the address below.

MEISSNER 6-TUBE, 2-BAND SUPERHET KIT

Typical example of the quality built into every Meissner Kit is this new 6-tube broadcast and shortwave receiver covering the frequencies between 500 and 1600 kilocycles and 6-18 megacycles. The shortwave band includes foreign stations, government, commercial and amateur services. Equipped with filter choke to provide hum-free output without power loss and an I-F wave-trap tc eliminate troublesome image interference. Large 6-inch speaker provides extended audio response without distortion. Tubes employed are 12SK7 R-F Amplifier, 12SA7 oscillator mixer, 12SK7 I-F Amplifier, 12SQ7 detector, AVC and audio amplifier, 35L6GT beam power output and 35Z5GT rectifier Pilot light for dial illumination. 110 volt, DC or 50-60 cycle AC operation.

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Within the INDUSTRY

HAROLD L. MANN is the new chief industrial engineer for the *Farnsworth Television & Radio Corporation.*

While Mr. Mann will make his headquarters at the company's Fort Wayne plant, he will also have charge of the industrial engineering programs at *Farnsworth's* plants in Marion, Huntington and Bluffton, Indiana.

He was formerly associated with *RCA* as a production control supervisor and later as machine shop superintendent at the Indianapolis plant of the same company. He also served as director of the standards division for the *Crosley Corporation* at Cincinnati.

* * *

ADMIRAL CORPORATION of Chicago recently opened a new plant in Harvard, Illinois, for the assembly of small radios.

The plant was built by the company to handle much of the production of its smaller sets. Harvard which is 80 miles northwest of Chicago is also the home of two other of the company's main plants and their cabinet factory. *Admiral* recently acquired another cabinet plant in Shelbyville, Indiana.

* * *

E. F. JOHNSON COMPANY of Waseca, Minnesota, has purchased the "Speedx" line from the *Les Logan Company* of San Francisco.

The line includes the "Speedx" bakelite and metal hand keys, high speed semi-automatic keys, and practice sets and buzzers for amateur and commercial work.

The purchase covers inventory, tools and rights to the "Speedx" name. The line will be manufactured in Waseca.

* * *

WILLIAM J. KELLY, who for nine years served as Eastern District Manager for the *McGraw Electric Company,* has joined the *Stromberg-Carlson* radio sales division as District Merchandiser covering the New York metropolitan area and the Eastern seaboard as far south as Virginia.

Mr. Kelly has been associated with the electrical appliance industry for the past 16 years, having served as retail radio and appliance salesman for the *New York State Electric and Gas Company* before becoming a factory representative for the *Edison General Electric Appliance (Hotpoint) Company.*

* * *

JAY GOULD, Executive Vice-President of the *Frankfort Distillers Corporation,* has been elected to the Board of Directors of *Majestic Radio & Television Corporation* to fill the vacancy caused by the death of James J. Walker.

Mr. Gould has been a sales executive with a number of prominent corporations and prior to his association with *Frankfort Distillers* was President of *Best Foods, Inc.*

* * *

SOLA ELECTRIC COMPANY, manufacturers of transformers, have recently moved into their new plant at 4633 West 16th Street, Chicago 50, Illinois.

The new building has been designed to provide greater engineering, research and production facilities than were previously available as well as ideal working conditions for the employees.

* * *

TERRY P. CUNNINGHAM has been appointed Advertising Manager of the Radio Tube, Electronics, and International Divisions of *Sylvania Electric Products Inc.*

Mr. Cunningham served as Advertising Manager for *Sylvania's* Radio Tube Division for two years before becoming Sales Manager for the Home Radio Division of *Colonial Radio Corporation,* a *Sylvania* subsidiary, in 1944.

He has specialized in radio advertising and merchandising campaigns while on the staff of Chicago and Milwaukee advertising agencies. His experience in the promotion of radio merchandise covers a period of twenty-one years.

* * *

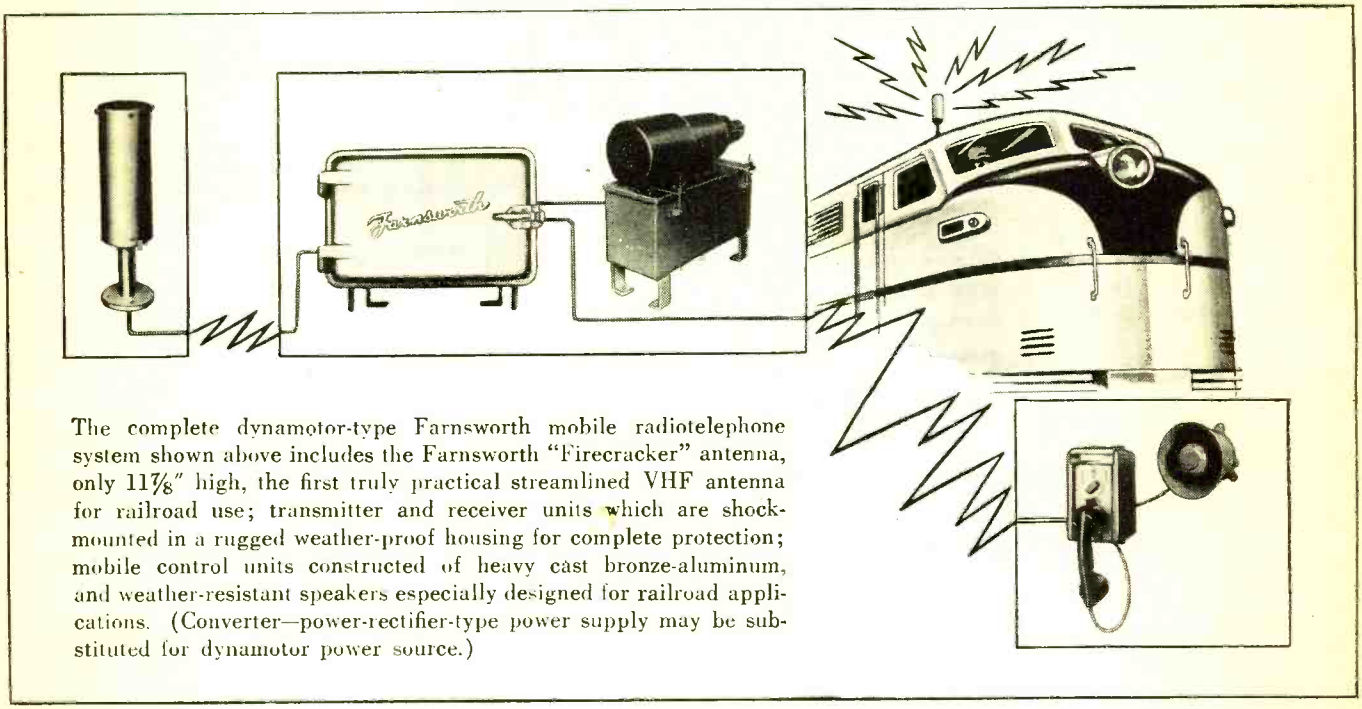
GENERAL ELECTRIC COMPANY has announced the completion of a one-way microwave radio relay circuit for commercial television operation between New York City and Schenectady, New York. Present plans call for the extension of this circuit to Syracuse, New York, if approved by the FCC.

Station WRGB, *General Electric's* television outlet in Schenectady, has an application pending before the Commission seeking to use this circuit commercially for relaying to the Troy-Albany-Schenectady area television programs available in New York City.

The new relay operates in the 2000 mc. region and is extremely direc-

Farnsworth

RADIOTELEPHONE SYSTEMS BUILT *specifically* TO MEET RAILROAD SERVICE REQUIREMENTS



The complete dynamotor-type Farnsworth mobile radiotelephone system shown above includes the Farnsworth "Firecracker" antenna, only 11⅞" high, the first truly practical streamlined VHF antenna for railroad use; transmitter and receiver units which are shock-mounted in a rugged weather-proof housing for complete protection; mobile control units constructed of heavy cast bronze-aluminum, and weather-resistant speakers especially designed for railroad applications. (Converter—power-rectifier-type power supply may be substituted for dynamotor power source.)

RADIO has already demonstrated its usefulness in railway operations. The design of proper specialized equipment for the practical application of this dependable communications tool in railway service is, however, dependent upon a thorough knowledge of the unique and exacting requirements of railway operation.

Because Farnsworth engineers have secured this knowledge through their pioneering accomplishments in adapting radio to railroad operations, Farnsworth is today producing VHF communications systems that have been *specifically designed and precisely developed for railway service.*

Standardized design and unitized construction are only two of many important engineering results of Farnsworth's pioneering, long-term development and field-testing program in railway radio communications. They give Farnsworth equipment these practical features:

- The same receiver, transmitter, and in some cases, power supply and remote control unit, is usable for mobile, wayside or relay installations, thus providing complete interchangeability of basic equipment.
- Because all connections are made by a single, break-away plug, transmitters, receivers and power converters can be instantly disassociated for purposes of maintenance or relocation without manually disconnecting a single wire.
- Personnel unlicensed by the FCC and without technical training can replace all units of Farnsworth systems.

Only Farnsworth radiotelephone systems offer all these vital service and maintenance advantages. For complete information write Farnsworth Television & Radio Corporation, Dept. RN-8, Fort Wayne 1, Indiana.

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tional. The microwaves are beamed from a transmitter on top of the *General Electric* office building at 570 Lexington Avenue, New York, to a relay station on Beacon Mountain 55 miles from the city. Another tower at Round Top Mountain picks up the relay and transmits it to the Helderberg mountains where it is finally transmitted a distance of 14 miles to the Schenectady terminus.

* * *

RICHARD W. BELLEW has been promoted to the post of Manager of the Amateur Sales Department for *Collins Radio Corporation.*

He has been an amateur (W8DYY, now W5FWD) since 1929. In addition to his amateur ticket, Mr. Bellew holds his radio telephone first class and radio telegraph second class commercial licenses.

During the war, from 1942 until 1945, Mr. Bellew was connected with the Standards Laboratory of *Raytheon Manufacturing Company.* He joined the *Collins* organization in the Amateur Sales Department in September of 1946.

* * *

SAM WILEY of Chicago has been appointed field representative for the Midwest territory of the *Snyder Manufacturing Company,* manufacturers of antennas and automotive radio accessories.

Mr. Wiley, who has been active in the sales field throughout the Midwest for several years, will coordinate field activities for the *Snyder* firm in that territory.

* * *

WILLIAM M. SHIPLEY has been named Eastern Regional Manager for the *Crosley Division* of *Avco Manufacturing Corporation.*

Mr. Shipley returns to *Crosley* after an absence of six years, during which time he served as Vice-President of *Thomas W. Berger, Inc.,* national sales and merchandising organization.

He served as Manager of major accounts at *Crosley* from 1937 until 1940.

* * *

SAMUEL C. MILBOURNE, formerly Chief Engineer for *Eastern Amplifier Corporation,* has joined the staff of *Streuber & LaChicotte* as Manager of the company's new engineering consulting and buying service, specializing in the electric, electronic, and motion picture fields.

Mr. Milbourne will function in connection with the company's new export buying service.

* * *

E. J. HENDRICKSON has been appointed Manager of the *Farnsworth* Sales Di-

(*Continued on page* 153)

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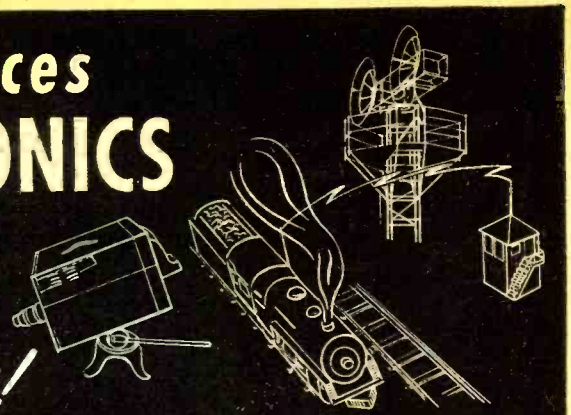

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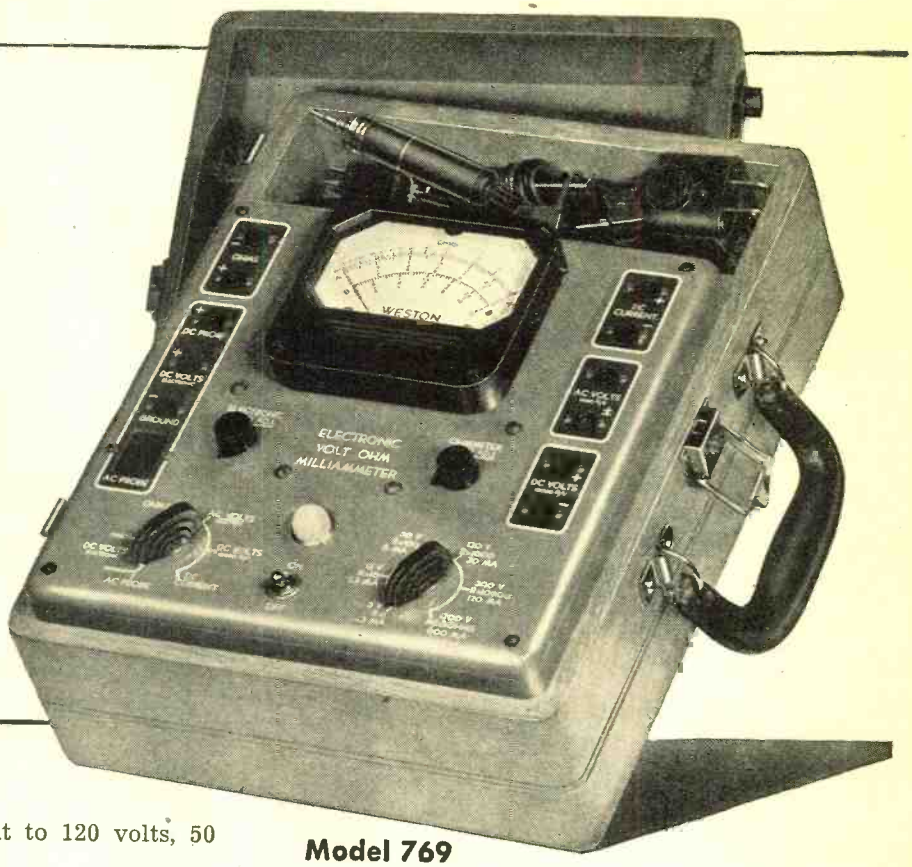

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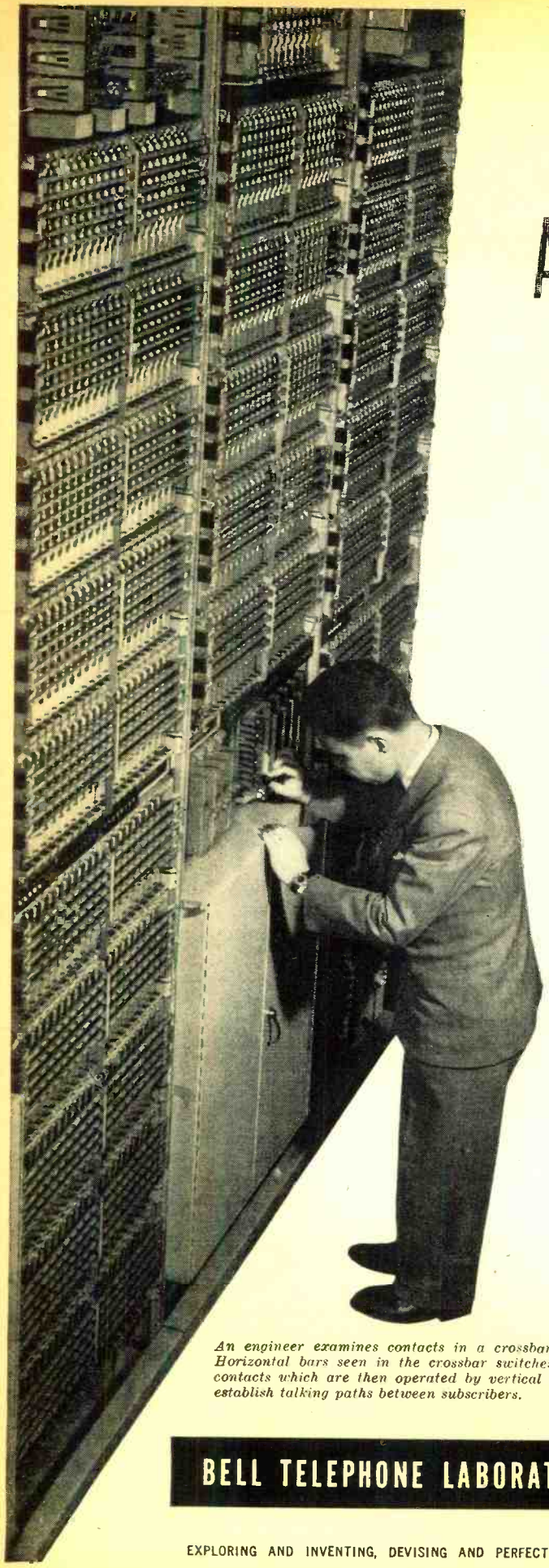
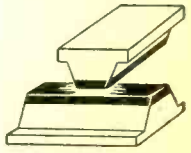


An engineer examines contacts in a crossbar office. Horizontal bars seen in the crossbar switches select contacts which are then operated by vertical bars to establish talking paths between subscribers.

A BILLION ORDERS A DAY

In a large modern telephone office 2,000,000 switch contacts await the orders of your dial to clear a path for your voice. They open and close a billion times a day.

At first, contacts were of platinum—highly resistant to heat and corrosion but costly. Years ago, Bell Laboratories scientists began looking elsewhere, explored the contact properties of other precious metals—gold, silver, palladium and their alloys—and with the Western Electric Company, manufacturing unit of the Bell System, restudied shape, size and method of attachment.



Outcome of this long research is a bar-shaped contact welded to the switch and positioned at right angles to its mate. For most applications, an inexpensive base is capped with precious metal.

Savings from these contacts help keep down the cost of telephone service. This is but one example of how Bell Laboratories serve the public through your Bell Telephone Company.

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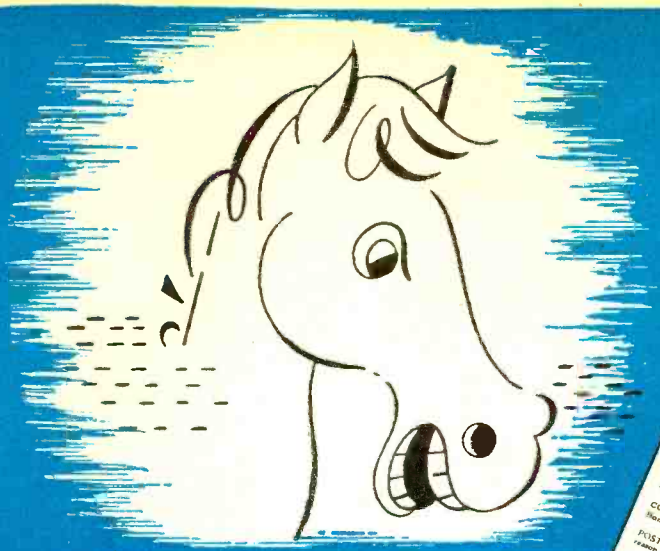

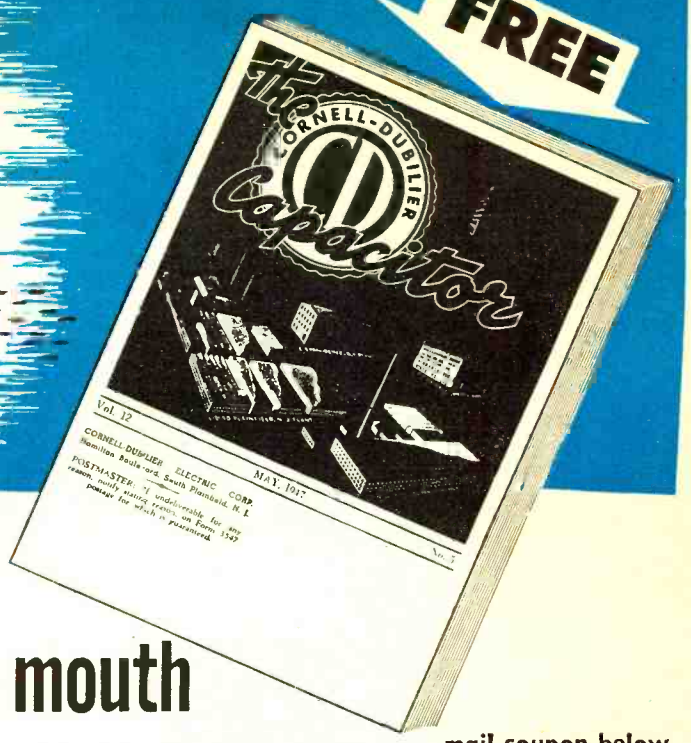

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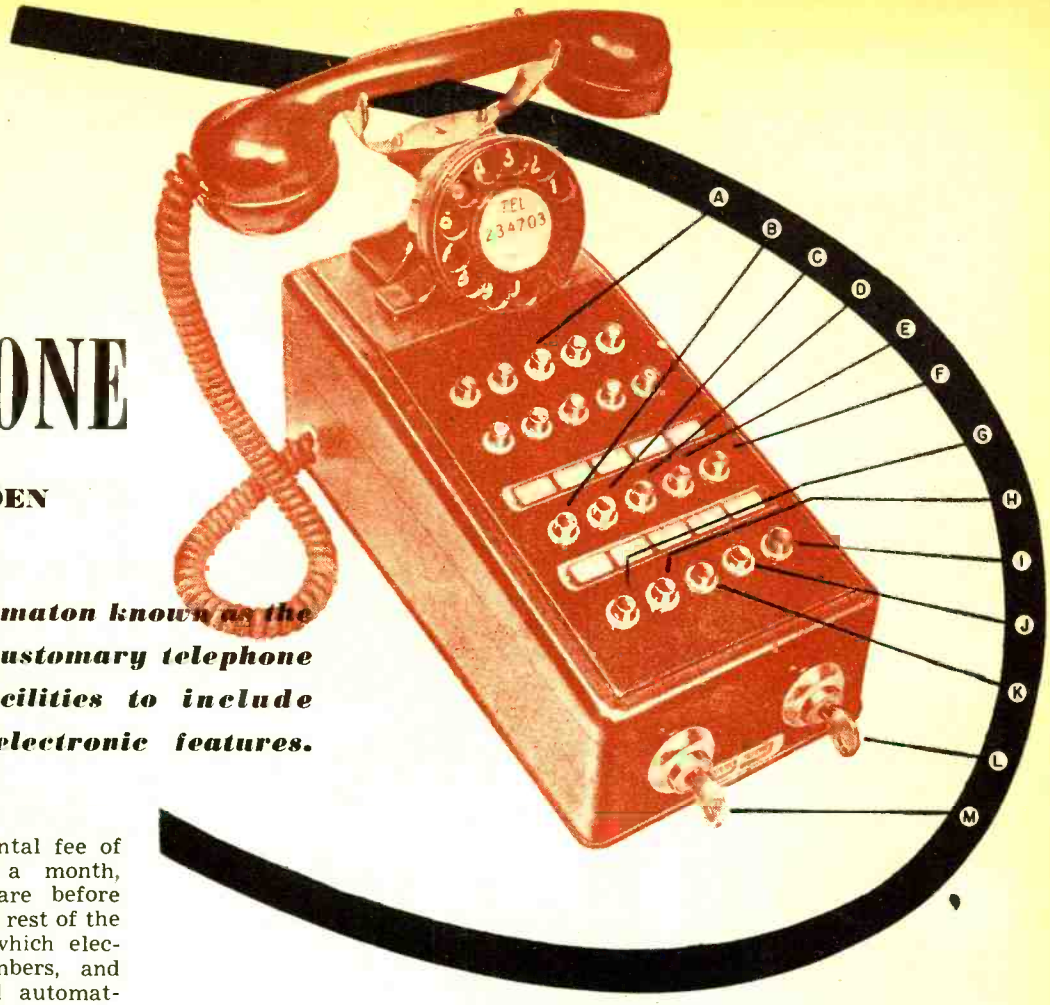
ROBOT TELEPHONE

By LEON LADEN
London, England

Swiss-invented automaton known as the Ipsophon extends customary telephone communications facilities to include remarkable new electronic features.



Push-button type keyboard is used with the Ipsophon. The various tele-control operations are: (A) buttons 1 through 0 for fixing code key, (B) button for external line, (C) button for internal line, (D) press-to-link telephone lines with Ipsophon, (E) press-to-record conversations on ordinary telephone line, (F) press-to-listen to conversations being recorded, (G) press-to-record messages or dictation, (H) press-to-listen to messages recorded by Ipsophon, (I) call button for internal installations, (J) push-to-erase recordings on Ipsophon, (K) press-to-repeat at will, (L) key for fixing internal line buttons, (M) secret code key.

AT AN all-inclusive rental fee of about 40 dollars a month, Americans will share before long with the Swiss and the rest of the world a robot telephone which electronically answers, remembers, and reveals messages recorded automatically during one's presence in, or absence from, home, office or store.

This extraordinary device, called the *Ipsophon,* is connected with the public telephone system in the same way as the ordinary telephone apparatus but, in addition to providing the customary communications facilities, acts as a dependable, critical two-way brain to everything coming through the line when the receiver is not picked up after the bell has rung four times in succession.

The equipment described was invented, developed, and perfected for everyday use by a team of engineers and physicists at the Research Division of the Oerlikon Machine-Tool Works of *Bührle & Company,* near Zürich, Switzerland, and is currently being produced in serial manufacture for installation throughout the network of the Swiss Telephone Service.

Principles of Operation

The basic concept of the *Ipsophon* is neither new nor spectacular. Projects to extend and amplify the communications facilities of the ordinary telephone in respect to time and space have been discussed frequently in the past and are as familiar to American telecommunications engineers as to their European contemporaries. In fact, the earliest recorded experiments on telephonographs, as these devices were originally named, date back to the end of the last century.

But progressive efforts tc design a workable telephonograph which could automatically accept incoming calls during one's absence, or whenever for one reason or other it was inconvenient to answer personally, presented formidable technical obstacles in practical application as long as no really efficient medium was available for recording, reproducing, and cancelling the spoken word.

Recent progress in the recording of sound for news services, broadcasting, and films, however, has led to the development of the magnetic metal tape or wire recording process—a durable as well as practically noise-free sound carrier system—ideally suited for the purpose.

As is well known, the physical principle of this process is based on the fact that longitudinal or transverse magnetization of a steel tape or wire takes place as it is drawn at constant speed past the poles of electromagnets. Adapted to the recording of messages in the *Ipsophon,* the magnetic sound system transforms the voice frequency variations into current variations which are fed to the coils of a small electromagnet. A thin moving wire of specially treated steel is drawn past this electromagnet and is magnetized according to the current intensity in the coil. The wire remains magnetized as long as desired for reproducing the spoken word. When needed, these voice frequencies are passed on to the receiver for audible reproduction in the earphones. The magnetism in the wire may be subsequently wiped out by magnetic cancellation.

Thus, there is no wear of either the wire or the reproducer even when the recorded messages require innumerable reproductions because cancellations proceed without mechanical alteration of the wire. In practical application, this means that a recorded message can be reproduced almost indefinitely and a wire reused for any number of recordings after prior cancellation.

Nevertheless, a telephonograph whose automatically recorded messages could only be heard by the subscriber through the device itself would, undeniably, make listening-in ex-

tremely tiresome and necessitate physical presence or the aid of servicing personnel.

To eliminate this contingency, and ensure that local and long-distance calls are communicated direct to the subscriber over the ordinary telephone at all times without delay or unauthorized "tapping," an ingeniously uncanny device is used, known as the acoustic code key.

This device operates not unlike the combination lock on a safe door.

For locking purposes, it merely requires the pressing down of selective buttons on a self-locking, ten-number keyboard which may be arranged to form any one of 1023 different possible cipher combinations.

On the other hand, to make the *Ipsophon* reveal on call from an outside telephone the message entrusted to it, the caller must give the previously selected cipher combination when ringing up his own number. This is done by him acoustically by emitting two vocal impulses at given intervals of time, which set in motion electronically-controlled cams linked with the sound carrier of the call system, thereby activating corresponding relay and contact switches to open or close the appropriate reproduction, recording, or cancellation circuits.

Practical Application

To illustrate the actual operation of the *Ipsophon,* let us assume that a Mr. Brown is expecting an important confidential call from his friend and business associate, Mr. Black.

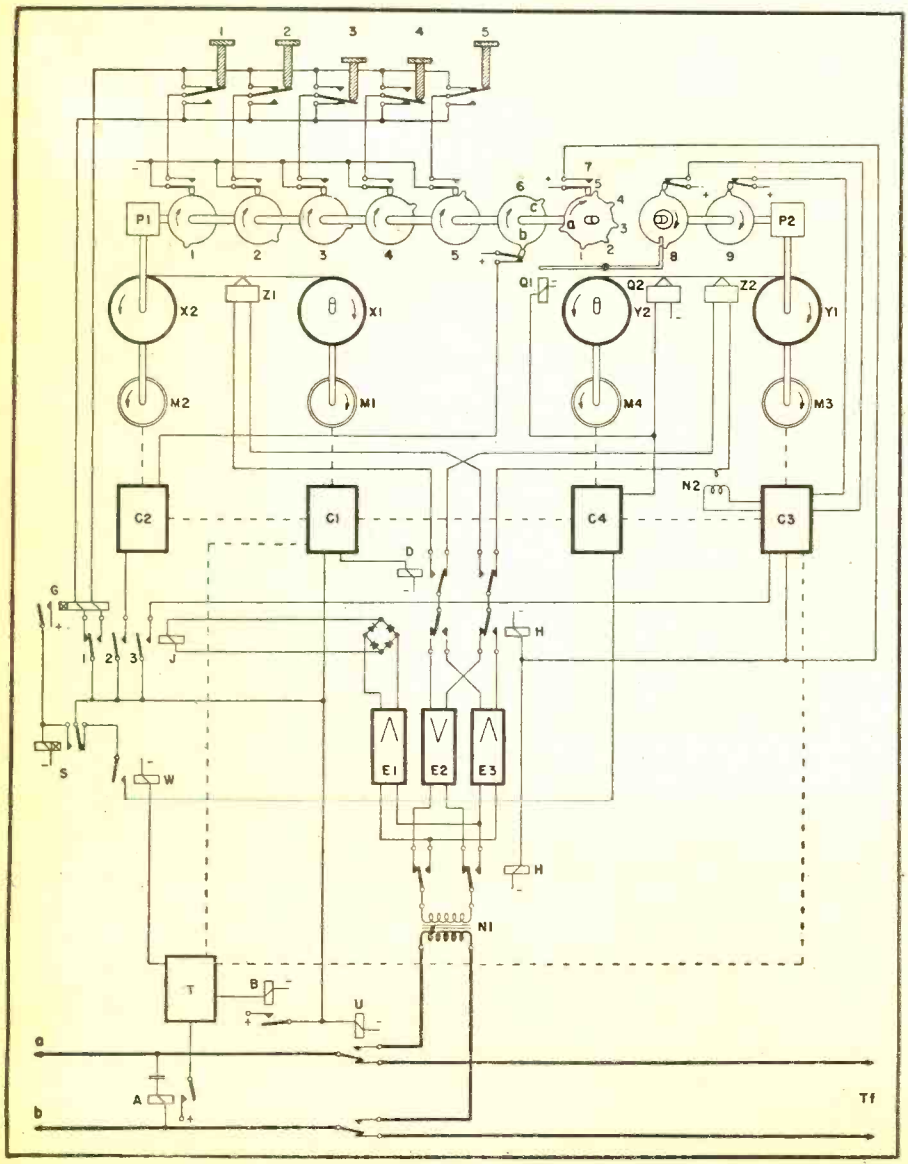
Before leaving his home, therefore, he sets the acoustic code combination key on the *Ipsophon* to form, say, the cipher 520.

Some time later, Mr. Black, on dialing his friend's telephone number, receives no reply.

Undismayed, Mr. Black holds the line until the bell at the other end has rung four times in succession and the instrument emits, of its own accord, the words:

"Hello, hello. This is the residence of Mr. Brown (address follows). This is Mr. Brown's *Ipsophon* speaking. Your call will be recorded automatically. Ready? Please start speaking now!"

Fig. 1. Schematic diagram shows operation of main functions (recording, reproducing, and erasing) performed by Ipsophon.



From that moment onwards, the instrument acts as Mr. Brown's proxy and faithfully listens to everything Mr. Black is saying, recording it word for word, sentence after sentence.

As soon as Mr. Black has finished speaking and has replaced the receiver, the line is clear for other callers.

Mr. Brown, who at about that time may be anywhere in or out of the country but still wants to know whether his friend and/or anyone else has rung up during his absence, picks up a telephone and dials his own number.

When the connection has been made, he hears the electronic voice emit the already familiar reply:

"Hello, hello. This is the residence of Mr. Brown (address follows). This is Mr. Brown's *Ipsophon* speaking. Your call will be recorded automatically. Ready?"

Immediately after hearing the word "Ready?", and before the instrument can proceed with the last sentence, Mr. Brown says twice, very distinctly, the words "Hello, hello."

Instead of continuing the announcement with the phrase "Please start speaking now!", the *Ipsophon* this time emits, at intervals of about two seconds duration, the range of numbers . . . 1 . . . 2 . . . 3 . . . 4 . . . 5 . . . 6 . . . 7 . . . 8 . . . 9 . . . 0.

Remembering that the cipher combination he arranged on the acoustic code keyboard before leaving his home was 520, Mr. Brown passes this secret number on to the electronic robot acoustically by repeating the words "Hello, hello" immediately after hearing each one of the relative numbers —5, 2 and 0—coming from the *Ipsophon.*

On completion of this code number, the instrument starts repeating without further ado all messages recorded during Mr. Brown's absence, reproducing separate calls in consecutive order of call at intervals of from 2 to 4 seconds and announcing the end of reproductions by a high-pitched note.

Special Features

When reproduction of all recordings has terminated, the instrument again emits a buzz. If the caller, immediately after hearing it, emits two vocal impulses by saying "Hello, hello," he can then dictate his answers to the messages just received.

This tele-answering facility is, of course, particularly valuable whenever the instrument is shared by two or more business partners living miles apart in different localities.

Equally, the tele-cancellation of all recorded messages can be carried out with the utmost simplicity by merely uttering the word "Cancel" into the microphone at the end of reproductions.

Another notable feature of the unit is the use of two separate sound carrier communication units; the first of these provides a recording capacity of

five minutes and the second one of twenty-five minutes. This means that the total recording capacity of the instrument—a half hour—is almost always available, since as soon as the capacity of the first recorder has been exhausted, the second unit automatically takes its place. Moreover, while one recording unit is occupied by reproduction, the other one is simultaneously rewound at quintuple speed, so that even when the recording capacity is being utilized to the full, it is never necessary to wait more than a minute for commencement of reproduction.

The diagram (Fig. 1) illustrates the control layout of the main functions performed by the *Ipsophon*. Since the automatic section alone comprises 74 relays, a complete blueprint of the entire instrument would involve a wealth of detail inimical to clarity. This diagram, therefore, is confined strictly to the connections necessary for carrying out the actual process of recording, reproducing, and cancelling the spoken word by vocal impulses from a distance.

This is done as follows:

The *Ipsophon* is connected to the telephone circuit at the two terminals *a* and *b* (Fig. 1). The relay *A*, wired in parallel with the calling bell of the telephone receiver T_f, is excited at each call, transmitting to the timing device, *T*, direct current impulses coinciding with the ring tones. This timing device, *T*, checks whether four ringing tones mature, which happens unless the receiver is lifted by the subscriber. The timing device engages the relay *B*, setting the mechanism of the *Ipsophon* in motion. The closing of the contacts of relay *B* switches the service line through to the repeater N_1 through the relay *U*. The motor control mechanism C_1 is then engaged. C_1 excites relay *D*, which shunts the sound head Z_1 onto the terminals of the output amplifier E_2. C_1 starts up motor M_1 controlling the feed of the spool X_1, which carries the sound recording element. The spool X_2 is set in motion by the sound recording wire, as a result of which the reduction gear P_1 begins to drive the cam-shaft with the cam-discs 1 to 7. Immediately after being set in motion, cam No. 6 opens its contact, thus setting in operation (in motor control mechanism C_2) the timing device, in agreement with the impulses sent out by the relay *J*. The feed of the sound recording wire releases (through the sound head Z_1, the amplifier E_2, the repeater and the service line) the announcement, whose wording is fixed once and for all, made to the inquirer in the following terms:

"Hello, hello. This is the residence of Mr. Brown (address follows). This is Mr. Brown's *Ipsophon* speaking. Your call will be recorded automatically. Ready?"

After the word "Ready?", cam 7_a switches the amplifiers E_1 and E_3 over, through relays *H*, for a period of 3 seconds, to their recording position. If the inquirer remains silent, the balance of the announcement, after amplifier E_2 has been switched on again, is communicated to the inquirer in the following terms:

"Please start speaking now!"

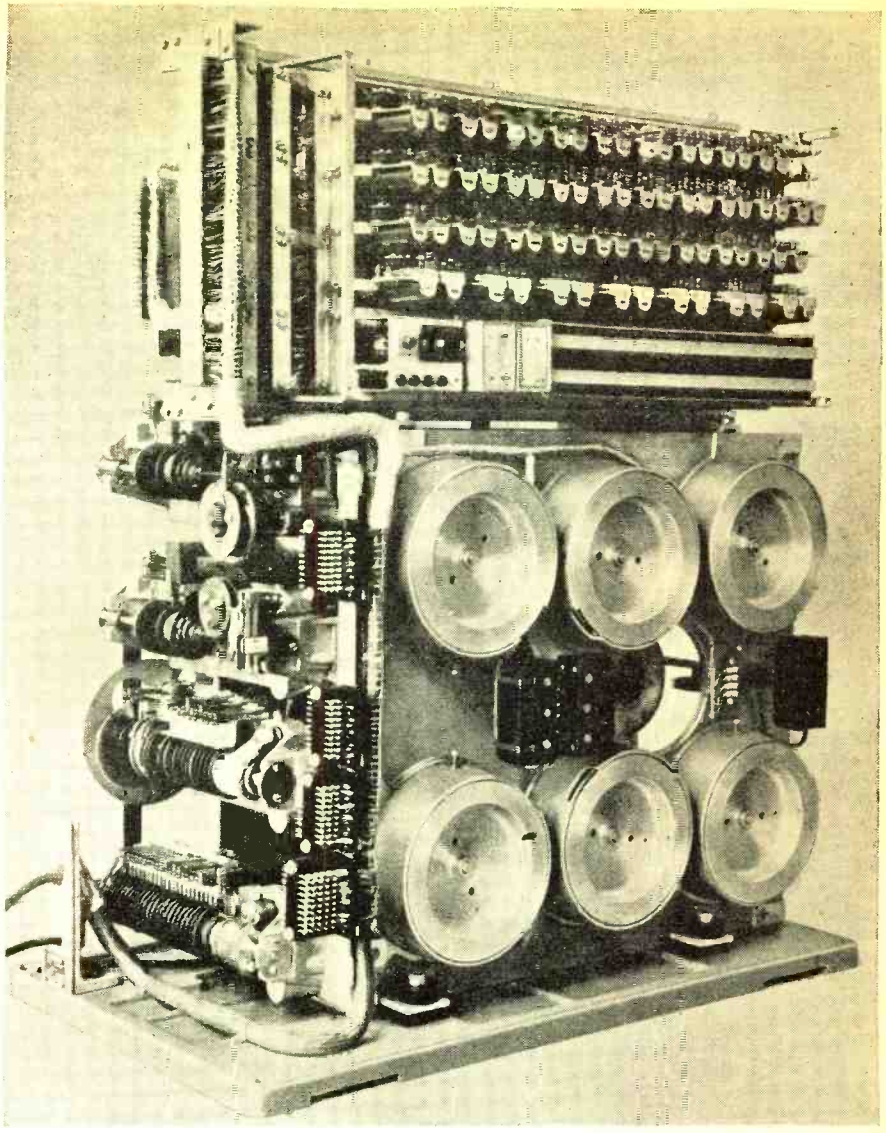
After this sentence has been pronounced, cam 6_c again closes its contacts, thus stopping motor M_1, through C_2 and C_1, and simultaneously switching on motor M_2, which controls the reverse motion of the sound recording wire. This movement is interrupted by cam 6_b. At the same time, C_2 engages motor control mechanism C_3 which controls the feed of the recording unit.

C_3, through relays *F*, switches over amplifiers E_1 and E_3 to recording, and M_3 takes care of the feed of spool Y_1, which carries the sound recording wire. The cam-disc 9, driven through the reduction gear P_2, opens its contact immediately after being started up, while cam-disc 8, mounted on a friction clutch, is held in its initial position by the pawl. The sound recording wire drawn along by Y_1 is magnetized by the sound head Z_2 (which is connected to E_3) in accordance with the vocal frequency applied. The impulse relay *J*, connected to amplifier E_1 through a current rectifier, supervises the arrival of the speech impulses. C_3 remains in engagement as long as the caller continues to speak. At the end of the call, the caller rings off. Since the relay *J* receives no further impulses, the timing device *T*, through C_3, measures off an interval of 12 seconds. If during this period, relay *J* is not again excited, the device *T* drops again, thus switching C_3 out of circuit and bringing about, as a result of the dropping of relay *U*, the switching back of the service line to the ordinary telephone receiver. The entire instrument is then back in its position of rest.

The same operations are repeated for each fresh recording, cam-disc 9 performing each time a rotary movement within the limits of an angle corresponding to the duration of the recording.

When the subscriber rings up his own number for the purpose of hearing calls recorded during his absence, he hears the usual announcement

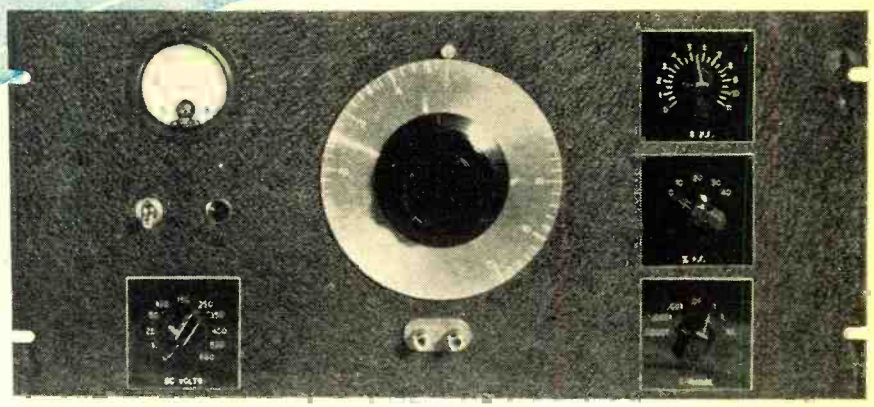
(*Continued on page* 102)



Recording apparatus with sound carrier and sound heads. When set in motion, the various relays and contact switches open or close circuits electronically.

A CAPACITANCE TEST BRIDGE

By
JOHN M. HEINRICH



Front panel view of home-built test instrument. The main control is R_{13}. To the left is S_1 and to the right, from top to bottom, are R_1, S_2, and S_3.

A direct reading test instrument. Condensers ranging from 1 μμfd. to 100 μfd. can be analyzed accurately under simulated operating conditions.

MOST servicemen have occasion to use a capacitance test bridge and one which can be built easily and inexpensively becomes a doubly welcome addition to the test bench equipment in a service shop.

The heart of this instrument is a modified general purpose bridge. Its advantages over the Wien bridge are that a single standard can be used for extremely wide ranges of measurement, each range varies in decade steps, and a polarizing voltage can easily be applied across the unknown without affecting the bridge or accuracy. As with any precision equipment, the factors of accuracy and reliability depend solely upon reliably stable and accurate bridge elements, and painstaking care in calibration. The fact that resistive elements are used to change the range simplifies both design and calibration in that it is usually much easier to determine the value of resistive elements as compared to that of reactive elements. The circuit is neither critical nor complex, but extreme care must be used in wiring for optimum results. Strong and solid construction is also a necessity that should not be casually overlooked.

In the original instrument the standard condenser (C_1) is a high quality mica with a rated capacity of .01 μfd. and a working voltage of 2500 volts. The actual measured capacity is .011 μfd. The variable resistance (R_{13}) is a *General Radio,* type #314 potentiometer rated at 10,000 ohms, and a measured value of 9165 ohms. In any duplications of this instrument, it is suggested that the counstructor try to match the resistance to the standard condenser instead of the reverse. Both time and expense can be reduced to a minimum in a search for the correct value of the standard.

This ratio of resistance to capacitive reactance, approximately 1 to 25 on the high end of the capacity dial and 1 to 250 on the low end, was experimentally found to give optimum results for both capacity and power factor measurements. A higher ratio will tend to slightly, but unnecessarily, increase the null point sensitivity for capacity measurements, but it will also, at the same time, decrease the power factor sensitivity. A smaller ratio will tend to generally decrease the over-all bridge sensitivity and drag the null point over a considerable portion of the dial. This combination begins showing the approaching null point three divisions removed either side of balance, and between 1 and 10 of the capacitance dial introducing 10% power factor causes the meter indication to decrease 80%. These features add considerably to the over-all accuracy of measurements. However, between 0 and 1 of the capacitance dial, the capacity null point is extremely sharp and the power factor determinations are almost as insensitive. Neither type of measurement is recommended in this portion of the dial.

The power factor control is a 25,000 potentiometer (R_1) and the decade resistors (R_2, R_3, R_4, R_5) are 24,000

Over-all performance data for the test bridge.

Capacitance Range: 1 μμfd. to 100 μfd. in seven decade ranges. Values are read directly from a linearly calibrated dial and multiplier switch.

Capacitance Accuracy: Within 2% over the main decade (1-10) of the dial for all ranges. On the lowest range, if the zero capacity of the bridge is taken into consideration (1 μμfd.), the same accuracy can be maintained if the unknown is connected directly to the terminal posts. On this range this method is recommended.

Power Factor Range: 0-50% in five decade ranges. Values are read directly from a linear potentiometer scale and a decade selector switch. Total power factor equals the sum of the two readings. The variable element covers 10% power factor and the selector switch introduces four 10% increments. In this way an extremely high degree of accuracy can be maintained as compared to conventional methods.

Power Factor Accuracy: Dependent upon the accuracy of the standard condenser and the tolerance of the resistances. With care an accuracy to within 2% can very easily be secured.

Voltage Applied to Unknown: Varies continuously with the setting of the bridge. For small capacities it is approximately 30 volts and decreases with range so that at 100 μfd. it is approximately 1 volt r.m.s.

Polarizing Voltage: A built-in power supply provides up to 600 volts d.c. in ten steps.

Controls: Capacitance dial, capacitance multiplier switch, power factor control, power factor decade switch, polarizing voltage selector switch and power switch.

ohms, 1 w. units. In any duplication of this instrument, the correct total value, for the series fixed resistors and the potentiometer, for 50% power factor measurement will be equal to ½ the reactance of the standard condenser at the bridge frequency.

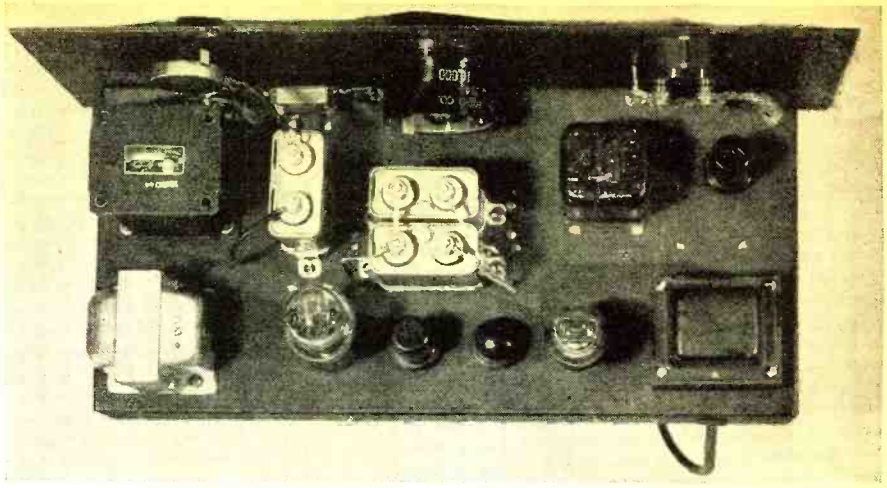
The seven range resistors are all 2 watt units padded out to the correct value. With this setup it is possible to keep the error as low as .6% for all ranges.

The terminal insulators are low-loss *General Radio,* type 274-Z, and the terminal posts are also *General Radio,* type 138-VD.

The bridge supply transformer is a government surplus driver transformer for 2A3's to 100TH's. The full primary winding is connected across the a.c. line, but only the outer half of the split secondary is used to supply the bridge outfit. The series condenser (C_6), 3 μfd., 1000 v., is to limit the voltage across the unknown condenser for the highest ranges; to protect the transformer in case the terminal posts are shorted, especially on the last three highest ranges; and to prevent the polarizing voltage from being shorted out by the transformer winding. The voltage rating of this condenser must be greater than the polarizing voltage to be applied since this voltage appears across the condenser. The value is not critical and can be increased (capacity and working voltage) to increase the null sensitivity of the bridge on the last range. The resistance side of the bridge should be grounded to prevent body capacity from affecting measurements, as well as to stabilize the lower ranges. This grounded side will produce the least stray capacity across the terminal posts and this feature should be duplicated for that reason. The resulting stray capacity, after calibration of the instrument, measured only 1 μμfd., whereas without a ground it increased to approximately 12 μμfd.

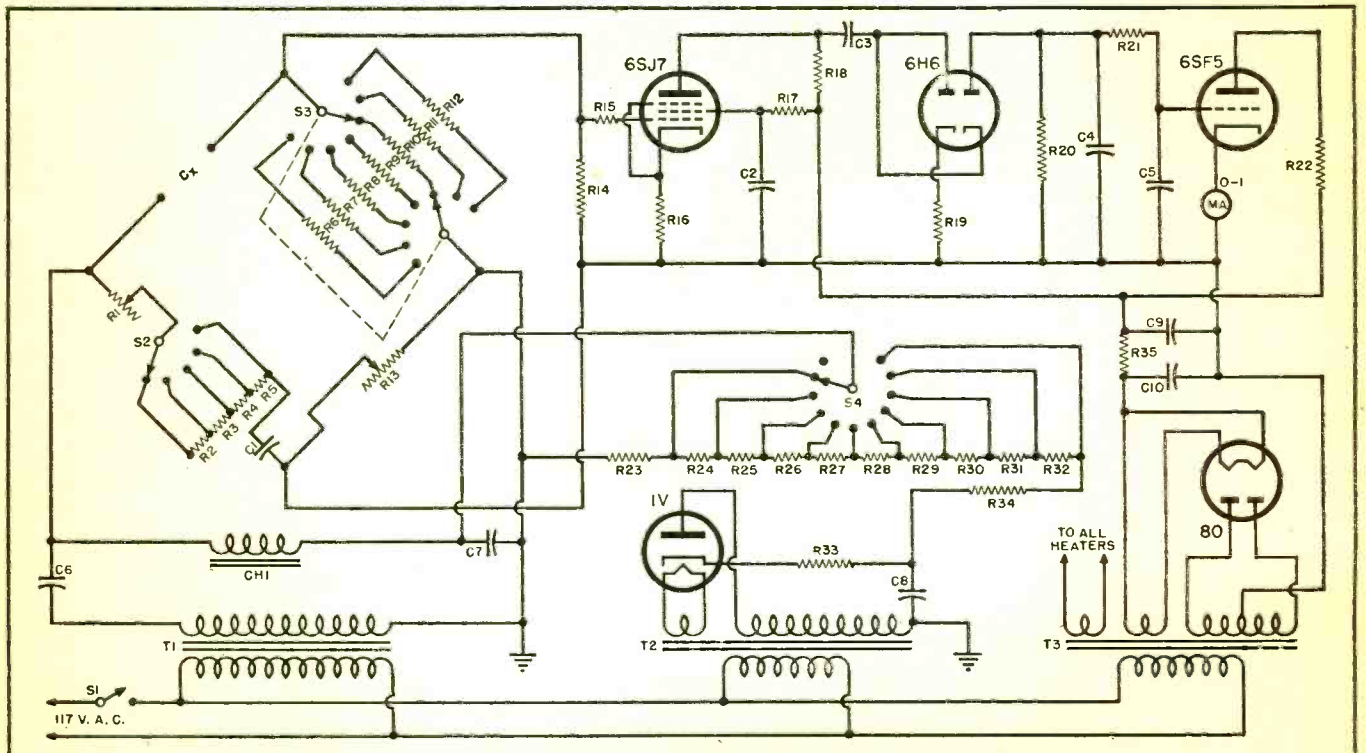
The choke, CH_1, is also a government surplus item. Its value is neither

(*Continued on page* 148)



Top view of completed test instrument. The relative placement of component parts is important and should be followed as closely as possible.

Schematic diagram of a.c. operated capacitance test bridge. Parts are easily obtainable or are to be found in most junk boxes.



R_1—*25,000 ohm, wirewound pot. (Clarostat S-58 Code 101A)*
R_2, R_3, R_4, R_5—*24,000 ohm, 1 w. res. ±1%*
R_6—*1 ohm, 2 w. res. ± 1%*
R_7—*10 ohm, 2 w. res. ± 1%*
R_8—*100 ohm, 2 w. res. ±1%*
R_9—*1000 ohm, 2 w. res. ± 1%*
R_{10}—*10,000 ohm, 2 w. res. ± 1%*
R_{11}—*100,000 ohm, 2 w. res. ± 1%*
R_{12}—*1 megohm, 2 w. res. ± 1%*
R_{13}—*10,000 ohm wirewound pot. (General Radio #314)*
R_{14}, R_{15}, R_{20}, R_{21}—*1 megohm, ½ w. res.*
R_{16}—*1500 ohm, ½ w. res.*
R_{17}—*2.2 megohm, ½ w. res.*
R_{18}—*500,000 ohm, ½ w. res.*
R_{19}—*40,000 ohm, ½ w. res.*
R_{22}—*200,000 ohm, ½ w. res.*
R_{23}—*2000 ohm, 2 w. res.*
R_{24}, R_{25}—*3000 ohm. 2 w. res.*
R_{26}—*5000 ohm, 2 w. res.*
R_{28}, R_{27}, R_{31}—*10,000 ohm. 2 w. res.*
R_{28}, R_{29}, R_{30}, R_{32}—*20,000 ohm, 2 w. res.*
R_{34}—*15,000 ohm, 2 w. res.*
R_{35}—*40,000 ohm, 2 w. res.*
C_1—*.01 μfd.. 2500 v. mica cond.*
C_2, C_3—*.03 μfd., 400 v. cond.*
C_4, C_5—*.01 μfd., 400 v. cond.*
C_6, C_7, C_8—*3 μfd., 1000 v. elec. cond.*
C_9, C_{10}—*10/10 μfd.. 450/450 v. elec. cond.*
S_1—*S.p.s.t. toggle sw.*
S_2—*S.p. 5-pos. rotary sw.*
S_3—*D.p. 7-pos. rotary sw.*
S_4—*S.p. 11-pos. rotary sw.*
MA—0-1 ma. d.c. meter
T_1—*Driver trans. from PP2A3s to PP100TH's grids was used (Stancor #A-4212 or any equivalent with 3:1 ratio may be used—see text)*
T_2—*Power trans. 650 v. @ 40 ma.; 6.3 v. @ .3 amp.*
T_3—*Power trans. 325-0-325 v. @ 40 ma.; 6.3 v. @ 1 amp.; 5 v. @ 2 amps.*
CH_1—*See text*
1—6SJ7 tube
1—6H6 tube
1—6SF5 tube
1—80 tube
1—1V tube

Antenna Loading Problems and Solutions

By J. T. GOODE
Asst. Chief Eng., Packard-Bell Co.

Standard panel light bulbs are the only pieces of equipment required to properly match antenna to transmitter.

ANYONE who loads a transmitting antenna for the first time soon finds out there is considerably more to the problem than what appears on the surface. The necessity of a proper match for transferring electrical power is a well established fact. Ways and means of accomplishing this result are numerous. To the engineer holding a college degree, the problem is purely mathematical. To the newcomer in radio, the problem is normally solved by an infinite number of experiments which result in a questionable answer. This same type of answer may be experienced by the engineer if he relies wholly on mathematics to create the proper match.

When a transmitter is correctly matched to an antenna, the mathematical solution is achieved. Mathematical solutions to such problems deal with all circuits in a perfect state, which is seldom possible. Such being the case, the engineer must be in a position to decide where a compromise can be made in the effort to obtain perfection. The purpose of this article is to show short cuts with various r.f. loading problems.

Many different types of low impedance transmission lines are now available. The first thing to keep in mind is that the proper impedance transmission line is required for different types of antennas. For instance, a folded dipole type antenna requires a 300-ohm transmission line for proper termination. The proper transmission line for a doublet antenna is 72 ohms.

Assuming that the proper impedance transmission line has been selected for a particular antenna, the next step would be proper termination at the transmitter end. Commercially constructed pickup coils are now available with a known impedance. If such a coil is not used, the correct number of turns can be established by experimentation.

Assuming the antenna is erected and the transmission line terminated on both ends to the best of your ability, the next move will be to make final adjustments and to determine that the adjustments are giving a maximum transfer of power from the transmitter to the antenna.

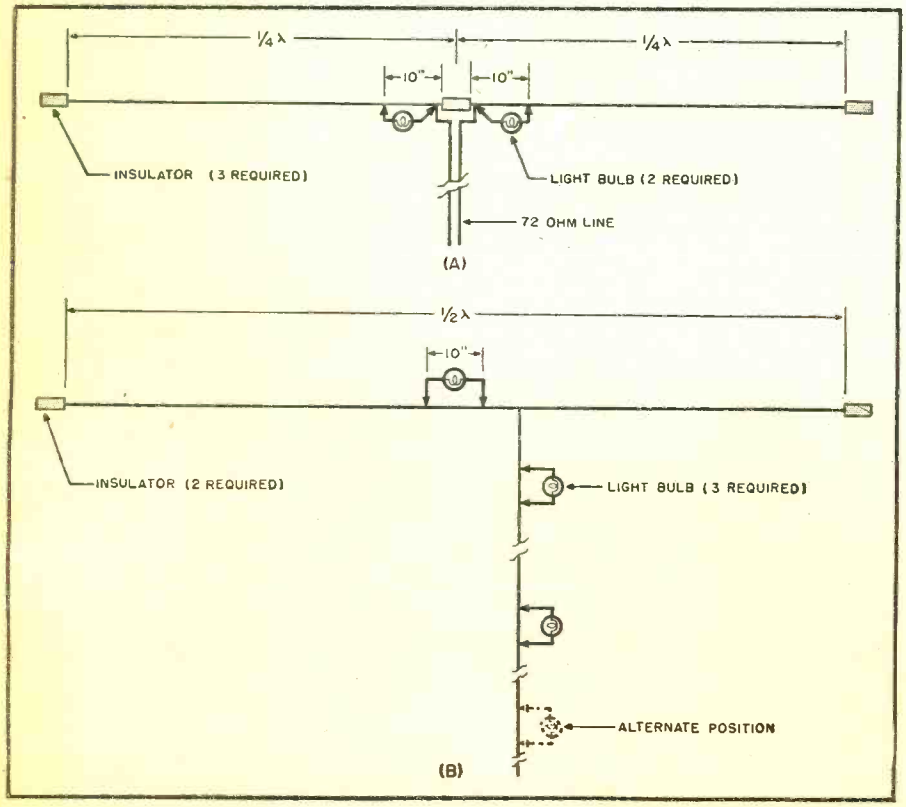
Proper termination on the antenna end of the transmission line can only be obtained when the antenna length is a half wavelength at that particular frequency. When the transmitter frequency is shifted above or below this center point, a noticeable decrease in transmitter load will result. Antennas naturally take a maximum load at one freqnuency, so as the frequency is changed two things cause the antenna loading properties to decrease—mismatch of the transmission line and incorrect antenna length for the particular frequency.

Although there are many methods of making final adjustments on an antenna, the author selects the following for reasons that can be readily understood, namely, economy and accuracy with a minimum amount of time and effort.

The use of two sensitive r.f. microammeters is perfectly satisfactory for the following adjustments, but the

(*Continued on page* 108)

Fig. 1. Pilot lights used to match doublet antenna (A) and off-center Hertz antenna (B).



Build Your Own TELEVISION RECEIVER

Complete construction details for a TV receiver that covers all channels from 44-88 mc.

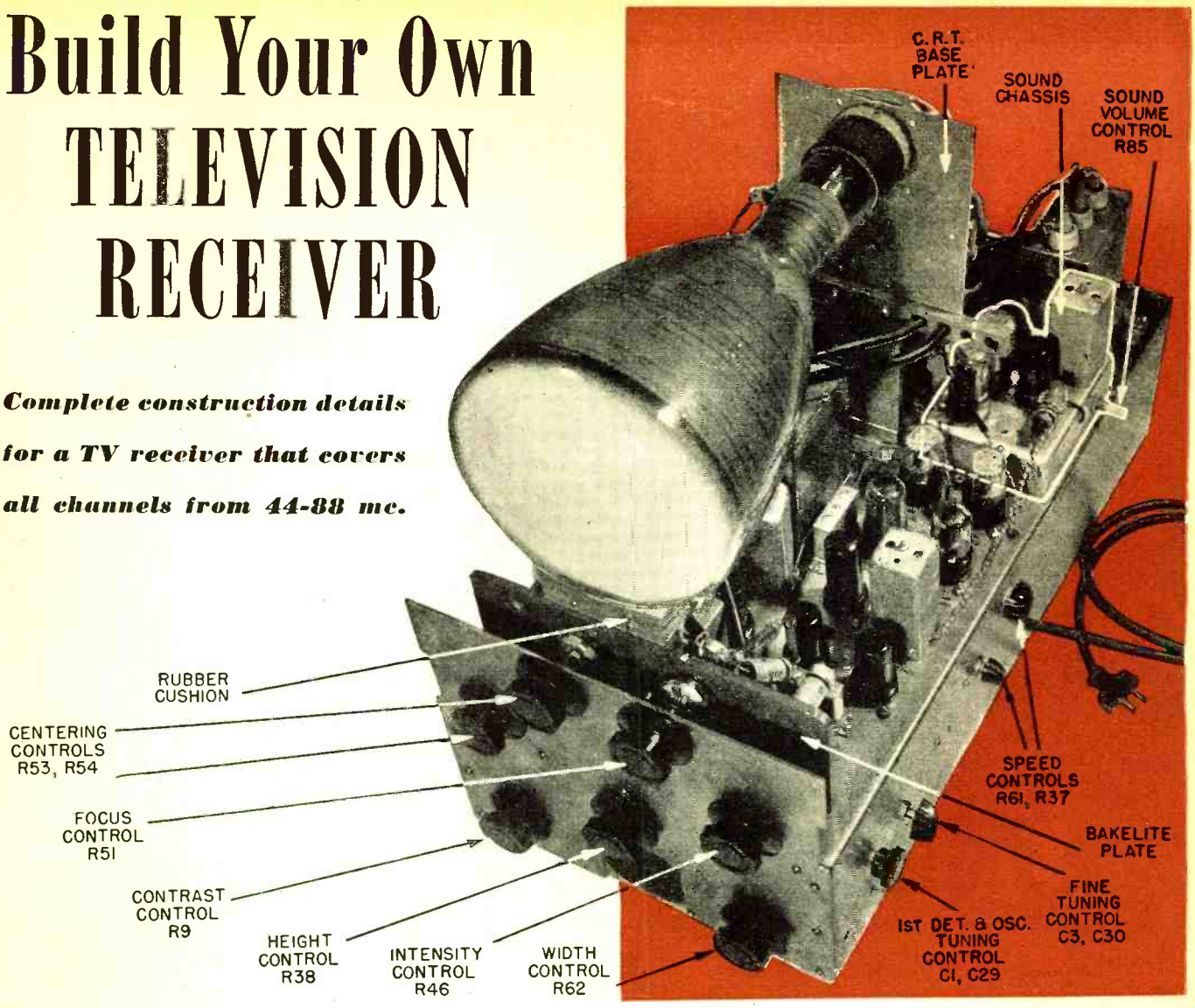


Fig. 1. Top-front view of completed television receiver with video tube shown in place. This unit has been converted from a war surplus type BC-412 oscilloscope. Many of the original components used in the oscilloscope are utilized in this set.

By

LEON S. WECKER and TOM GOOTÉE

AN EXCELLENT home television receiver can be constructed from the principal parts, tubes, and chassis of a low-cost, war-surplus oscilloscope; the type BC-412.

The completed television set has a 5-inch picture tube, self-contained high-voltage and low-voltage power supplies, and a video and sound circuit that is efficient and modern in every respect. Following the first detector stage are four sound stages feeding a PM speaker and five video stages feeding the grid of the cathode-ray tube. Necessary horizontal and vertical sync and control voltages for the picture tube are supplied by conventional circuits.

Using the easily obtained BC-412 war-surplus oscilloscope as the *basis* for this television receiver, actual cost of conversion is remarkably low, because the normally expensive components—used in the power supplies—are included in the complete oscilloscope unit.

The required scope is an Army Signal Corps type—numbered either BC-412-A or BC-412-B—easily recognizable by its large steel cover and by its excessive weight. It was originally used with the *first* mass-produced Army radar set (the SCR-268), but is now available at a very nominal price through most radio firms dealing in surplus war equipment.

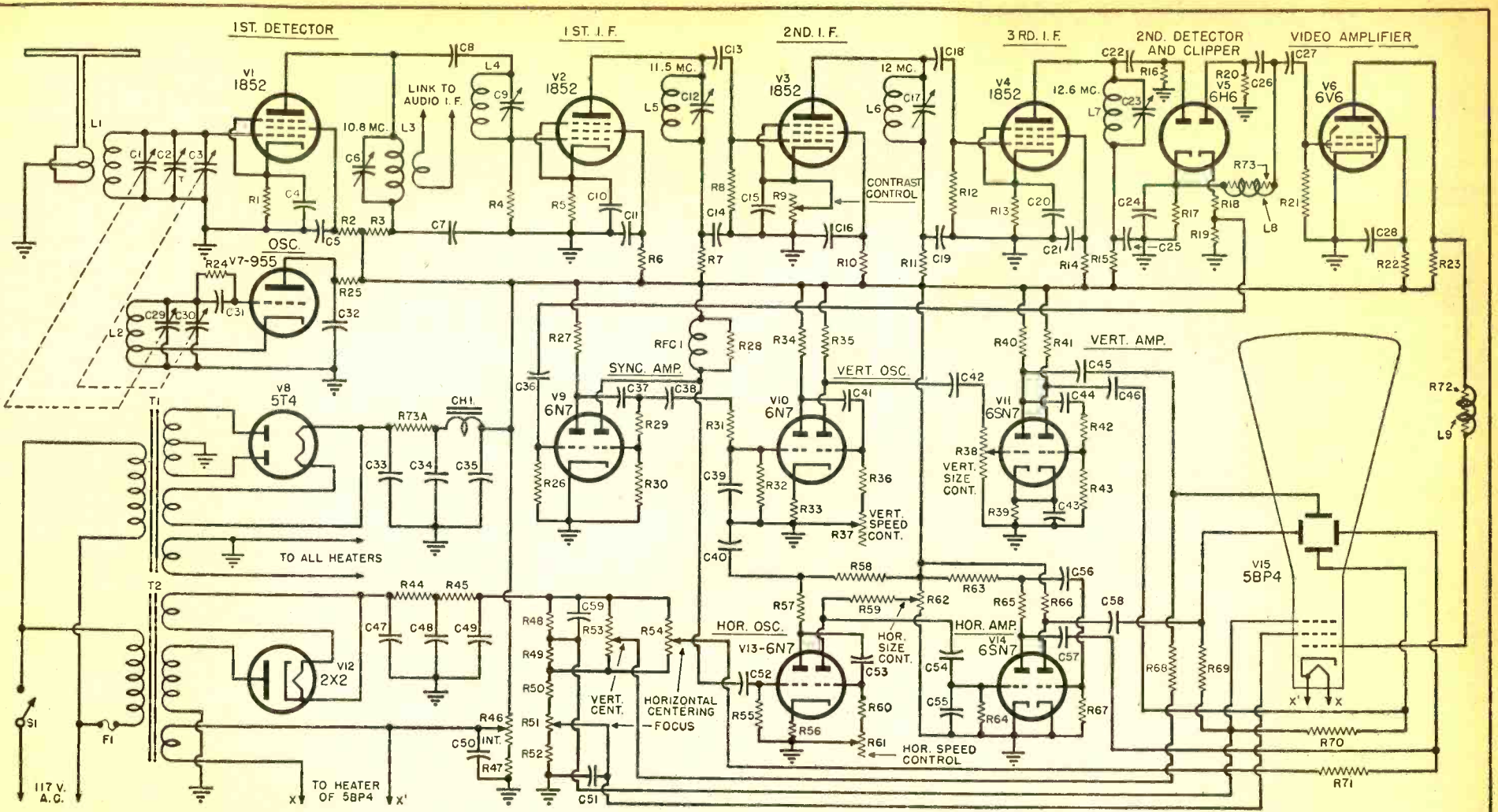
However, the BC-412 scope selected for conversion *must* be equipped with a type 5BP4 cathode-ray tube. Some of the available surplus scopes have a tube with a greenish-tinted screen which is *not* satisfactory for video reproduction.

EDITOR'S NOTE: *The techniques used in constructing and servicing television receivers are far removed from those used for AM receivers. Because television receivers are comprised of various intricate circuits it should be borne in mind that in order to successfully construct the unit described in this article one should have had some previous practical experience in the construction of radio equipment.*

This television receiver, designed by Leon S. Wecker, W2FZR, may also be constructed, in the same manner described, using standard parts and components purchased individually. Circuit arrangement and wiring should be relatively the same as shown in accompanying illustrations. The process may be tedious, however. The simplest method of construction is to buy a surplus BC-412 scope and perform the conversion according to these instructions.

In performing any work, adjustment, or repair of television sets and circuits, *always take proper safety precautions!*

Operating voltages often are as high as several thousand volts. Use tools that are well insulated. Avoid direct contact with any part of a television circuit! Even when the set is turned off, exercise extreme care, since the circuits contain high-voltage condensers that may still be charged.



R_1, R_{33}, R_{56}—500 ohm, ½ w. res.
R_2, R_8, R_{10}, R_{14}, R_{29}, R_{47}—100,000 ohm, ½ w. res.
R_6, R_7, R_{11}, R_{15}—1000 ohm, ½ w. res.
R_4, R_8, R_{12}, R_{16}—2500 ohm, ½ w. res.
R_5, R_{13}—200 ohm, ½ w. res.
R_9—50,000 ohm pot. with sw.
R_{17}, R_{39}—4000 ohm, ½ w. res.
R_{18}—5000 ohm, ½ w. res.
R_{19}, R_{28}, R_{55}, R_{63}—2000 ohm, ½ w. res.
R_{20}, R_{32}, R_{67}, R_{69}, R_{71}—1 megohm, ½ w. res.
R_{21}, R_{34}, R_{35}, R_{36}, R_{40}, R_{41}, R_{45}, R_{50}, R_{59}—500,000 ohm, ½ w. res.
R_{22}—5000 ohm, 10 w. res.
R_{24}, R_{25}, R_{31}—20,000 ohm, ½ w. res.
R_{26}, R_{30}, R_{42}, R_{64}, R_{68}, R_{70}—2 megohm, ½ w. res.
R_{27}, R_{20}, R_{60}—10,000 ohm, ½ w. res.
R_{37}, R_{62}—500,000 ohm pot.
R_{38}—2 megohm pot.
R_{48}—60,000 ohm, ½ w. res.
R_{44}, R_{57}, R_{58}, R_{65}, R_{66}—50,000 ohm, ½ w. res.
R_{46}, R_{61}—100,000 ohm pot.
R_{18}, R_{49}, R_{52}—200,000 ohm, ½ w. res.
R_{51}, R_{53}, R_{54}—200,000 ohm pot.
R_{72}, R_{73}—.5 megohm 2 w. res. (See coil table)
R_{73A}—300 ohm, 50 w. res.
C_1, C_{29}—50 μμfd. variable cond.
C_2—2-plate trimmer (Comp. type)
C_3, C_{30}—10 μμfd. trimmer (Fine tuning cond.)
C_4, C_5, C_8, C_{10}, C_{11}, C_{13}, C_{15}, C_{16}, C_{18}, C_{20}, C_{21}, C_{22}, C_{32}, C_{41}, C_{54}—.01 μfd., 600 v. cond.
C_6, C_9, C_{12}, C_{17}, C_{23}—See text
C_7, C_{14}, C_{19}, C_{25}, C_{56}—.006 μfd., 600 v. cond.
C_{24}—25 μμfd. mica cond.
C_{26}, C_{27}, C_{28}, C_{36}, C_{37}, C_{38}, C_{39}, C_{40}, C_{42}, C_{43}, C_{44}, C_{60}, C_{61}, C_{50}—.1 μfd., 600 v. cond.
C_{31}—100 μμfd. temp. compensated cond.
C_{33}, C_{34}, C_{35}—8 μfd., 450 v. elec. cond.
C_{45}, C_{46}—.01 μfd., 2500 v. cond.
C_{47}, C_{48}, C_{49}—.1 μfd., 4000 v. cond.
C_{52}—100 μμfd. mica cond.
C_{53}, C_{58}—.001 μfd., 600 v. cond.
C_{57}, C_{59}—.002 μfd., 2500 v. cond.
L_1, L_2, L_3, L_4, L_5, L_6, L_7, L_8, L_9—See coil table
RFC_1—2½ mh. r.f. choke
S_1—S.p.s.t. sw. on R_9
F_1—110 v., 1 amp. fuse
CH_1—8 hy., 150 ma. filter choke
T_1—Power trans. 375-0-375 v. @ 150 ma.; 5 v. @ 2 amps.; 6.3 v. @ 8.5 amps.
T_2—Power trans. 2500 v. @ 10 ma.; 2.5 v. @ 1.75 amps.; 6.3 v. @ .6 amp.

Whether the set is off or on, don't take chances with high voltage! Death hides in small wires and innocent looking components!

Preparing the Chassis

First step in converting the BC-412 scope is to remove the heavy steel case or cover. Then unscrew and remove the four handle brackets on the chassis.

Examine the main components above and below the chassis, and become familiar with their location and appearance, especially parts associated with the power supplies. A circuit diagram of the scope is glued to the shield surrounding the cathode ray tube, and this diagram can be used to identify parts and components.

Remove all tubes from their sockets, taking care in handling the type 5BP4 cathode-ray tube and its round metal shield.

Next strip and remove all wiring above and below the chassis—*with the exception of wiring associated with the low-voltage and high-voltage power supplies and the filament connections.* Use a soldering iron; don't cut wires! Some of them may be used later in rewiring the chassis.

The top portion of the steel front panel is sawed off on a horizontal line that will just clear the tops of the two highest controls when the knobs are in position.

At the bottom center of the steel front panel cut an opening suitable to accommodate a 5-inch PM speaker, and drill mounting holes.

A bakelite or wooden support bracket for the cathode-ray tube should be attached to the top of the large bakelite plate (just behind the steel front panel). Heavy felt or other cushioning material should be used on the top surface of this bracket, so that the tube rests securely.

The chassis is now ready to be rewired, according to the circuit diagram of Fig. 2.

Use wire having adequate insulation for voltages likely to be encountered. If in doubt, use *heavier* insulation! For all high-voltage leads use ignition cable.

Always allow adequate spacing between adjacent wires, particularly in crowded parts of the receiver. All high-voltage circuits are wired in *above* the chassis.

Use a good grade of solder with rosin core for connections, avoiding cold-soldered joints. Most likely sources of later trouble and defective operation are; badly soldered and loose connections, insufficiently insulated wiring, and improperly shielded and bonded wiring.

C-R-T Control Circuits

First to be mounted and wired are the four variable controls used with the high-voltage circuit of the cathode-ray tube. These are the potentiometers controlling; *HORIZONTAL CENTERING, VERTICAL CENTERING, FOCUS,* and *INTENSITY.*

Mounting holes for seven controls are already positioned in the steel front panel, and the upper four are now used to accommodate the proper potentiometers.

They are mounted behind the large bakelite plate, so that their shafts extend out and pass through the mounting holes in the front panel. These four high-voltage controls *must* be properly insulated from their shafts by means of insulated couplings (Figs. 1 and 3). Original knobs can then be replaced on the four protruding shafts.

Since the high-voltage circuits are wired in *above* the chassis, the height of these four potentiometers makes their position ideal for all wiring. Select the proper values of associated resistors, and connect the high-voltage control circuits according to the circuit diagram.

Use ignition cable for all wiring. Make certain the proper size potentiometers are used for the four panel controls. Note that the resistance value of the *INTENSITY* control is 100,000 ohms.

Nomenclature of the original four controls (printed on the face of the steel front panel) should now correspond to the function of the new television controls.

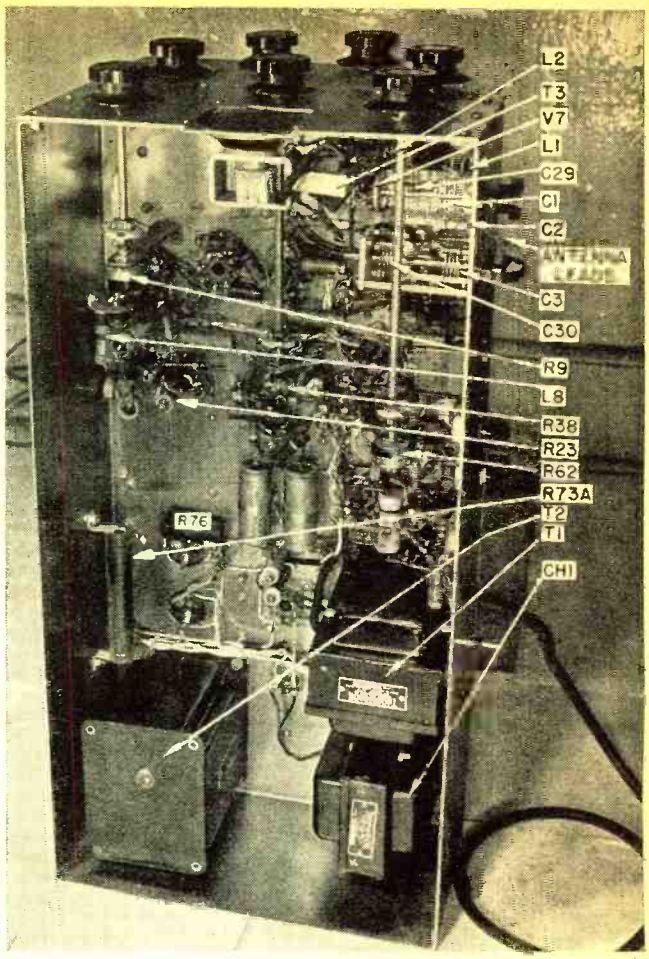


Fig. 3. Under-chassis view of completed receiver. Note that all components are grouped closely to form their respective stages. Sound trap, L_1 (not visible in the photo), is mounted directly under the tuning condensers. C_3, C_{30}.

C-R-T Amplifier Stages

Next to be connected are the *horizontal amplifier* and *vertical amplifier* stages which control the operation of the picture tube.

The two amplifiers are somewhat similar in design, each using a type 6SN7 tube in a stage of phase-inverting amplification and each performing a similar, though independent, function. Saw-tooth waves previously generated by the *horizontal oscillator* stage are amplified by the *horizontal amplifier* and then applied to the horizontal deflecting plates of the picture tube, causing the electron beam to sweep horizontally across the face of the tube at a high frequency. Saw-tooth waves previously generated by the *vertical oscillator* stage pass through the *vertical amplifier* and are then applied to the vertical deflecting plates of the picture tube, causing the electron beam to sweep vertically at a lower frequency.

Mount the tubes for the *horizontal amplifier* and *vertical amplifier* close to the cathode-ray tube (Fig. 4). Then wire the two stages according to the circuit diagram.

Bias for the *horizontal amplifier* tube is obtained from the rectified grid current.

Couple the output of each amplifier through the 2500 w.v. condensers (mounted behind the cathode-ray tube base plate and socket), and then connect to appropriate deflecting plates of the picture tube.

C-R-T Oscillator Stages

The *horizontal oscillator* and *vertical oscillator* stages operate similarly but independently, each using a type 6N7 tube in a modified multivibrator arrangement to generate a saw-tooth voltage waveform. The *horizontal oscillator* provides a high-frequency wave which is coupled to the *horizontal amplifier* stage. The *vertical oscil-*

←

Fig. 2. Complete schematic diagram of the video section of the home-built television receiver. The diagram covering the audio channel for this receiver is shown in Fig. 5.

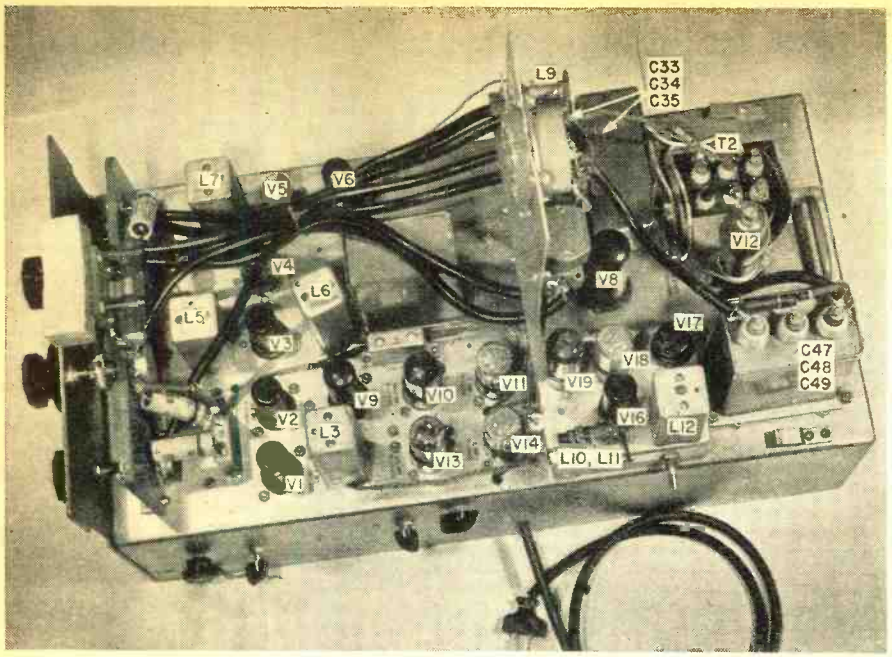


Fig. 4. Top view of completed television receiver, with cathode-ray tube removed. Note cushioned bracket for picture tube. High voltage units are toward rear of the chassis near the actual tube connections. The large, unidentified can, mounted in the center of the chassis, contains a bank of .1 μfd., 600 v. condensers.

lator provides a saw-tooth wave of lower frequency which is coupled to the *vertical amplifier* stage.

When free-running, each oscillator functions at a frequency determined by the resistance-capacitance balance in the grid and plate circuit. However, when sync pulses from a television transmitter are amplified (by the *sync amplifier* stage) and applied to the grid circuit of each oscillator, the multivibrator "locks" with the frequency of the incoming sync pulses.

In this manner the *horizontal oscillator* and *vertical oscillator* stages produce saw-tooth waves *in ratio to each other* and in frequency according to the incoming sync pulses from the *sync amplifier* stage.

Referring to the parts arrangement shown in Fig. 4, the *vertical oscillator* tube is placed in front of the *vertical amplifier* tube, and the *horizontal oscillator* tube is placed in front of the *horizontal amplifier* tube.

Wire the two oscillator circuits according to the circuit diagram, after proper controls have been mounted.

The free-running frequency of either oscillator stage is controlled by varying the resistance in the grid circuit. The *horizontal oscillator* uses a 100,000 ohm variable resistor known as the *HORIZONTAL SPEED* control. And the *vertical oscillator* uses a 500,000 ohm variable resistor known as the *VERTICAL SPEED* control. Mount both controls on the side of the chassis near their respective oscillator tubes so that the grid leads are as short as possible.

Amount of output voltage from the *horizontal oscillator* is controlled by means of a 500,000 ohm potentiometer known as the *HORIZONTAL SIZE* control, or the *WIDTH* control.

Amount of output voltage from the *vertical oscillator* can be varied by means of a 2 megohm potentiometer known as the *VERTICAL SIZE* control, or the *HEIGHT* control. These two controls determine the width and height of the television image on the screen of the cathode-ray tube.

The *HEIGHT* and *WIDTH* controls are mounted underneath the chassis, each on a bracket that is part of the steel chassis. Extension shafts *with insulated couplings* protrude through openings in the lower part of the steel front panel (Fig. 3). Original knobs can be placed on the two protruding shafts, and their panel designations changed to *HEIGHT* and *WIDTH* respectively.

Preliminary Test

At this point; a preliminary check of the assembled equipment can be made to test the operation of the scope control circuits.

First, turn *all* controls on the front panel to the *"OFF"* position (full counter-clockwise) and apply 110-120 volts a.c. to the power stages.

Turn up the *INTENSITY* control slowly—until a faint spot appears on the screen of the picture tube.

Then vary the position of the *FOCUS* control to obtain the smallest and sharpest pin-point of light. However, don't make the spot too bright, since this may seriously damage the screen of the tube.

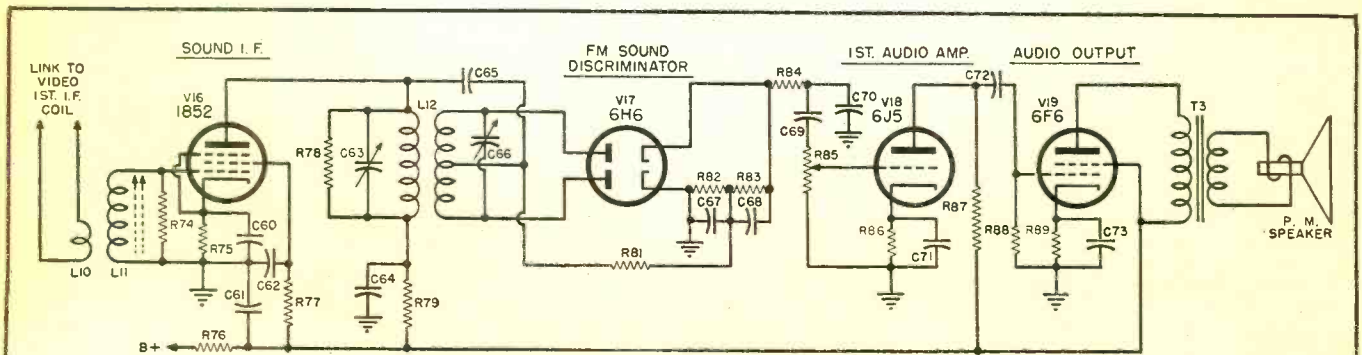
Next, check the operation of the two centering controls. Any adjustment of the *HORIZONTAL CENTERING* control should cause a horizontal movement of the spot on the screen. Adjustment of the *VERTICAL CENTERING* control should cause a vertical movement of the spot. Action of the two centering controls must be independent of each other.

If the spot fails to react to one or more of the four front panel controls, turn off the equipment and recheck all wiring relative to these circuits.

If the spot reacts favorably, advance the *HORIZONTAL SIZE* or *WIDTH*

(*Continued on page* 134)

Fig. 5. Schematic diagram of the audio section of the television receiver. This channel is link-coupled to the video section.



R_{74}, R_{78}—200,000 ohm, ½ w. res.
R_{75}—200 ohm, ½ w. res.
R_{76}—100 ohm, 10 w. res.
R_{77}, R_{82}, R_{83}, R_{87}—100,000 ohm, ½ w. res.
R_{79}—1000 ohm, ½ w. res.
R_{81}, R_{84}—75,000 ohm, ½ w. res.
R_{85}—500,000 ohm pot.
R_{86}—2500 ohm, ½ w. res.
R_{88}—250,000 ohm, ½ w. res.
R_{89}—500 ohm, 5 w. res.
C_{60}, C_{62}, C_{64}, C_{69}, C_{72}—.01 μfd., 600 v. cond.
C_{61}—8 μfd., 450 v. elec. cond.
C_{63}, C_{66}—See text
C_{65}, C_{67}, C_{68}—100 μμfd. mica cond.
C_{70}—.001 μfd., 600 v. cond.
C_{71}, C_{73}—5 μfd., 50 v. elec. cond.
Speaker—5" PM speaker
T_3—Output trans. 6F6-to-voice coil
L_{10}, L_{11}, L_{12}—See coil table

Practical TRANSFORMER DESIGN and CONSTRUCTION

By C. ROESCHKE

Part 3. Concluding article covering the design and construction of iron core transformers and reactors.

IN THIS final article on transformer design we will discuss the design and construction of a plate modulation transformer, and an audio output transformer. Several valuable hints on the practical construction of transformers are also included for the assistance of the builder.

A modulation transformer, like any audio power transformer, is designed to match the output impedance of one piece of equipment to an input impedance of a second piece of equipment. This matching is done to insure maximum power transfer and satisfactory frequency response.

When a load is connected to the secondary winding of an audio transformer, there is reflected into the primary circuit an impedance which is determined by the turns ratio of the transformer. This is the ratio of the number of turns in one winding to the number of turns in the other winding.

Mathematically, the turns ratio is equal to the square root of the ratio of the two impedances, or *turns ratio* = $\sqrt{Z_1/Z_2}$.

For example, consider a transformer which is to work out of a 5000 ohm circuit into a load of 50 ohms. Then

$$\text{Turns ratio} = \sqrt{\frac{\text{Primary Impedance}}{\text{Secondary Impedance}}}$$

$$= \sqrt{\frac{5000}{50}} = \sqrt{100} = 10$$

This means that the primary winding must have ten times as many turns as the secondary to match the 5000 ohm primary circuit to the 50 ohm secondary load.

For the purpose of design demonstration, assume that a plate modulation transformer is required for the following conditions of operation.

1. Modulator output is push-pull pentodes requiring load impedance of 10,000 ohms and that each tube draws 60 ma. plate current.
2. Audio output power to be 7.5 watts.
3. The Class C r.f. amplifier to be plate modulated draws plate current of 70 ma. at 420 volts.
4. Voice frequencies are to be used.

The secondary load resistance is equal to the r.f. amplifier d.c. plate voltage divided by the r.f. amplifier plate current. In this case then: $R = 420/.07 = 6000$ ohms

To calculate turns ratio:

$$\text{Turns ratio} = \sqrt{\frac{10{,}000}{6000}} = 1.29$$

Therefore, the primary must have 1.29 times the number of turns used in the secondary.

When a transformer is employed in the plate circuit of a vacuum tube, it is necessary that it be designed to reflect the proper load impedance for the tube. In addition, the primary inductance will determine the low frequency response of that audio stage. For this reason, Fig. 16 is included to indicate proper primary inductance for good low frequency response at 50 cycles or 150 cycles. Fig. 9 ** can be used to calculate the primary inductance. Since our modulator tubes are pentodes and we are interested only in voice frequencies, we see in Fig. 16 that the primary inductance should be about 10 henrys.

Fig. 5* shows that the primary could be wound with No. 34 wire to carry 60 ma. and the secondary can be wound with No. 33 wire for 70 ma.

For convenience we shall use No. 33 for both windings.

This transformer is to handle 7.5 watts so, according to Fig. 17, we can try to design it with 1" laminations and a stack of 1".

Let us tabulate the data we have so far:

Primary impedance = 10,000 ohms
Primary d.c. = 60 ma.
Primary inductance = 10 hy.
Primary wire size = No. 33
Secondary impedance = 6000 ohms
Secondary d.c. = 70 ma.
Secondary wire size = No. 33
Core size = 1" stack of 1" laminations
Turns ratio = 1.29

First let us try 2700 turns, center tapped, for the primary winding. Then the secondary must have 2700/1.29 = 2090 turns. Next we calculate the coil size as explained previously and find that the build is 81 per-cent which means that the coil will fit into the core.

The primary is for push-pull tubes and therefore must be center tapped at 1350 turns. Since "B+" is connected to the center tap, the direct current flows in opposite directions in each half of the winding which means that the core saturation effect is cancelled out as far as the primary is concerned. But the secondary has 70 ma. d.c. flowing through its entire length in one direction and this must be considered in the calculation of inductance.

Then for the secondary, $NI = 2090 \times .07 = 146$. But we are interested in the primary inductance so let us convert this effect into the primary. Thus:

Since $NI = 146$
Then $2700 \times I = 146$
And $I = 146/2700 = .054$ amp.

This means that 54 ma. flowing in the 2700 turns primary would give the same core saturation effect that 70 ma. flowing in the secondary would give. For this reason we shall use the figure 54 ma. in our primary inductance calculation.

(*Continued on page* 123)

Fig. 16. Primary inductance required for good response at low frequencies.

FOR TRIODE TUBE			FOR PENTODE TUBE		
D.C. Plate Resistance Ohms	Inductance for 50 cycles	Inductance for 150 Cycles	Load Impedance * Ohms	Inductance for 50 Cycles	Inductance For 150 Cycles
800	3.5 hy.	1.0 hy.	2500	8.5 hy.	3.0 hy.
1000	4.5 hy.	1.5 hy.	4000	13.0 hy.	4.0 hy.
1500	6.5 hy.	2.0 hy.	5000	16.5 hy.	5.0 hy.
2000	8.5 hy.	3.0 hy.	6000	20.0 hy.	6.0 hy.
3000	13.0 hy.	4.5 hy.	7000	25.0 hy.	7.0 hy.
5000	20.0 hy.	5.5 hy.	8000	27.0 hy.	8.0 hy.
10,000	40.0 hy.	15.0 hy.	10,000	33.0 hy.	10.0 hy.
			15,000	50.0 hy.	15.0 hy.

* This is plate-to-plate impedance for push-pull tubes.

* Figs. so designated appear in Part 1 of this article published in the June issue of Radio News.
** Figs. so designated in Part 2 of this article published in the July issue of Radio News.

and is ready to receive a signal from the recording head. The application of a supersonic signal to the recording head provides a bias, as mentioned previously, and helps to overcome the nonlinearity of the normal magnetization curve of the magnetic material.

Magnetic Materials

We will avoid the term wire recorder wherever possible inasmuch as magnetic recording techniques apply equally to other materials such as paper tape and paper discs to which has been added a coating of magnetic material. In addition, certain alloys have been found which give excellent results in magnetic recording.

Recording Bias

Either d.c. or a.c. bias will improve the linearity of the magnetic material magnetization curve, as previously mentioned. The following will explore the advantages and disadvantages of each.

Referring to Fig. 8 we see the magnetization characteristics of a typical magnetic material. Beginning at point *A*, with the material demagnetized, the magnetizing force *(H)* is increased to point *B* and then reduced to zero. The material, however, has become permanently magnetized and the flux density *(B)* does not return to zero but instead only drops to a value of *C*.

If the magnetizing force had been increased to point *D* and then reduced to zero, the residual flux density would now correspond to *E*. Note that *(B)*, the residual flux density is not proportional to *(H)*, the field intensity. This is a source of nonlinearity better illustrated in Fig. 9 where the residual flux density is plotted against original magnetizing force. From the origin to point *X* the characteristic is very nonlinear. Between points *X* and *Y* the linearity is excellent while after *Y* it again becomes nonlinear. Obviously, for good reproduction some biasing is necessary to enable operation on the linear section between *X* and *Y*. Two systems—one using d.c. and the other a supersonic bias, have been developed and are widely used.

The d.c. bias employs a saturation erase. The material in passing the erasing head is magnetized to point *D* (Fig. 8) and therefore will return to a residual flux density of *E*. (*D-E-M-N* is the hysteresis loop of the material.)

In order to operate on the linear portion of the loop to the left of *E* a fixed negative field, *F*, is applied to the material by the recording head. When the material leaves the recording head, the flux density decreases along a nearly straight line to *G*. Suppose a signal superimposed upon the fixed negative bias varied the field intensity between *H* and *J*. If the material leaves the influence of the recording head pole-pieces, when the field intensity is *J*, the flux density would proceed along the practically straight line to *K*. From *H* it would have gone to *I*. Within a limited range in the neighborhood of *F* the lines *H-I*, *F-G*, and *J-K* will be almost straight and parallel. This means that the induced reproducing voltages will be linearally related to the recording fields.

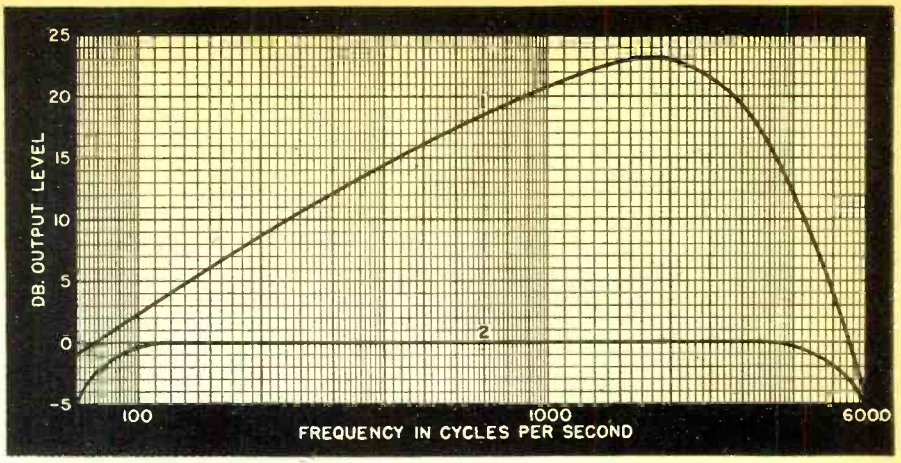


Fig. 5. Frequency response curves for wire recorder. Curve 1 shows output level minus corrective network. Curve 2 shows output with corrective network.

Of great importance is the magnitude of the fixed negative bias employed. If this bias is too small, the signal will be distorted by the nonlinear section near *E*. Too large a bias will cause signal distortion by carrying over into the section near *M*. There is a limit to the magnitude of the recording audio field, for the curve is linear only in a limited region around *F*. In addition, too large a field will produce distortion. We have ignored the self-demagnetization effects of thin sections of material such as are used in magnetic recording. Demagnetization will tend to further reduce the amplitude of linear recording when d.c. bias is employed.

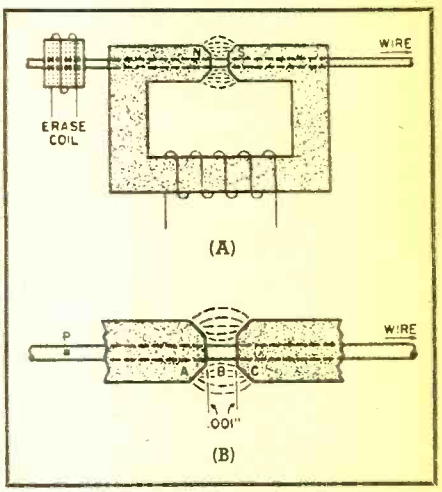


Fig. 6. (A) Cross sectional view of magnetic wire recording head. (B) Drawing illustrates details of the recorder pole pieces.

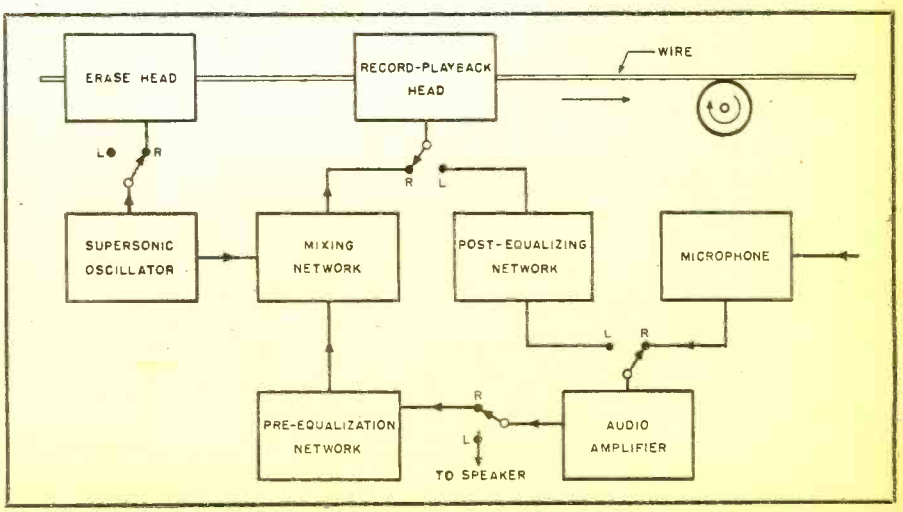
Supersonic Biasing

To overcome the nonlinearity of the magnetization curve, supersonic biasing was developed. It possesses several advantages over d.c. bias. Supersonic biasing, as its name implies makes use of a supersonic signal (30 kc. is commonly used) as a bias upon which the audio signal is superimposed. Normally the supersonic oscillator is also used for the erasing head, so that the magnetic material enters the recording head completely demagnetized.

Fig. 10 illustrates the action of supersonic biasing. Here a field which is a mixture of the supersonic bias and an audio signal is shown applied to the residual flux density curve. Let us

(*Continued on page* 142)

Fig. 7. Simplified block diagram of a typical wire recorder.



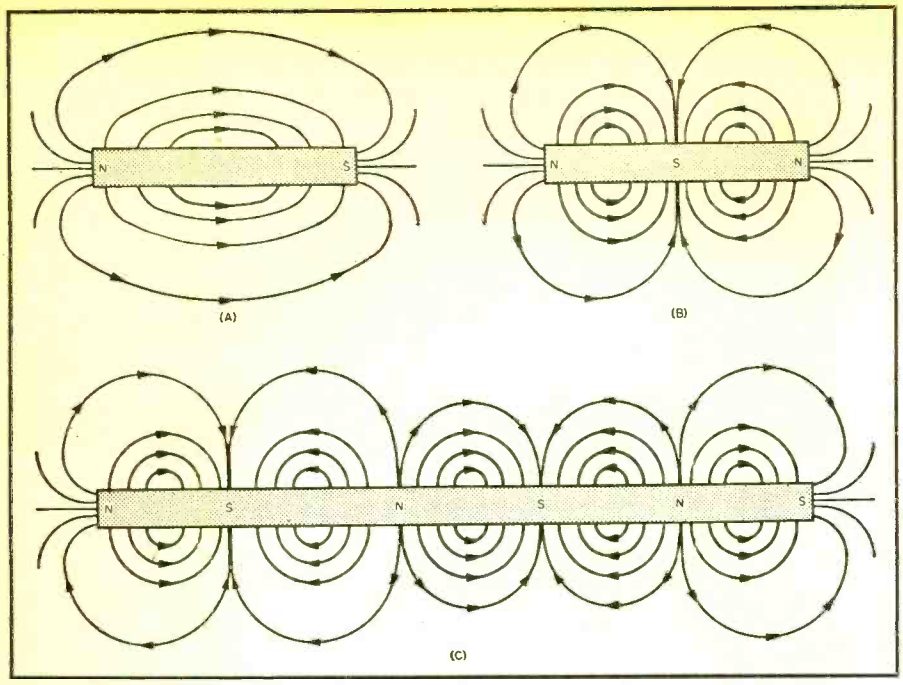


Fig. 1. Methods of magnetizing steel bars. (A) Dipole magnetized; (B) tripole magnetized; and (C) multipole magnetized steel bar.

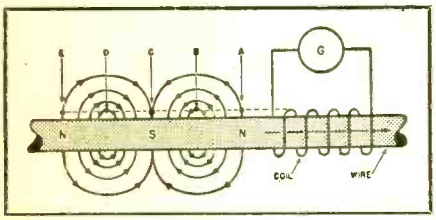


Fig. 2. How variations of magnetic field intensity are converted to an a.c. voltage.

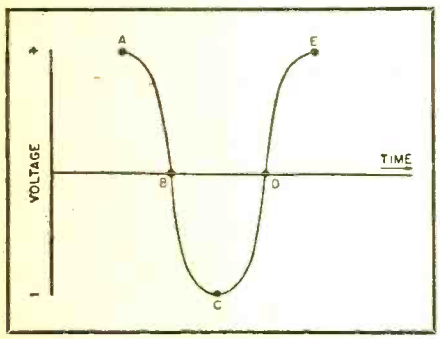


Fig. 3. Waveform (output voltage) on recording head when wire is magnetized as in Fig. 2. Peak voltage occurs when coil is at points A, C, and E. At B and D where there is no flux change, voltage is zero.

C. The ratio of the magnetizing force in the gap to that in the poles, may be estimated from the equation:

$$H = \frac{\mu}{B}$$

where:

H is the magnetizing force.
B is the flux density.
μ is the permeability.

Assuming that the flux density B is constant throughout the magnetic circuit, then the magnetizing force varies inversely as the permeability. Since the permeability of the pole-pieces is about 1000 times as great as that of the gap, the magnetizing force inside is only $\frac{1}{1000}$ that of the gap.

The magnet illustrated in Fig. 6A is used also for pickup of the recording from a magnetized wire. Analysis shows that the voltage picked up from the wire can be given by the expression:

$$E = B_m V \sin \frac{\pi W}{\lambda}$$

where:

E is the relative induced voltage.
B_m is the maximum flux density in the wire.
V is the velocity of wire travel.
W is the width of the air gap.
λ is the recorded wavelength.

The frequency response curve calculated from this formula is plotted as curve No. 1 in Fig. 5. Fixed values of $B_m V$, and W, have been chosen in this case. It will be noted that at frequencies low enough so that $\sin \pi W/\lambda$ is practically the same as $\pi W/\lambda$, the output voltage decreases at the same rate as the frequency. This limits the low frequency response.

High frequency response is limited by length of the recording gap, and also by the demagnetizing effect of adjacent magnetic poles at short wavelengths. The frequency characteristic can be made fairly flat by the use of a corrective network, as shown in curve No. 2 in Fig 5.[1]

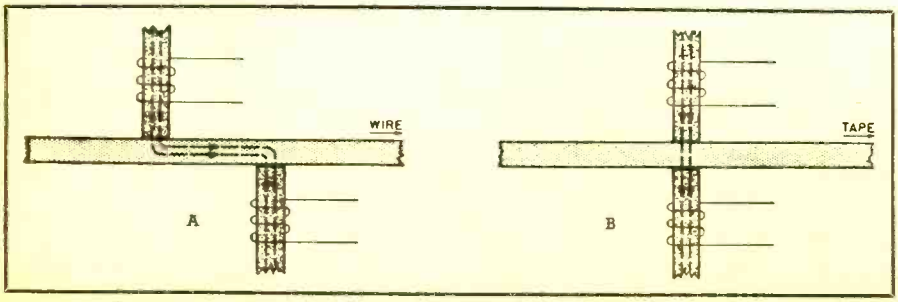
Generally speaking, magnetic recording machines are not particularly complicated. A magnetic material, such as wire or tape, is drawn past a recording head. As it passes through the head, the material becomes and remains magnetized. The amount of magnetization remaining in the material at each instant is governed by the impressed signal upon the recording head. In playing back, the magnetized material is drawn past a playback head. The varying magnetization which remains in the material induces corresponding voltages in the coil of the playback head. In modern practice the recording and playback heads are incorporated into a single unit.

The erasing of a signal from a magnetic material is accomplished by means of an erase head. This head impresses a field upon the material, which, erasing the old signal, makes the material ready to receive another signal or to be re-recorded. Basic components of magnetic recorders include the magnetic material, the record-reproduce head, and the erase head. In addition are the other component parts such as the drive mechanism, the spools or containers for the wire or tape, a compensated record and playback amplifier, conventional microphone, speaker, and special filter systems to overcome the nonlinearity of the magnetization curve of the recorded material.

It was discovered, following initial experiments with wire recording, that the application of a supersonic signal to the recording head was necessary to provide a bias to overcome the nonlinearity of the normal magnetization curve of a magnetic material.

Fig. 7 is a block diagram of a typical magnetic recorder. It will be noted that in the "record" position, the supersonic oscillator serves double duty by providing high frequency for both the demagnetizing head and the recording head. First the magnetic material passes through the erase head. The material is demagnetized

Fig. 4. (A) Longitudinal magnetization of wire using two pole pieces. (B) Perpendicular magnetization of tape using two pole pieces.



[1] Camras, Marvin. Armour Research Foundation. "A New Magnetic Wire Recorder" Radio-Electronic Engineering Edition of Radio News, November, 1943.

The RECORDING and REPRODUCTION of SOUND

Wire recorder becomes modern dictating machine

By OLIVER READ
Editor, Radio News

Part 6. Covering the theory and practice of various methods employed in magnetic recording on wire, tape, and non-metallic, magnetically coated materials.

PRESENT methods of sound recording by magnetic means are the result of discoveries of Valdemar Poulsen, a Danish scientist, who, in 1898, experimented with magnetic recording on wire.

It is well known that hard steel can be magnetized to form a bar magnet as in Fig. 1A. It is not as well known, however, that the same bar can also be magnetized as in Fig. 1B, with a north pole at each end, and a south pole at the center. This idea is carried still further in Fig. 1C, which illustrates magnetic poles unequally spaced, and of different strength. It can be shown that within limitations, to be described later, it is possible to form a magnetic pattern corresponding to any desired wave shape.

Suppose that a magnetized bar, such as shown in Fig. 2, were to be pulled at uniform speed through a rather closely fitting coil, in accordance with Faraday's Law of Electromagnetic Induction, there would be an e.m.f. across the coil which is:

$$E = N\, d\phi/dt \text{ abvolts}$$

where:

E is the induced e.m.f.
N is the no. of turns in the coil.
$d\phi/dt$ is the time rate of change of flux.

The output voltage wave is illustrated in Fig. 3. It will be noted that the peak voltage occurs when the coil is at point *A*, *C*, and *E* where the flux change is most rapid. At points *B* and *D*, where the flux change is nil, the voltage is zero.

The principles just outlined were first used by Valdemar Poulsen about forty-five years ago. To magnetize a steel wire longitudinally, he used a pair of electromagnets arranged as in Fig. 4A. While this system worked fairly well, the magnets affected a rather long section of the wire, and necessitated a high wire speed. This may be clarified by the following practical example:

Suppose that it were desired to record a 5000 cycle wave ($f = 5000$) on the wire, and the pole pieces were spaced $\frac{1}{16}$ inch ($\lambda = \frac{1}{16}$). Then the speed corresponding to wavelength of this size would be:

$V = f\lambda = 5000 \times \frac{1}{16} = 312$ in. per sec.

For good waveform the speed might have to be several times this figure.

Obviously, the mechanical problems of handling wire at such high speed were serious. Poulsen's device was bulky and noisy. The wire broke frequently, and pole-pieces wore so rapidly that they had to be renewed like phonograph needles.

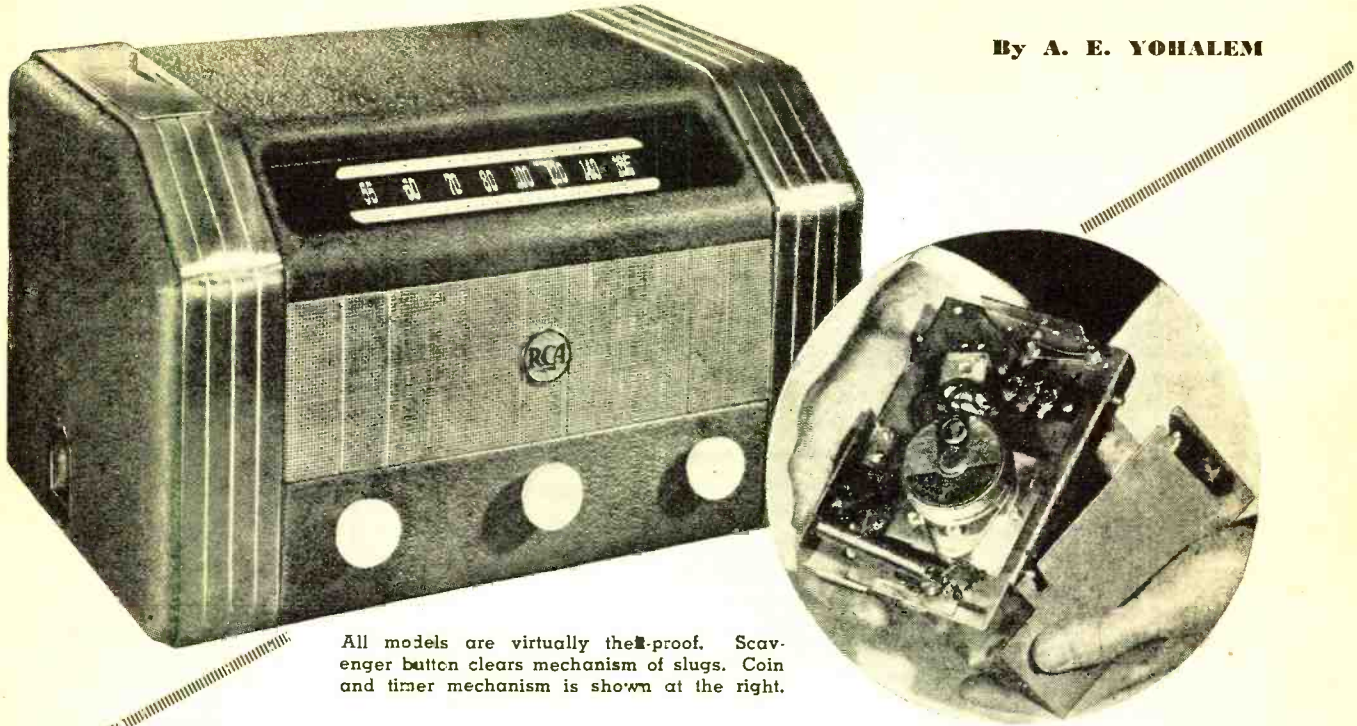
Later experiments tried various methods of decreasing the pole-piece spacing. When the pole-pieces are opposite one another, the limit of decreasing pole-piece spacing is reached, as shown in Fig. 4B. This system is unsuited for use with round wire, because the wire might rotate about its axis between the time a record was made and the time it was played, thus causing objectionable variations in amplitude.

In an attempt to correct the difficulties previously encountered in magnetic recording, experiments at the *Armour Research Foundation* were directed toward a new type of recording head illustrated in Fig. 6. With this new unit, the recording was done in a small air gap, instead of by the use of sharpened pole-pieces. This air gap was made as short as 0.001 inch, so that only a very small portion of the wire was affected at one time.

Point *P* on the wire is moving in the direction indicated in Fig. 6B. When this point is at *A*, in the interior of the pole-piece, the magnetizing force acting on it is practically zero. As soon as it passes into the air gap *B*, it is magnetized by a concentrated field set up by the coil. As the wire continues moving, point *P* passes into the field-free interior of the second pole-piece

YOU PAY BEFORE YOU PLAY

By A. E. YOHALEM



All models are virtually theft-proof. Scavenger button clears mechanism of slugs. Coin and timer mechanism is shown at the right.

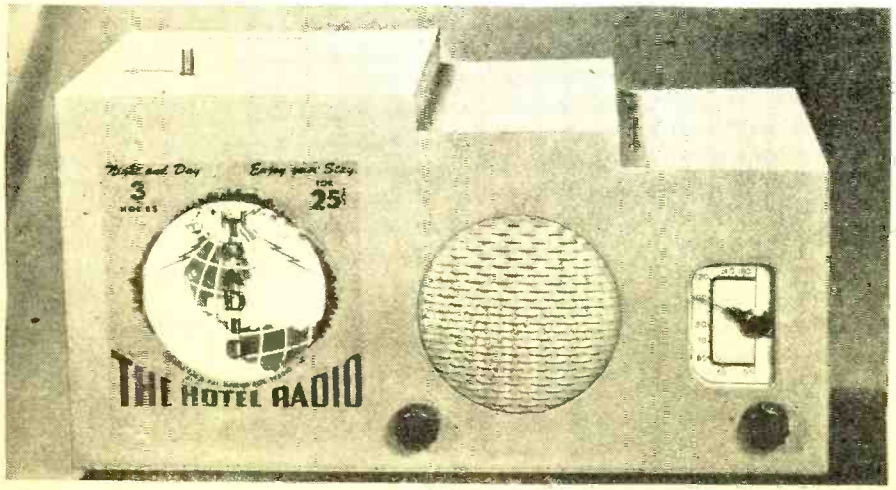
There is a fast-growing market for coin operated receivers. 60,000 units are now in use.

BACK in the 1920's when some unknown gadgeteer first hit on the idea of coupling a coin-operated timing device and a radio set, the scheme was regarded as a momentary fad capitalizing on the novelty of broadcasting. Today, a flood of these coin models is beginning to pour off assembly lines into hotel rooms, tourist cabins, and hospital wards all over the country, and the pay-before-you-play sets are taking their place as a brand new market for radio production.

The clink of dimes and quarters dropping into the slots of some 60,000 sets scattered around the country is playing a pleasant tune for the radio industry. Seeking a new outlet for their booming postwar production, manufacturers expect to sell at least $75,000,000 worth of these slot models within the next two years.

The recent addition of *RCA Victor* to the growing ranks of coin radio manufacturers served notice that the slot set had "arrived" after a twenty year uphill battle. When the first coin radios made their debut in 1927, they followed in the footsteps of a procession of nickel-in-the-slot music boxes, player pianos, and phonographs that had been used in public locations as crowd entertainers. After successful trials in a variety of Chicago locations, ranging from restaurants to barber shops, thousands of coin-operated radios were marketed and placed in similar sites in other large cities. At the same time, several manufacturers turned out timing devices which could be used by location owners to adapt their own radios for coin play.

Housed in a sturdy steel cabinet, this rugged unit is designed to withstand the rigors of coin operation. The cash box holds up to 25 dollars in quarters.



Initial public interest in these slot sets depended on the newly discovered wonders of broadcasting. One advertisement of the period noted that the coin radios "appeal to that inborn desire of everyone to work the controls," while sets were placarded: "It's New! Tune-in Yourself! Hear the colorful tone of radio!"

The development of the coin set paralleled the evolution of radio. Once sets emerged from their early unsightly stage and were electrified, given speakers and single-dial tuning, radio was hailed as an ideal entertainment medium. By 1929, the leading coin-phonograph manufacturers regarded broadcasting as a serious rival, and began to produce combination juke-box and radio units, which either played a record or operated the radio for five minutes when a nickel was dropped into the slot.

These devices sold for as high as $1000, but were crude by modern standards. They oscillated, whistled and howled, and their strong point was the reception of static. Under the unskilled handling of a patron, sets

(*Continued on page* 112)

Run wire from the new speaker to the remote speaker already in service. Connect the voice coils of these speakers in series. If the voice coils are 4 ohms each, we now have a total input impedance of 8 ohms feeding T_1 which makes it necessary to change the tap on T_1 to match. This does not complete our changeover, however, as our master speaker is matched for 4 ohms impedance, and during talk-back operations, the 4 ohms of SP_2 would be feeding into the 8 ohms of T_1. To finish matching, merely add a 4 ohm resistor in series with the voice coil of SP_2 and change the connections on T_2 to match 8 ohms. The switching arrangement for talk-back is not complicated in any way, being simply a double-pole, double-throw switch of the spring-back lever type, which is connected in such a way that the voice coils of the speaker are interchanged.

A *Federal* anti-capacity switch will work as well in this application, as will a conventional toggle switch.

Connecting the input circuit to the grid of the first tube is a little tricky, inasmuch as any attempt to couple the transformer directly to the grid of the 12SQ7 will result in a considerable decrease in gain. From 25% to 50% loss of voltage gain will be experienced, depending on the type of transformer used. As will be noted in Fig. 2, the input transformer T_1 has a 500,000 ohm potentiometer connected across its secondary, while the movable contact of the pot is connected to the grid of the 12SQ7 through the coupling capacitor C_2. The grid circuit is completed by the use of a 5 megohm resistor which tends to keep the grid circuit at a high impedance. The 12SQ7 was chosen because of its high gain characteristics as well as the fact that its filament current rating was identical with that of the 50L6, enabling the two filaments to be connected in series. The resistance-capacitance coupling is conventional and needs no explanation. The 50L6 is a beam power tube capable of delivering up to 2 watts of power output. The bias of —6 volts is developed across R_5 and the bypass capacitor C_5 which is used to smooth out the audio pulses caused by the plate current flowing through R_5. The output transformer T_2 is identical with T_1 and all connections are the same.

Figs. 1 and 3 show the general layout. On top of the chassis are located two tubes, the speaker (SP_2), the two transformers (T_1 and T_2), and the filter choke (CH_1), while below the chassis are the remaining parts. The selenium rectifier is shown mounted under the chassis at the left rear. At first glance it might appear that the rectifier has been mounted too close to the filament dropping resistor R_6, but careful inspection will show that connections to R_6 are made to the adjustable center terminal and the end terminal farthest from the rectifier. This places the rectifier approximately 2 inches away from the heat of R_6.

In testing and adjusting the unit for final performance, no special instruments are necessary. However, those wishing to check operation critically will employ the following apparatus:

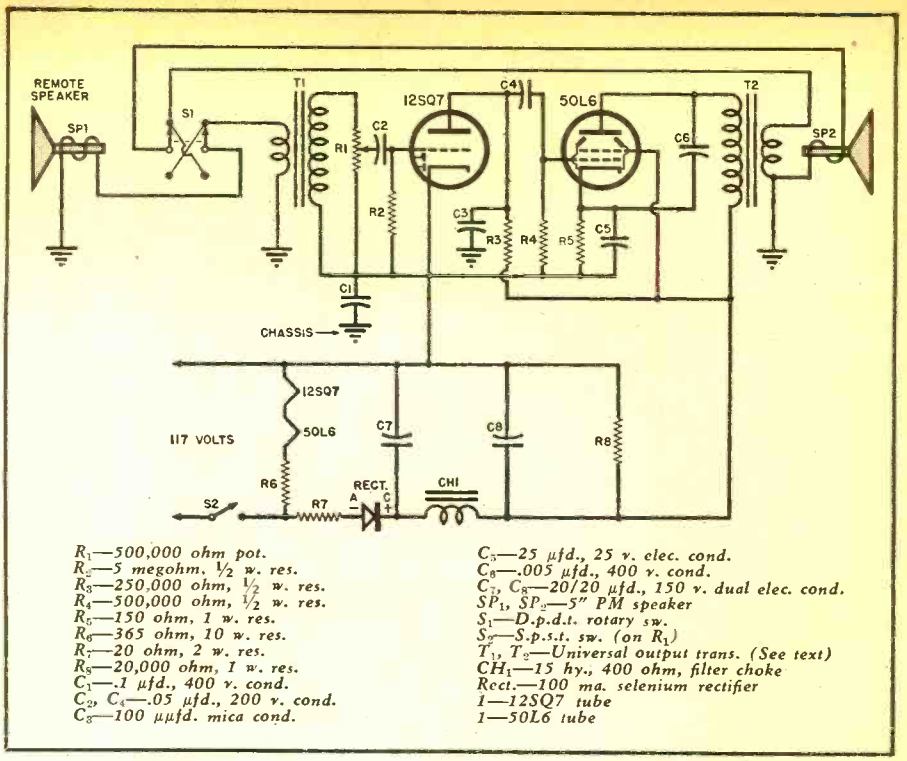
1. A high impedance vacuum tube voltmeter capable of measuring a.c. voltages up to 100 volts r.m.s.
2. An audio oscillator (the 400 cycle fixed type will do).
3. An oscilloscope. Not absolutely necessary, but will help in locating distortion.
4. A d.c. voltmeter of the high resistance type, at least 20,000 ohms-per-volt.

The first step is to ascertain whether or not the tubes are receiving proper d.c. voltages. Connect the negative terminal of the d.c. voltmeter to the negative return (not to the chassis), and the positive terminal to the plate of the 50L6. This should give 85 volts d.c. Next, shift the positive lead to the screen grid where the voltage should be 105 d.c. volts; then to the plate of the 12SQ7 where the voltage should be 60 volts d.c.; and last, to the cathode of the 50L6 where the d.c. voltage should be 6. This cathode voltage has the same value as the negative d.c. on the 50L6 control grid.

The voltages listed above were taken by the author with the line voltage set at 115 volts. Slight variations in d.c. voltages should be expected at different line voltages. Different voltage readings will also occur if the voltmeter has a sensitivity of less than the 20,000 ohms-per-volt value.

Now that the d.c. voltages have been checked, proceed to measure the voltage gain. Connect the audio oscillator across R_1, set its output at .01 volt by means of the v.t.v.m. or by means of

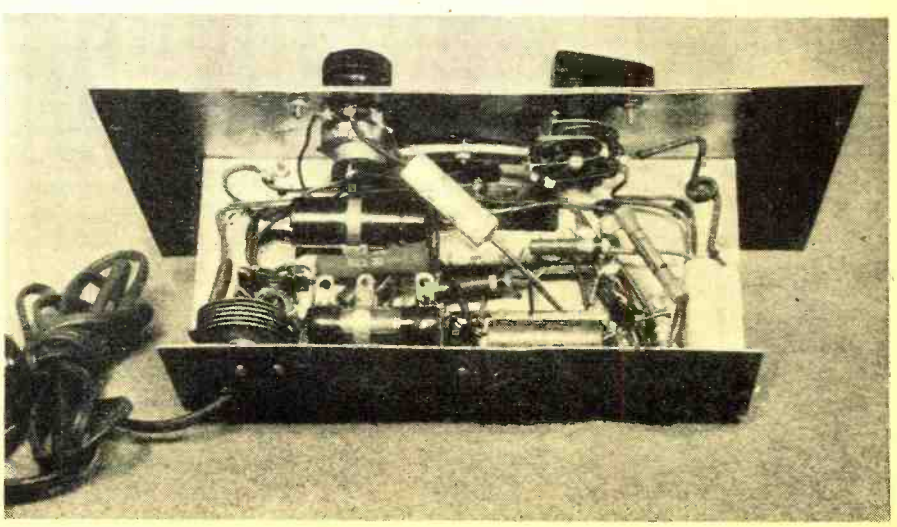
(*Continued on page* 100)



R_1—500,000 ohm pot.
R_2—5 megohm, ½ w. res.
R_3—250,000 ohm, ½ w. res.
R_4—500,000 ohm, ½ w. res.
R_5—150 ohm, 1 w. res.
R_6—365 ohm, 10 w. res.
R_7—20 ohm, 2 w. res.
R_8—20,000 ohm, 1 w. res.
C_1—.1 μfd., 400 v. cond.
C_2, C_4—.05 μfd., 200 v. cond.
C_3—100 μμfd. mica cond.
C_5—25 μfd., 25 v. elec. cond.
C_6—.005 μfd., 400 v. cond.
C_7, C_8—20/20 μfd., 150 v. dual elec. cond.
SP_1, SP_2—5" PM speaker
S_1—D.p.d.t. rotary sw.
S_2—S.p.s.t. sw. (on R_1)
T_1, T_2—Universal output trans. (See text)
CH_1—15 hy., 400 ohm, filter choke
Rect.—100 ma. selenium rectifier
1—12SQ7 tube
1—50L6 tube

Fig. 2. Schematic diagram of intercom. Diode plates of the 12SQ7 are not used.

Fig. 3. Underchassis view. All parts are standard and are readily available.



A Two-Tube INTERCOM

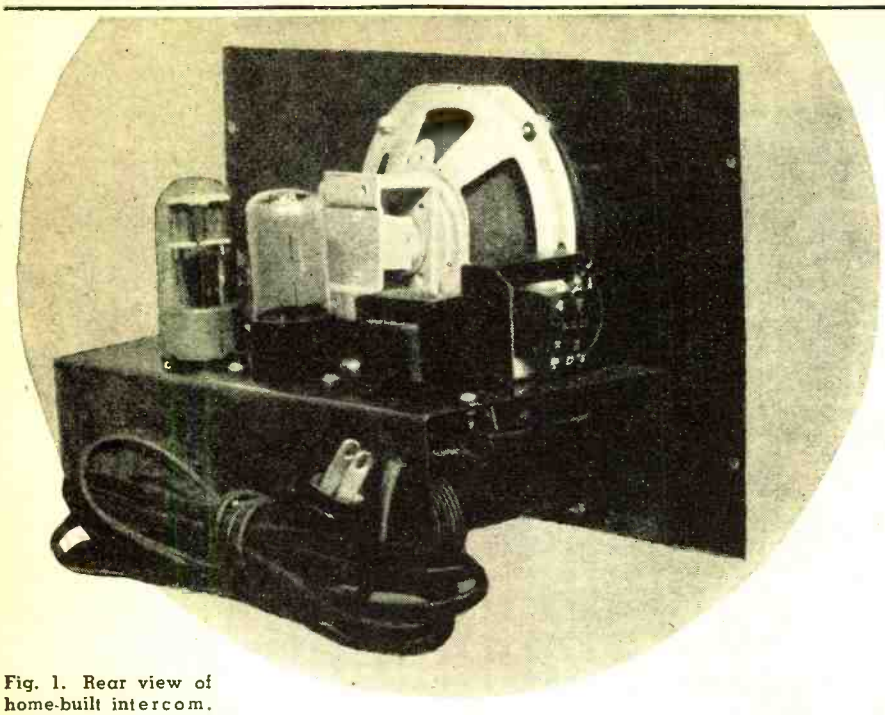


Fig. 1. Rear view of home-built intercom.

By
E. BRUCE PRAY
Eng., Electronics Division
Sylvania Electric Products Inc.

Construction details for a low-cost, two-tube, a.c.-d.c. powered audio amplifier that has been especially designed to be used as an intercom.

HOW often have you wished you had an inexpensive, small, audio amplifier unit? A unit of this type can be hooked up to operate between house and workshop to carry conversations, signals, telephone bell, etc.

A unit for this application should be lightweight for ease of handling; it must be small in size; it must have sufficient gain to insure maximum coverage; it should be equipped with a suitable talk-back arrangement; it should be relatively free of 60 cycle hum; it must also be inexpensive and easy to build.

The "intercom" being presented in this article was built from material which may be found in the "junk" box. It is small sized (5"x7"x12"), weighs only 5 lbs., and has approximately 1.5 watts output. It has sufficient over-all voltage gain to make the drop of a pencil audible. Two tubes make up the total tube complement; a 12SQ7 and a 50L6. The power supply in this case is the new type NC5 selenium rectifier recently placed on the market by *Sylvania Electric Products Inc.* Although this power supply is a half-wave job, there is practically no hum noticeable in the output.

Since the selenium rectifier is relatively a newcomer to the field of rectifiers, a short review of its characteristics is in order.

The selenium rectifier is a compact, rugged, lightweight, heaterless, metallic type of rectifier, measuring only $^{13}/_{16}$" thick by 1⅜" in diameter. It was developed for a wide variety of rectifier applications, especially for small power supplies for home radio receivers. This unit incorporates between two metallic control surfaces, a chemically and electrically treated selenium layer which permits current flow in one direction but blocks it in the other, thus rectifying the applied a.c. In many instances the selenium rectifier has been used to replace a vacuum tube, with an increase in d.c. output resulting from the low voltage drop encountered across the selenium unit.

These units may be used in voltage doubler circuits to great advantage, and a socket for mounting is not required, which, together with the absence of a power transformer, greatly reduces the cost of constructing experimental equipment. It should be noted at this time that there are several precautions that must be observed when using this type of rectifier, namely:

1. Selenium rectifiers are limited to operation at temperatures lower than 75°C (167°F). This means that one should take care not to mount the unit too close to power tubes or high wattage resistors.

2. It must be remembered that this unit (except for the mounting eyelet) is alive (115 volts to ground), therefore take care to keep it away from the chassis and other parts to avoid short-circuits.

3. A series peak limiting resistor must be used with these rectifiers to limit the peak current which could damage the units. A minimum of 20 ohms, 2 watts is recommended, although slightly higher values may be used with a corresponding decrease in d.c. output.

4. Never apply more than 130 volts r.m.s. as the unit is not rated for higher voltages.

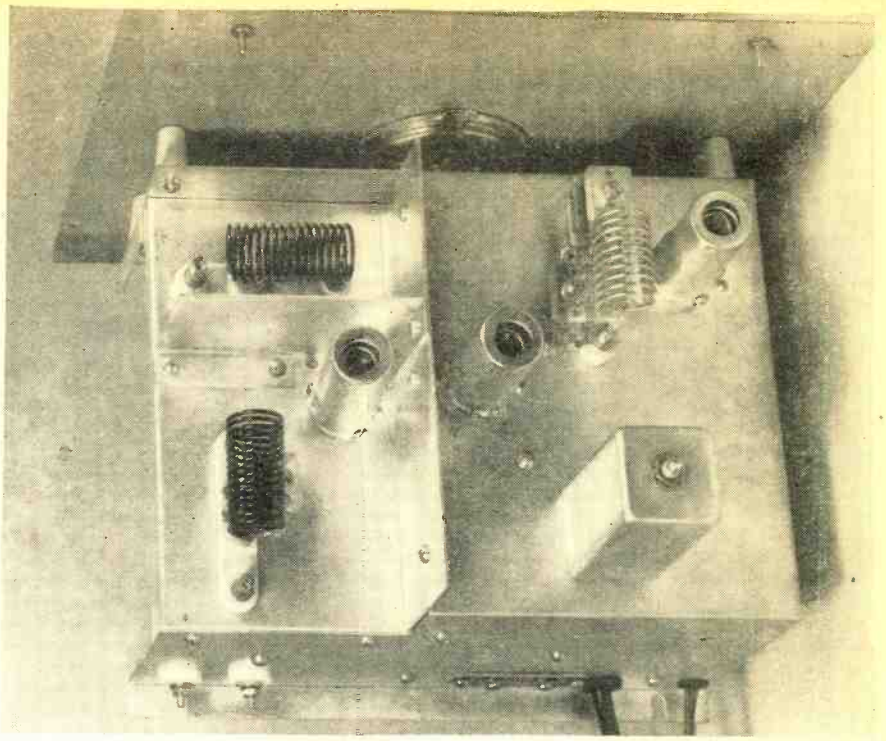
The selenium rectifier is connected with a peak limiting resistor in series with the rectifier anode and the a.c. line. The cathode end of the rectifier, which is the output terminal, is connected to a conventional pi-type filter, consisting of two 20 microfarad electrolytic capacitors and a 15 henry, 400 ohm choke. A 20,000 ohm, 1 watt bleeder completes the power supply which delivers 120 volts at 100 milliamperes. The tube filaments are connected in series and then to the 115 volt line through a 365 ohm, 10 watt resistor (R_6).

Because of the danger of shock to the operator and of blowing fuses, it is very unwise to connect either side of the line directly to the chassis. Instead, connect all the negative returns to a common point and ground this single point to the chassis through a capacitor (C_1). In place of a microphone, a 5 inch PM type speaker with a 4 ohm voice coil is used, feeding into a universal output transformer connected backwards. If the transformer primary is tapped, disregard the tap and use the entire winding for maximum impedance. On the voice coil side, choose the two terminals which will match the 4 ohm voice coil of the speaker. A universal transformer is very useful if you want to match two remote stations instead of one. For example, let us say that after building the unit with one remote station we decide to add another remote station. This can be accomplished in the following manner.

design since the circuit employed is well known for its frequency stability and sure-fire performance. The use of the parallel and series pads, consisting of zero coefficient silver mica condensers with compression type mica trimmers, where specified, results in a high *C* circuit. The use of the fixed condensers, in addition to the trimmer condensers, provides easier adjustment of the bandspread due to the more or less limited tuning range of the trimmer. In addition to this, freedom from drift is assured. It is usually desirable to operate the oscillator on the high frequency side of the incoming signal as less trouble from images and harmonics will result. Needless to say the oscillator may be operated on the low frequency side with equal performance. By tuning the oscillator on the low frequency side of the incoming signal a slightly higher *C* circuit results and therefore presents less likelihood of oscillator drift. Very little oscillator drift, if any, will be experienced, especially after the oscillator coil has had a chance to age and provided that a reasonable amount of care is taken when the oscillator coils are made up.

Each of the r.f. grid coils on both 6 and 10 or 11 meters has a 3 to 30 compression type trimmer connected across it. This condenser is employed to track the grid and the plate circuit of the r.f. stage regardless of whether the antenna employed provides inductive or capacitive reaction.

Oscillator frequency drift is completely eliminated except during the initial warm up period. This is accomplished by leaving the oscillator running with "B+" on it, during standby periods. Tests indicate only 25 kc. drift during warm up.



Top view of converter unit. Coils are of the plug-in type. Coil L_1, L_2 is shown at lower left, coil L_3 may be seen at the upper left, while L_4 is shown at right.

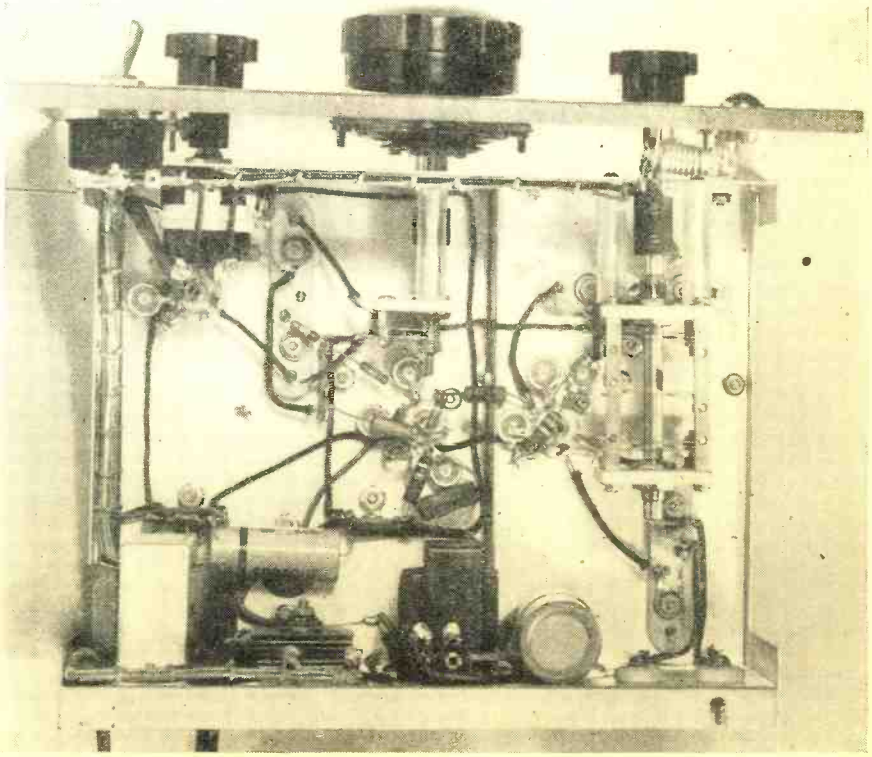
Construction Details

From the illustrations of the converter it will be noticed that the layout is a bit unconventional since practically all of the components are mounted below the chassis. The rear apron of the chassis supports the selenium rectifier, filament transformer, and the filter choke as well as the electrolytic filter condenser. Supported from the front apron of the chassis by means of tapped standoff insulators are the two variable condenser assemblies. Insulated shaft couplings are employed since the entire inner chassis is kept completely insulated from the cabinet in order to avoid ground potential difficulties and possible shock. It is suggested that anyone who builds this converter use similar precautions as the slight additional trouble more than compensates for the increased safety achieved. The small standoff cone insulators supplied with the *National* type XB-16 coil base are removed from the base and used between the chassis and panel. All leads should be kept as short and direct as possible with grid and plate leads, as well as coupling condensers, etc., kept a reasonable distance from the chassis. Each tube has one side of its heater grounded to the chassis, while the other side is bypassed. Silver mica button type bypass condensers are employed and these are grouped conveniently around the tube socket in order to provide short direct leads. As a matter of fact, the small lugs that are part of the silver mica button condensers are of sufficient length to connect directly to the particular tube prong being bypassed thus eliminating the need for any wire whatsoever.

The illustrations of the converter along with the schematic diagram and coil information should be self-explanatory. It will be noticed that the r.f. section of the chassis is a removable unit faciliting ease of assembly and wiring in addition to providing excellent shielding and mechanical

(*Continued on page* 101)

Under chassis view shows placement of various component parts.



	11 METERS—5/8" i.d.	10 METERS—5/8" i.d.	6 METERS—1/2" i.d.
L_1	4 t., #20 pushback, closewound 3/8" i.d., pushed in ground end of L_2	Same as for 11 meter coil	Same as for 11 meter coil except 5/16" i.d.
L_2	13¼ t. #18 en. @ 12 t. per inch tracked with C_2	Same as for 11 meter coil	8 t., #18 en. @ 7 t. per inch tracked with C_2
L_3	13¼ t., #18 en. @ 12 t. per inch	Same as for 11 meter coil	8 t., #18 en. @ 7 t. per inch
L_4	10 t. #18 tinned en. @ 9 t. per inch. Tap at 6th t. from grid end	Same as for 11 meter coil. Adjust C_{16}	5 t., #18 tinned en. @ 7 t. per inch. Tap at 2nd t. from grid end
C_{15}	40 μμfd. silver mica ± 5 %	40 μμfd. silver mica, ± 5 %	20 μμfd. silver mica, ± 5 %
C_{16}	Adjust bandset	Adjust bandset	Adjust bandset
C_{18}	Adjust bandspread	Adjust bandspread	Adjust bandspread
C_{19}	40 μμfd. silver mica, ± 5%	40 μμfd. silver mica, ± 5%	10 μμfd. silver mica, ± 5%

Mechanical details for constructing various coils needed in unit.

and 11 meter operation. One oscillator coil is employed for 6 meters while another oscillator coil may be used for both 10 and 11 meter operation with a little sacrifice in bandspread. If desired a separate oscillator coil can be made up for 11 meter operation and any desired degree of bandspread obtained on this band or the 10 meter band. Complete coil specifications have been included in the coil table shown above.

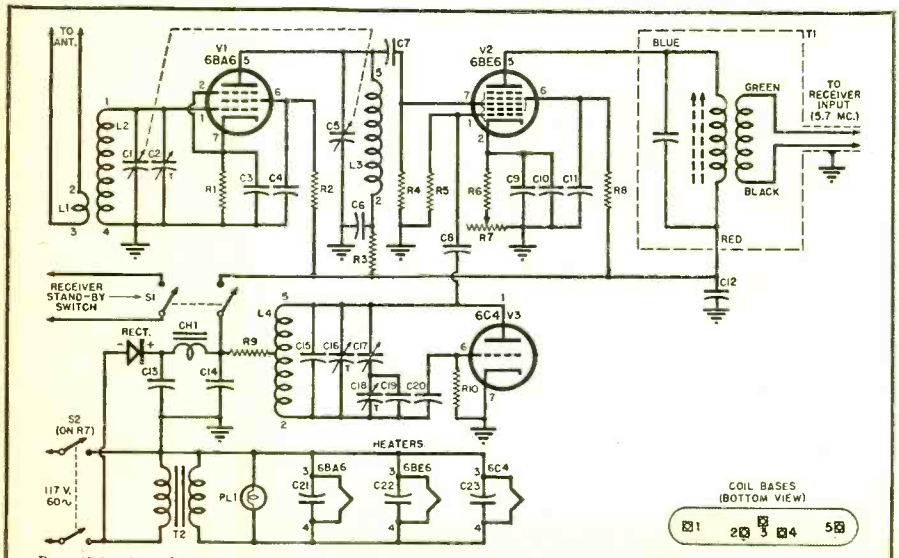
The Mixer

Several tubes were tried as mixers, including the 6AK5, 6BA6 and the 6BE6 which was finally adopted. All of these tubes, when properly adjusted, provided practically the same performance. It was found however that in order to obtain equal performance when using the 6AK5 or the 6BA6 as a mixer with grid injection, the injection voltage became extremely critical for optimum conversion efficiency. This is not the case with the 6BE6 where the injection voltage may vary over wide limits with no noticeable effect on the conversion efficiency. Since all of these tubes are exceptionally high gain mixers, in view of their high transconductance, it was found that all had a tendency to be regenerative and that this was primarily a function of grid loading. It is for this reason that the 100,000 ohm grid resistor and the two cathode bypass condensers are employed in the control grid circuit of the 6BE6 mixer. Apparently the silver mica button type condenser provides better r.f. bypassing for the input signal frequency while the larger mica bypass condenser is advisable for the i.f. frequency bypassing. Actually the silver mica button condenser could be eliminated. However for ease in duplicating performance and results, it is suggested that dual bypassing be employed.

It was considered advisable to provide a means of adjusting the gain of the converter in order to make it as versatile as possible. This is the reason that a variable cathode bias resistor was used in the mixer cathode. Proper adjustment of this control will reduce the background noise to near inaudibility. Of course the combination is not working at maximum sensitivity under these circumstances, but there are times when it is desirable to operate in this fashion especially when working locals and possibly when employing break-in operation. In addition, if you are unfortunate enough to have several powerful locals nearby and you are having some cross modulation difficulty this can usually be reduced to a minimum, if not eliminated entirely, by increasing the bias on the mixer. The control also makes it possible to reduce gain where it will reduce background noise most effectively. It can be readily appreciated that any small amount of noise ahead of a sensitive communication receiver is greatly amplified by that receiver. The ability to more or less control the noise at the source is therefore a decided advantage. The bias control also incorporates a double-pole, single-throw switch that is used to turn the power on and off. An extra safety factor is provided by the use of the d.p.s.t. switch although a single-pole, single-throw switch is normally employed as the power or a.c. switch. Because a selenium rectifier is used one side of the a.c. line is at chassis potential and even though the chassis is completely floated, the use of the double-throw switch completely eliminates ground potential or possible shock by disconnecting the converter from *both* sides of the power line.

A separate double-pole, single-throw toggle switch is used as the *"Receive-Transmit"* or *"Standby"* switch, one circuit being used to open the "B plus" circuit. The other circuit of this switch is brought out to two terminals on the rear apron of the chassis, from which point it is connected to the communications receiver standby switch terminals. This one switch, therefore, makes it possible to turn on or off both the converter and receiver during transmit-receive cycles.

Complete schematic diagram for 3-tube, a.c. operated converter.



R_1—470 ohm, ½ w. res.
R_2, R_5—22,000 ohm, ½ w. res.
R_3—1500 ohm, ½ w. res.
R_4—100,000 ohm, ½ w. res.
R_6—270 ohm, ½ w. res.
R_7—5000 ohm pot.
R_8—15,000 ohm, ½ w. res.
R_9, R_{10}—50,000 ohm, ½ w. res.
C_1, C_5—10 μμfd. dual var. cond.
C_2, C_{16}, C_{18}—3-30 μμfd. trimmer cond.
C_3, C_4, C_6, C_{10}, C_{11}, C_{21}, C_{22}, C_{23}—400 μμfd. button type cond.
C_7—25 μμfd. ceramicon cond.
C_8—10 μμfd. ceramicon cond.
C_9—.01 μfd. mica cond.
C_{12}—.1 μfd., 400 v. cond.
C_{13}, C_{14}—50/30 μfd., 150 v. elec. cond.
C_{15}, C_{19}—See coil table
C_{17}—15 μμfd. var. cond.
C_{20}—50 μμfd. ceramicon cond.
L_1, L_2, L_3, L_4—See coil table
T_1—5.7 mc. i.f. trans.
T_2—Fil. trans., 6.3 v. @ 1 amp.
CH_1—Filter choke, 300 ohm, 40 ma.
S_1—D.p.s.t. toggle sw.
S_2—D.p.s.t. sw. (on R_7)
PL_1—6.3 v. pilot light
Rect—100 ma. selenium rectifier
V_1—6BA6 tube
V_2—6BE6 tube
V_3—6C4 tube

Parts for this unit are available in kit form from Radio Wire Television, Inc.

The Oscillator

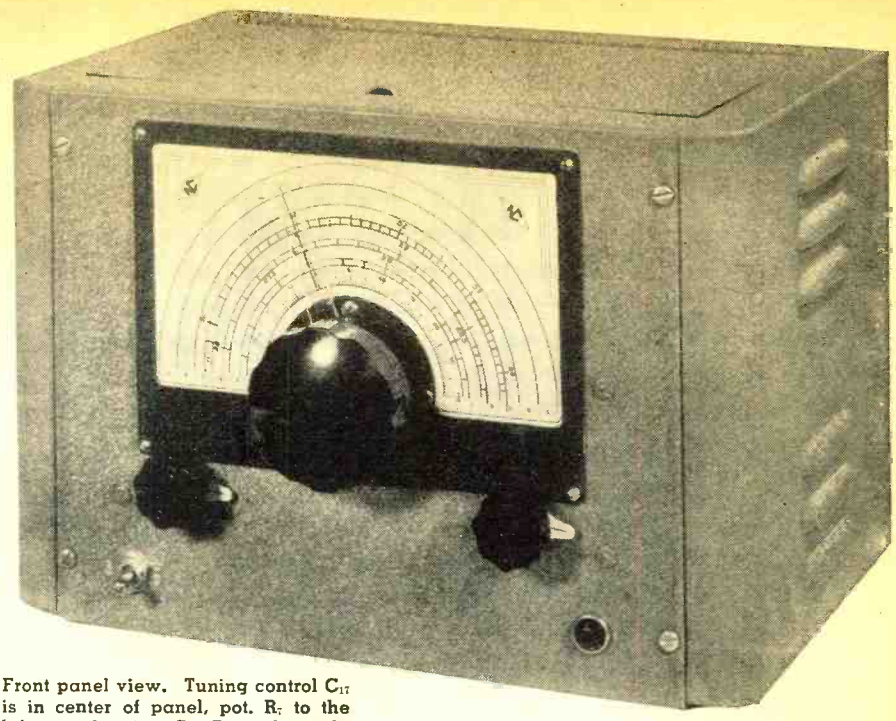
This was the only portion of the converter where it was deemed unnecessary to experiment with circuit

Old communications receivers can be improved by adding this well-designed converter.

By

FRANK LESTER, W2AMJ

Radio Wire Television, Inc.



Front panel view. Tuning control C_{17} is in center of panel, pot. R_7 to the left, condenser C_1, C_3 to the right and standby switch S_1, lower left.

NEW 6-10-11 METER CONVERTER

THE advisability of using a converter ahead of a good communications receiver is something that requires little discussion since by this time it can be assumed that the advantages of such a combination are now, more than ever, a well known fact. A good converter will usually bring an old communications receiver back to life by either extending the frequency range or very greatly improving the performance of the receiver on the high frequency end.

The converter about to be described was designed with the thought in mind that it should be as inexpensive as possible and at the same time capable of excellent performance. The instrument is low in cost in spite of the fact that only quality components were used.

For ease of construction and from past experience with converters it was found to be a definite advantage to eliminate the tracking problem by going to what may be termed two dial control. In other words, the oscillator tuning was separate from the r.f. tuning. It is possible, using this method, to make the bandspread adjustable to any desired degree. In addition many other advantages are gained which by far exceed the apparent disadvantage of a two control system. Actually, in use, the converter is essentially a single dial control unit except when one is looking for very weak signals when, of course, the r.f. end must be kept in tune in order to get the last db. gain that is possible.

Very often it will also be found quite advantageous to be able to detune the front end of the converter when local QRM is heavy.

It will be noticed that the usual power transformer is not employed and consequently a saving in cost is made possible. The use of the new selenium rectifier in conjunction with a filament transformer provides a very excellent power supply that is comparable costwise to the usual a.c.-d.c. set-up and at the same time eliminates the majority of a.c.-d.c. vices. By using the selenium rectifier and the condenser input filter arrangement shown in the schematic diagram it is possible to obtain as high as 150 volts output with a 120 volt a.c. line voltage. The output is usually in excess of 125 volts except where the line voltage is exceptionally low. The use of the new miniature tubes makes the usual power transformer unnecessary since the tubes will supply plenty of gain with as low as 100 volts on the plates and screens. Using the selenium rectifier, therefore, will result in a saving in cost and can be said to have practically no effect whatsoever on the performance of the converter, when compared to a transformer type power supply.

The R.F. Stage

In the early design stages of the converter, since it was very desirable to obtain the highest possible signal-to-noise ratio and at the same time realize good gain from the r.f. stage, several tubes and circuits were tested in an effort to get the best possible combination. As a result of these experiments, the 6BA6 was adopted because it provided the most satisfactory performance in this application.

The value of bias resistance chosen results in the r.f. stage being very stable on 6 meters without any antenna loading whatsoever. On 10 meters, however, due to the additional gain, the r.f. stage may oscillate without an antenna cut for this band loading the stage down. Increasing the bias value results in stabilizing the r.f. stage on 10 meters. However, this procedure resulted in a slight loss insofar as 6 meter performance is concerned. It was therefore decided to keep the r.f. stage hot on 10 meters and eliminate the slight instability by proper antenna loading.

If any instability is experienced on 10 or 11 meters this will be due to insufficient loading. To eliminate this condition, should it exist, an 8200 ohm, ½ watt resistor may be connected across the r.f. grid coil. Since this will be installed on the coil itself it will have no effect on the 6 meter performance as it will be removed when the coils are changed. In all probability the resistor will not be necessary but its use is being mentioned to take care of possible trouble. This system provides excellent gain on 6 and 10 meters without any tendency for the stage to oscillate regardless of antenna loading.

One set of coils is used to cover the entire 6 meter band in the r.f. stage while another set is employed for 10

The problem of extending credit to your customers can be solved by your banker. Consult him now.

By
LOUIS J. ASTERITA
Sec'y, Consumer Credit Comm.
American Bankers Association

Appliance Financing by Commercial Banks

THAT the commercial banks will be prepared to offer satisfactory financing to approved appliance dealers is clearly demonstrated by the results of surveys conducted by the Consumer Credit Committee of the American Bankers Association. These surveys show that more than 7000 banks have formulated plans to finance appliance dealers when merchandise and installment paper is again available.

In order to implement this program, the American Bankers Association conducted a comprehensive study of home appliance financing with the result that a manual of operations was issued in an endeavor to acquaint banks with the techniques and methods of operation in connection with this type of financing. To date, almost 10,000 banks of the country have requested copies of this manual and approximately 5000 copies have been sent to others interested in consumer durable goods and services: This is an indication of the tremendous interest in this field.

The Committee on Consumer Credit of the American Bankers Association, in keeping abreast of the rapid growth and development of installment sales finance business, is constantly on the alert to assist and implement the lending program of the banks. A project was recently completed which will aid considerably in the development of installment paper business in banks. The first part of the project indicates as rapidly as possible which banks in the country are doing an installment loan business, and the second part is the organization of a nationwide collection system for these banks.

A questionnaire was sent to member banks requesting them to inform the American Bankers Association whether or not they would be interested in participating with other banks in a collection arrangement on a reciprocal basis. The results of this survey have been tabulated in a directory with symbols used to indicate the extent to which each bank is engaged in the various phases of consumer lending and to what extent they will cooperate in this nationwide collection system. This gives to the banking system a collection service for handling "skip" and other specially treated paper that is far superior to anything yet developed in the credit field.

This publication lists the names of almost 10,000 banks located in virtually every section of the United States which extends installment credit to the public buying necessary durable goods and financing through dealers. More than 7000 of these banks have indicated their willingness to cooperate with each other on a reciprocal basis in a nationwide collection service on "skip" or delinquent consumer installment accounts. In addition, this directory should be of great assistance to manufacturers of consumer durable goods and services as a source of information on the location of banks engaged in installment financing and for the type of credit services offered. With this thought in mind directories were mailed to almost 500 manufacturers throughout the country with the compliments of the banking fraternity. A specific manufacturer can look in the directory and find in any town, village, or city in the country, the installment loan services the banks in that area extend. This should, in our opinion, help the banks of the nation to obtain a reasonable share of this business.

Obviously, before the program of the banks can become effective, much will depend on the production of consumer durable goods in sufficient quantity to place the program at the disposal of the dealers. The pent-up demand that has been frequently estimated discloses some interesting fig-

(*Continued on page* 155)

EVERY HOME A *Bonanza!*

By DR. LOUIS BADER
Assoc. Prof. of Marketing
School of Commerce, N. Y. U.

Tap a rich source of revenue in your trading area by making every home owner "electrical living" minded.

THE "E" home is one which is occupied by an electrically-minded family. The members of the family have been educated by general reading, advertising, and, more particularly, by the dealer, to an appreciation of the part that electrical devices can play in making the home easier to operate, more comfortable and healthy to live in, and a source of envy and admiration to friends and neighbors.

All this, and more, applies to the "E" farm. These families have been sold the joy of living in the electrical home or on the electrified farm. To a dealer such a place may be made to become the "Acres of Diamonds" on which the Rev. Russell H. Conwell so often gave lectures, the proceeds from which helped to build Temple University of Philadelphia. Dr. Conwell said, in effect, work your own fields to discover the riches in them. Let's see, Mr. Dealer, how you can apply this formula in building your store to a point where it provides you with a worthwhile living.

Your "E" family can be taught that they ought to have nearly all of the devices listed in Table 1. But you, Mr. Dealer, will have to do most of the persuading—*and all of the selling.* What an opportunity! Work it properly and you will have your own "Acre of Diamonds."

If your capital permits you can open an *Appliance Department Store* where merchandise can be arranged in related groups, or if space permits you may even lay out rooms with the merchandise displayed in natural settings. If it is possible to stock complete lines you can then devote your energies to the selling and upgrading of customers.

The biggest opportunity with a complete line is in canvassing your trading area, visiting in the homes, surveying the lack of equipment in the homes and then planning how to reach each and every family on their electrical appliance needs. The job means going *out* after business,—not puttering around your store waiting for it to come in. The job also demands that you be a friendly salesman, not an indifferent human icicle.

Lack of capital may prevent your carrying the full line of radios and appliances indicated in Table 1. If this is the case, the thing to do is to study your trading area with relation to the principal items people are likely to buy. If your study reveals that kitchen equipment will find a ready market in your trading area then stock kitchen equipment and build your reputation as a specialist in this field. If it is some other item do likewise in that field. Become the community expert in the sale and servicing of your special line. Then, as you grow, add line after line until you have an "appliance department store."

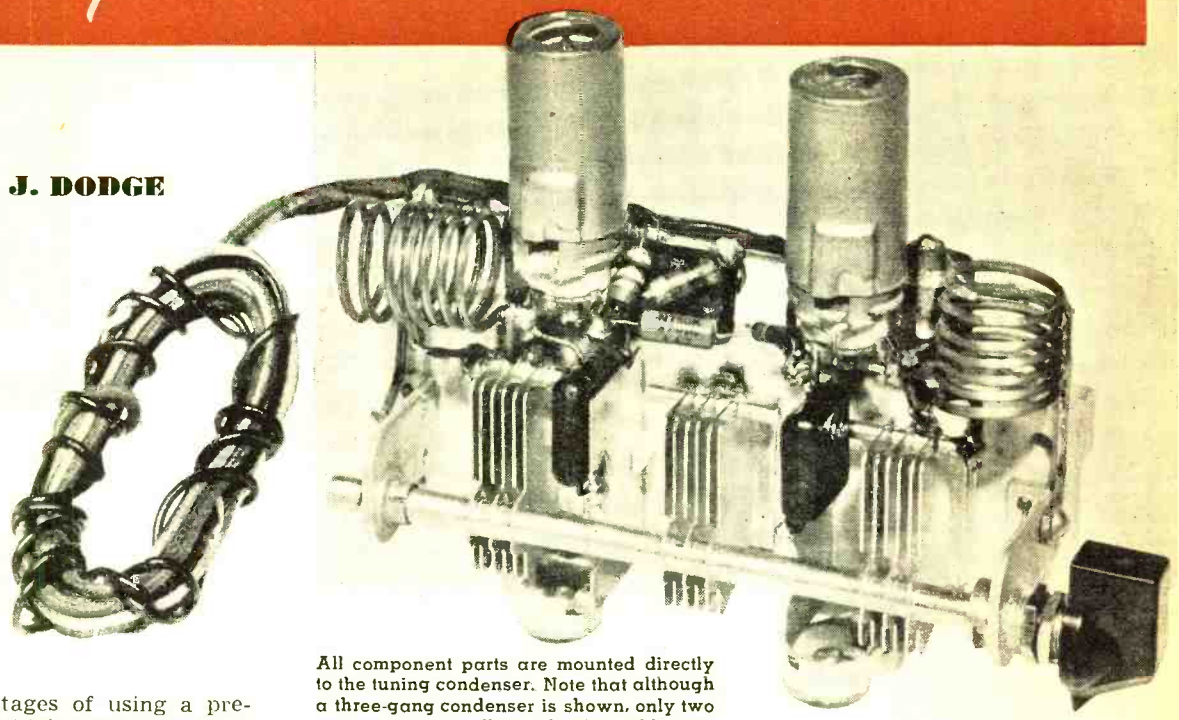
The main items listed in the table usually are not bought—they must be *sold.* To sell them you must frequently seek out the prospective customer and do her the service of selling her, ofttimes in her home. This means you must, for one thing, plan to do regular, consistent, thoughtful, friendly canvassing of your trade area.

Each day you and your salesmen must plan and make a certain number of calls. You should cover the territory consistently, beginning at some predetermined point, cover it completely, and then begin over again. The point to begin is where your market survey indicates a good possibility of making sales. This gives encouragement and, by example, opens the way for more sales among the neighbors and friends of those

(*Cont. on page* 151)

An Inexpensive 18-db. PRESELECTOR

By T. J. DODGE



All component parts are mounted directly to the tuning condenser. Note that although a three-gang condenser is shown, only two sections are actually used. The middle section acts as a shield between the stages.

Improve your 10 meter DX reception with this easy-to-build, low-cost preselector.

THE advantages of using a preselector at high frequencies is a well established fact. The preselector increases the sensitivity as well as the image ratio.

While many amateurs use preselectors, others do not due to the expense involved when a manufactured preselector is purchased. The preselector described in this article can be constructed in approximately two hours and requires no chassis or cabinet and a bare minimum of parts costing a total of less than $10.

The high-frequency sensitivity of some of the older type communication receivers was considerably down at 28 megacycles in comparison to the lower frequency ranges of the receiver. This accounts for operators using such a receiver experiencing poor "DX" reception on 10 meters. When the 18 db. preselector is added to such a receiver, marked improvement will result.

The use of the preselector ahead of a modern communication receiver will result in better signal-to-noise ratio, since the i.f. gain of the receiver can be reduced by the manual control.

Considerable interference is created by image response and the preselector will improve this condition radically.

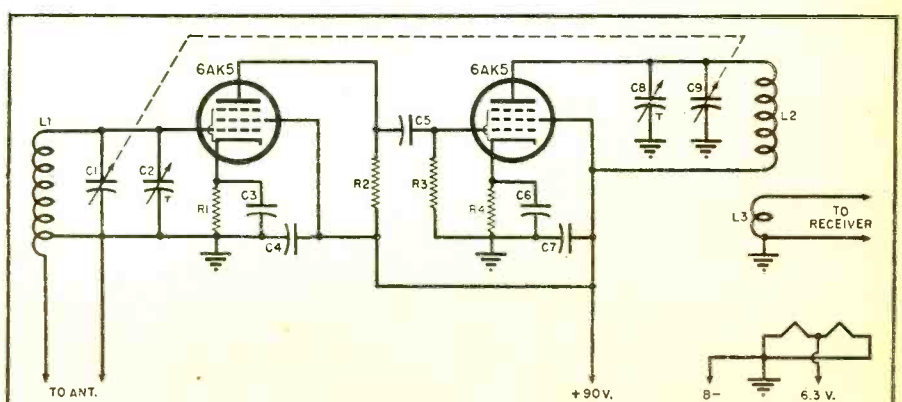
The actual noise created in a receiver normally results from high-gain stages (low frequency i.f. amplifiers and mixers). The noise created by a high-frequency r.f. amplifier is extremely low and can usually be discounted. This being the case, additional gain ahead of the mixer allows the reduction of gain behind the mixer, resulting in an over-all improvement in signal-to-noise ratio.

A signal-to-noise ratio of 1:1 is insufficient for practical reception regardless of the gain capabilities of the receiver. Adding the preselector to such a receiver and reducing the i.f. gain of the receiver to a point where the over-all sensitivity is the same will result in a greatly improved signal-to-noise ratio. Although a 1-microvolt signal could be received under both conditions, under one condition the signal would be unintelligible and the other perfectly readable.

When a communication receiver is designed, the engineer must compromise between high sensitivity and signal-to-noise ratio, and the retail price

(*Continued on page* 140)

Schematic diagram of home-built, two-tube preselector.



R_1, R_4—300 ohm, 1 w. res.
R_2—10,000 ohm, ½ w. res.
R_3—300,000 ohm, ½ w. res.
C_1, C_6—20/20 μμfd. 3-sec. var. cond. (center sect. not used)
C_2, C_5—30 μμfd. ceramic trimmer cond.
C_3, C_4, C_6, C_7—.005 μfd., 200 v. cond.
C_8—50 μμfd. ceramic cond.
L_1*—7 t. tapped 1 turn from ground end
L_2*—6 t.
L_3*—2 t.
2—6AK5 tubes
* All coils wound with #16 tinned wire, ¾" diam., and 1/16" spacing between turns.

A 3-ELEMENT ROTARY BEAM

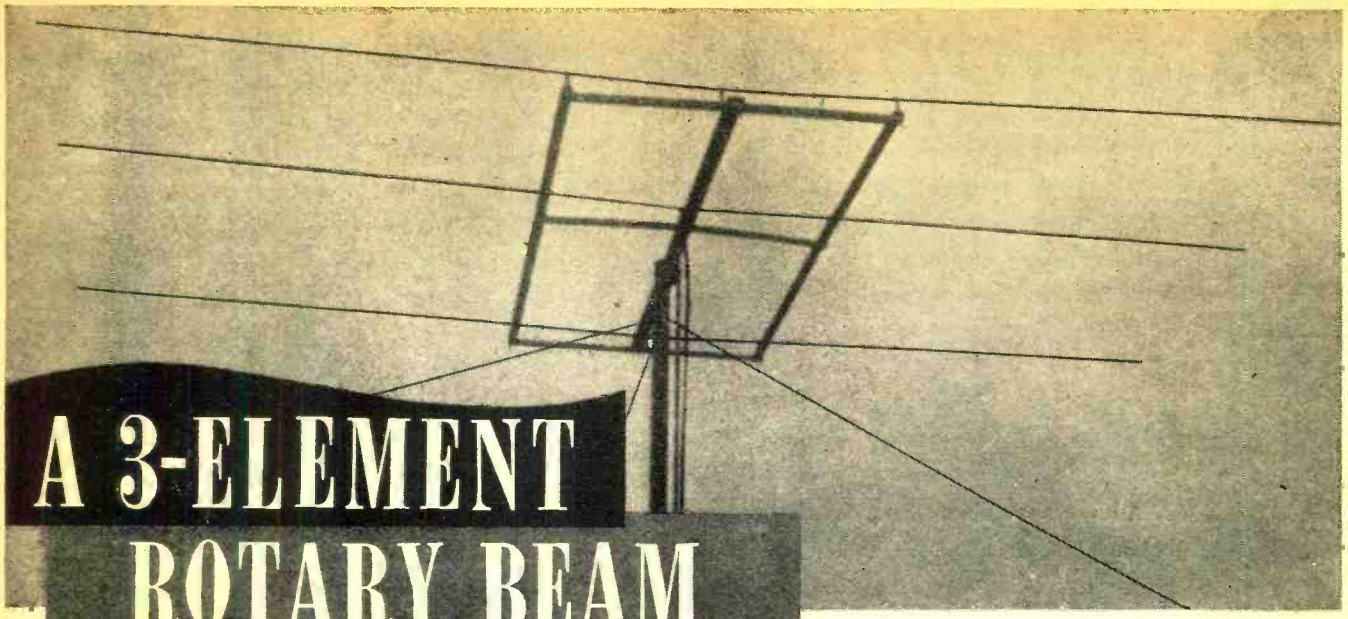


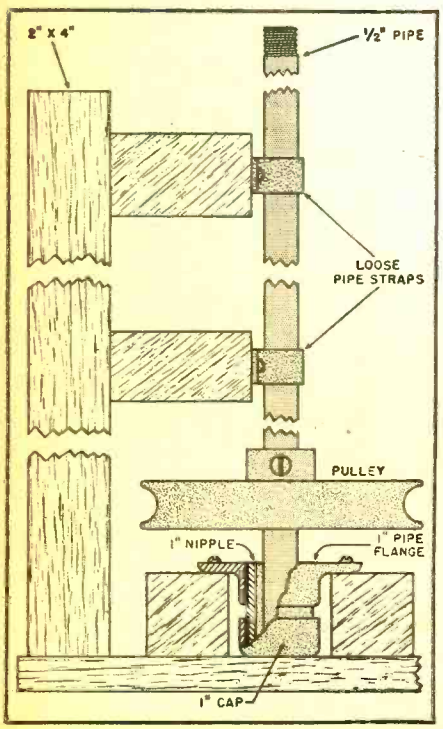
Fig. 1. Rotary beam antenna built by the author.

By H. E. SCHWARTZ, JR., W2NUD

Complete details for constructing your own rotary beam antenna. All parts are readily available.

THE need has been expressed by many hams for more complete information on the construction of an inexpensive rotatable array. The array to be described involves no machine work, and requires only ordinary hand tools and a few hours time. This antenna in no way compromises on efficiency, gain, appearance, or ease of rotation, and is comparable to manufactured arrays costing several times as much.

Fig. 2. Details of pulley assembly.



Before the beam itself is described, it may be of interest to hear some of the reasons that led up to its construction. In the haste to get on ten meters after the band was reopened, the simplest possible antenna, a dipole, was erected high enough to be in the clear. The transmitter at W2NUD runs 120 watts input to the final on any frequency from 28.1 to 29.7 megacycles through the use of an e.c.o. and should therefore have been able to "get out." As it did not, and all other factors had been absolved of responsibility, it was evident that the antenna was at fault. A lot of breath was wasted calling DX stations, only to hear them come back to other local stations. Almost invariably the operator of the local station who had succeeded in working the DX would be heard to say those seemingly magic words: "The antenna here is a three element rotary beam old man" and so the decision was reached to construct a beam. Although the location did not seem suitable for a rotating array, as the ham shack is on the fifth floor of a six story apartment house in Manhattan, the whole scheme worked out far better than was expected.

Some thought was given regarding the relative merits of two and three element arrays, with anything larger ruled out as too bulky. The two element seemed hardly worthwhile as it is a relatively simple matter to add the third element, once the rotatable framework is constructed, and since the gain of a three element array is greater, it was decided to build that.

The beam was constructed for a total cost of ten dollars exclusive of transmission line, which can be anything you have on hand or prefer to use. For the matching section to be described, it should be either 72 ohm coaxial cable or twisted pair of approximately 72 ohms characteristic impedance. If you are using single wire feed, or have no antenna system at all, then the cost will be increased by the price of the feeders, but will still be quite reasonable, fifteen to twenty dollars for an array which gives very nearly the ultimate in performance. The three elements cost the author only $4.68, and the wood and pipe required made up the other five dollars.

To start construction, four lengths of ½" o.d., .035" wall aluminum or dural tubing should be purchased. These come in standard lengths of twelve feet and should be cut according to Fig. 5A, which shows how to obtain the basic elements from the stock lengths. Then the radiator must be extended slightly by means of scrap tubing from the junk box—these pieces were about 2½" long and overlap sufficiently so that 1½" is added at each end. They can be any metal tubing that will force fit into or over the ½" tubing. The total length of the radiator is given by the formula:

$L = 468/f$ where L is the length in feet and f the frequency in megacycles. This gives 16'3" for a frequency of 28.8 mc., which is the center of the ten meter phone band for which this beam was designed. The basic formulas are given throughout so that an array may be built for any frequency (greater than 14 mc. to be practical) that you desire.

The director and reflector each have a joint made from a piece of brass tubing which fits snugly inside the elements, which are split by a hacksaw

cut for about 1", so that they can be compressed tightly by means of a small strap type clamp (the type commonly used to mount ½" diameter tubular capacitors) on each piece. The director must be cut down to a length 4% shorter than the radiator; given by the formula:

$L = 450/f$ which becomes 15'7⅜" for 28.8 mc. The reflector must be added to with short pieces of scrap tubing, as described for the radiator, in order to make it 5% longer than the radiator, or a length given by the formula:

$L = 492/f$ or 17'1" for the center of the ten meter band.

Next a wooden frame must be constructed as shown in Fig. 4. The ½" pipe flange is mounted to the 1x4 with four #10 wood screws and the 1x2's are drilled and bolted together and to the 1x4 with two #10 by 2" machine screws and nuts at each joint. Small ceramic standoff insulators are held to the frame by #8 wood screws and have small "U" clamps, normally used to mount ½" diameter tubular capacitors, bolted on them. These hold the tubing quite nicely. In order to keep it from slipping out a 1/32" diameter hole is drilled through the element and a piece of wire is passed through the hole and wrapped around the element and clamp.

A thirteen foot long piece of 2x4 lumber must be purchased to serve as a mast, and is guyed by three lengths of clothesline to points on the roof approximately 120° apart. A fourteen foot piece of ½" galvanized iron pipe is mounted by loosely fitting pipe straps to small blocks, which in turn are nailed to the mast as shown in Fig. 2. The pipe must be off-set sufficiently so that the pulley will clear the mast. A suitable pulley, which will fit ½" pipe, has a set screw to fasten it and is about six inches in diameter can usually be found in a junk yard. The original set screw was removed from the pulley and a bolt of the same size and about three inches long was substituted. This bolt hits a small block of wood which is nailed to the mast, limiting rotation to approximately 350° so as not to foul up the feeders, which hang loosely to permit turning the beam. The bottom end of the pipe turns in a bearing constructed of standard plumbing parts as shown in Fig. 2. The length of the pipe can be increased to obtain greater height if desired.

The beam is turned quite easily, efficiently, and cheaply by means of a dollar's worth of ordinary clothesline. The line is wrapped around the pulley twice to give sufficient friction to turn it and passes over two clothesline pulleys, which are fastened together and suspended at a 45° angle. At the bottom end the line passes through a single pulley and the two ends are tied together to make one continuous length; this pulley has a tension spring, of the type used on screen doors, between it and the window sill, so that the line is kept under a few pounds tension at all times. It is located at the side of the window in the ham shack, and can be easily reached. In some locations it should be possible to pass the control lines through holes in a board, which would be placed above or below the window, so that control from inside could be obtained.

An indicator can easily be rigged up, if desired, to show which way the beam is pointing, for example, a pointer of sheet metal on one line with a piece of cardboard fastened to the side of the window frame close to it, calibrated with the points of the compass and covered with transparent, adhesive, cellulose tape. However, this was not deemed necessary at this QTH as all that's needed is to look out the window and up, and the direction of the beam can be determined at a glance. Even this simple expedient is not normally required, though, for the operating procedure here is to point the beam in what seems to be the correct direction and then turn it for a maximum reading on the receiver "S" meter on a received signal. This is also automatically the correct position for transmitting.

Setting the antenna in a particular direction by means of points of the compass is only correct if a great circle path is plotted. This involved procedure seems to be the hard way to do it when the method with a received signal is so simple and accurate.

In designing the mechanical system for turning an array of this sort, a compromise must be reached in the amount of friction at the bearings in which the supporting pipe turns. The friction involved in the straps is quite small, as they serve merely as radial bearings, however the bottom bearing is also a thrust bearing, and has the

(*Continued on page* 110)

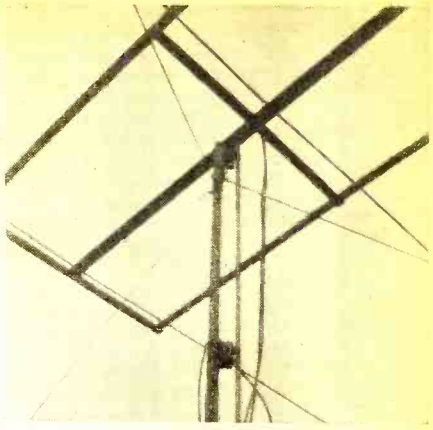


Fig. 3. Close-up view of frame assembly.

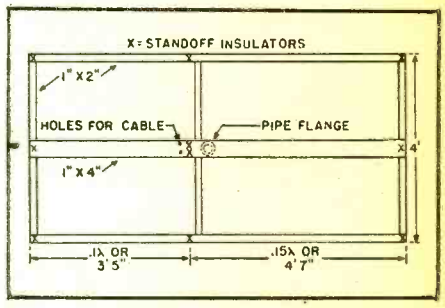
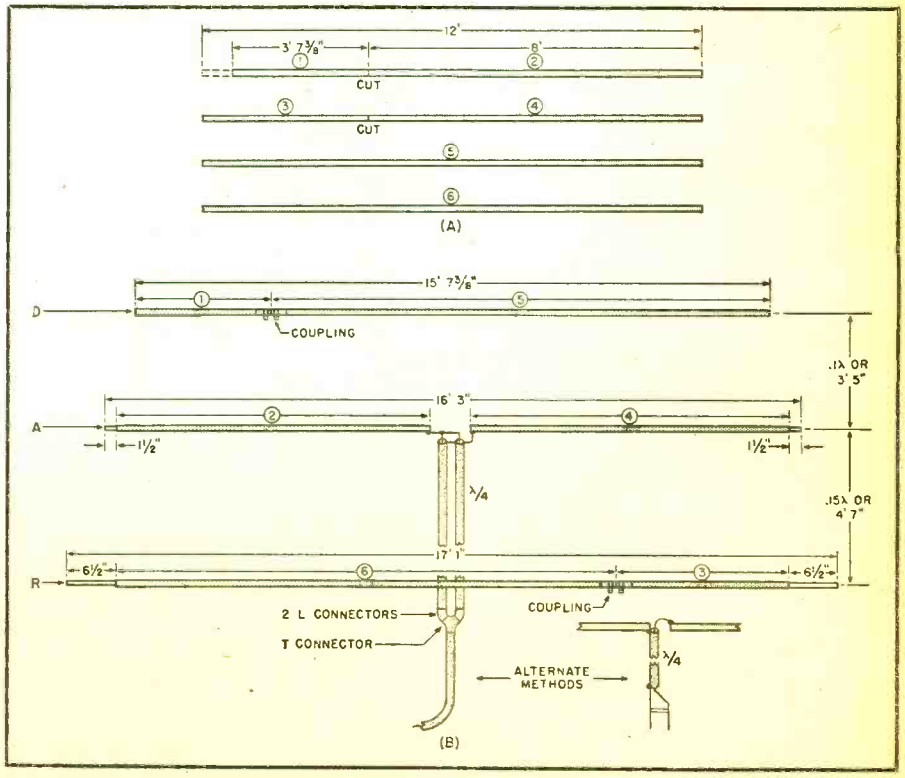
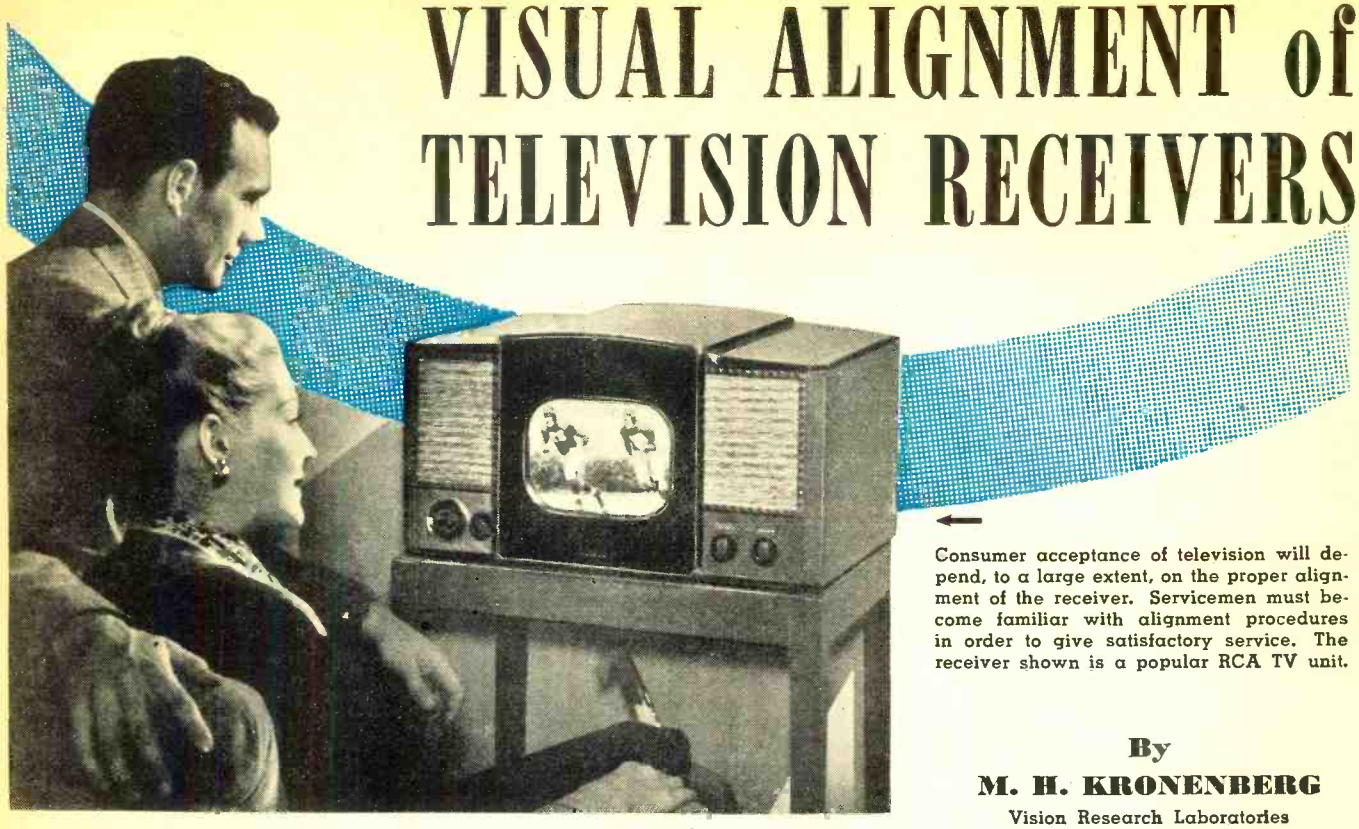


Fig. 4. Details of frame construction.

Fig. 5. Mechanical details of antenna elements and feed system. As shown in (A), the four 12-foot aluminum tubes are used to make up the antenna. Two of these, sections numbered 5 and 6, are used as is. The other two tubes are cut to make up sections 1 through 4. The complete antenna which is shown in (B) is made up of these six sections. Placement of the various components can be readily identified by their numbers.



VISUAL ALIGNMENT of TELEVISION RECEIVERS



Consumer acceptance of television will depend, to a large extent, on the proper alignment of the receiver. Servicemen must become familiar with alignment procedures in order to give satisfactory service. The receiver shown is a popular RCA TV unit.

By
M. H. KRONENBERG
Vision Research Laboratories

The use of a sweep signal generator and oscilloscope for aligning television receivers is recommended by the service departments of many TV manufacturers.

THE present state of the art of television transmission and reception requires that adjustments on such equipment be carried out with great care and understanding of the circuits involved, if optimum performance is to be achieved. The importance of visual alignment in the production, servicing, and development of television receivers is realized by all those familiar with or working in this new field. Technique of aligning a television receiver with the aid of a sweep signal generator differs somewhat from methods used on ordinary broadcast or communications receivers, but with proper equipment the procedure is quite simple and perhaps a lot more exacting.

To align the receiver by visual means, the service bench or laboratory must contain a sweep signal generator, oscilloscope, and the usual conventional test equipment. There are several sweep generators commercially available and they are quite similar in operation but differ somewhat in circuit design. The sweep signal generator is basically a frequency-modulated signal source with means provided for variation of the sweep width, the average operating frequency, and as in the ordinary signal generator, the output signal amplitude. Before discussing the details of visual alignment, it would be well to review some facts about present day television receiver practice. There are two important i.f. frequency bands in use at the present time, one 8-13 mc. which was adopted before the war, and the other 21.25-26.5 mc. The latter is now accepted as standard for television broadcast receivers and will probably supersede the old i.f. band entirely. The few television broadcast stations presently in operation utilize channel allocations below 88 mc. (44-88 mc.), however, in the near future, as these channels become filled, it will be necessary to provide test equipment for use on the higher frequency bands.

Bandwidth requirements for the i.f. amplifier vary with the type of receiver in use, particularly with the size of the picture tube. In some smaller picture tubes, 5" or 7", picture definition may be limited by the size of the scanning "spot" and thus a bandwidth of 2.5 to 3.5 mc. will suffice. However, the larger tubes, particularly those of later design, produce an exceedingly fine luminous spot. Here the maximum definition of the system may be realized and i.f. stages are adjusted for 3.75 to 4.25 mc. widths. The "front end" circuits of the conventional receiver require that the whole channel be amplified instead of just the video signal as in the picture i.f. amplifier. Since the picture and sound carriers are situated on opposite ends of the channel, 4.5 mc. apart, then the r.f. and mixer circuits must be tuned to operate over a range of about 5 mc.

Location of the video and picture carriers with respect to the receiver selectivity curve is another very important adjustment. This is another way of saying that the response curve of the receiver must not only be of proper bandwidth to accept the television signal, but must also be shaped accurately. The reason for this, illustrated in Fig. 1, is that transmission of the television signal is accomplished by the vestigial sideband system. In order to reproduce the lower frequencies (those sidebands near the carrier frequency) faithfully, the characteristic of the receiver must be such that it allows these components to add up to a value that is equal in amplitude to the single sideband frequencies situated further away from the carrier (high frequency components). This is accomplished by designing the i.f. circuits so that with proper alignment, a sloping amplitude vs. frequency curve exists at the edge of the high frequency side of the i.f. bandpass, whereby the picture carrier frequency (reduced to i.f.) is situated where the response falls to about 50% of the mid-band value. At the same time the picture i.f. amplifier must reject the sound carrier, and traps provided for this purpose must be tuned exactly 4.5 mc. lower than the picture carrier frequency.

From this the importance of visual alignment may be realized and equipment requirements be evaluated. The sweep generator for use in television receiver alignment must be capable of producing a calibrated frequency modulated signal capable of operation

in the frequency bands mentioned and also capable of generating sweep widths considerably greater than actual amplifier requirements. The oscilloscope used in conjunction with the sweep generator may be of the 3" variety. However, more satisfactory operation is obtained by using a 5" cathode-ray tube. Since the sweep generator generally supplies both horizontal and vertical deflection voltages, it is only necessary to provide a cathode-ray tube with suitable power supply in order to obtain the visual alignment trace.

The Sweep Generator

The several sweep generators currently on the market for use in television work are capable of generating widths of from 100 kc. to 20 mc. and to operate at frequencies within the video, i.f. and r.f. bands. The sweep generator contains a wobbulated or FM signal source, amplifier, and output attenuator. Some units also contain calibrated wavetraps for frequency marking of the visual trace. The cathode-ray tube that produces the alignment trace is usually incorporated in an oscilloscope as a separate piece of equipment. Present day sweep generators differ mainly in their method of frequency modulation. Narrow-band FM signal generators utilize the reactance tube and thus are purely electronic in operation, however, in wide-band sweep generators where sweep widths of 10 or 20 mc. are required, mechanical modulating systems are sometimes used. Some prewar sweep generators used a motor-driven rotating capacitor as the frequency modulating element. Present day sweep generators use either a reactance tube modulated oscillator or a vibrating slug actuated by a magnetic drive similar to that used in loudspeakers. Since the signal generator must operate over such a broad frequency range, and also because of the broad sweep width requirements, it has been found desirable to incorporate a heterodyne oscillator system, whereby the output of two high frequency oscillators is mixed and their difference frequency selected to produce the desired lower frequency output. A block diagram showing a typical method for obtaining the sweep signal is given in Fig. 2. One of the oscillators is frequency modulated either electronically or mechanically and its mean or average frequency kept constant. The other oscillator is not modulated but is manually tuned so that the desired difference frequency appears in the mixer load circuit. The resultant or difference frequency thus obtained contains the desired sweep width and can be adjusted to sweep through the required frequency range by varying the sweep mechanism amplitude.

The sweep generator output is applied to the amplifier or receiver under test and the output of this amplifier is rectified and fed to the vertical deflection plates of an oscilloscope. At the same time the sweep generator must supply a horizontal deflection voltage in order to produce a composite trace on the cathode-ray tube screen. This horizontal voltage is usually derived from the same source as that used to actuate the sweep mechanism. Therefore, the trace as it appears on the screen consists of a voltage fluctuating in accordance with the amplifier's response over a wide band of frequencies, plotted against a horizontal time base. The horizontal scale indicates frequency and the vertical scale, amplitude response within the band of frequencies under investigation. The most important relationship between horizontal and vertical deflection voltages is that they be exactly in phase and of the same frequency or in some definite harmonic relation. The way in which the composite trace is formed is shown in Fig. 3A, which indicates the result of a sweep generator whose output voltage, frequency modulated sinusoidally, is fed through a broad-band amplifier, and plotted against a sinusoidal time base of equal frequency.

In order to obtain a substantially linear frequency scale on the visual trace, it is necessary to use like waveforms in the sweep mechanism and horizontal sweep. This condition is satisfied in Fig. 3A although some variation in intensity of the trace will result due to the fact that the cathode-ray tube spot velocity varies from "slow" at the edges to "fast" at the center, and the edges of the trace will appear quite bright. While the sinusoidal sweep is perhaps the most convenient method of generating a visual alignment trace, other waveforms have been successfully used such as the saw-tooth and pyramid or triangular sweeps. Generators utilizing triangular or saw-tooth waveforms are useful mainly in electronic type sweep mechanisms. In mechanical systems it is more convenient to use a sinusoidal sweep.

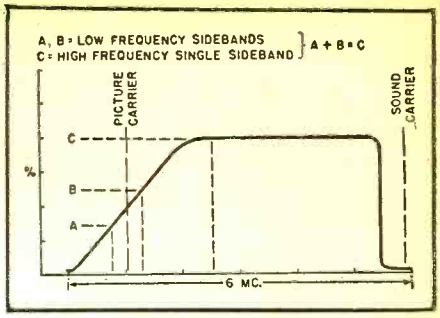


Fig. 1. Idealized video i.f. response curve showing operation of standard method of vestigial sideband television transmission.

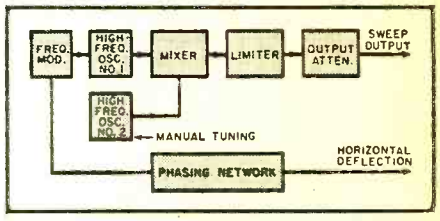


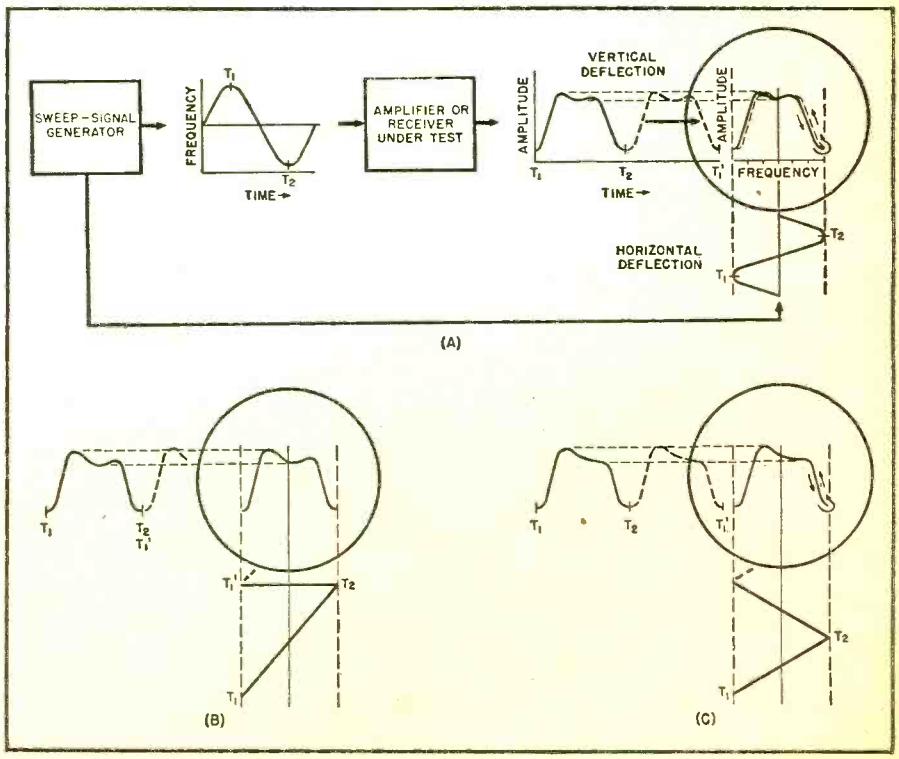
Fig. 2. Block diagram shows typical method used for obtaining the sweep signal.

Behavior of Over-coupled Circuits

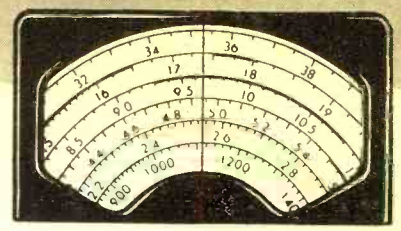
The conventional television receiver contains 3 or 4 stages of i.f. amplification and usually a stage of r.f. ahead of the mixer. This means that adjustments must be made on at least 5 or 6 separate broad-band coupled cir-

(*Continued on page* 118)

Fig. 3. Visual alignment wave shapes formed by sinusoidal sweep (A), saw-tooth sweep (B), and triangular sweep (C).



International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

IT IS with pleasure that this month's issue of *ISW* is dedicated to *Radio Luxembourg*, Europe's most powerful commercial radio station (on long-wave) and which operates on 6.090 short-wave. Thanks go to P. Bouillon of the station, and to Guy Bolam, New York, American representative of the owners, for this data.

Luxembourg, last independent Grand Duchy to survive two World Wars, lies hidden away in a corner southeast of Belgium. The preservation of its independence throughout its thousand years of history is really remarkable, and its native language common to all Luxembourgers is an outward sign of this independence. It distinguishes the inhabitants of the Grand Duchy from its neighbors and gives them the consciousness of being a distinct community.

Nowadays, Luxembourg is very small, and has a population of under 300,000 inhabitants. Although it is one of the smallest of European countries, it is certainly one of the most beautiful. In no other country can one find —within an area of 999 square miles —such a succession of changes of scenery—highlands and valleys, forests and plains, gorges and rivers, every imaginable kind of landscape, except high mountains and the sea coast. The Grand Duchy has large mineral deposits, iron ore being its greatest source of wealth; before the war, despite its size, Luxembourg was numbered among the first eight iron-steel exporting countries of the world.

If Luxembourg is rich in natural resources, it is even richer in historical monuments. Nowhere is the ancient and the modern mixed more closely than it is here. All over the country, medieval buildings of rough-hewn stone are to be found adjoining modern steel and concrete structures, and each, through careful architectural control, enhances the effect of the other.

Until 1933, Luxembourg was mainly known to stamp collectors and scarcely at all to the European traveler, but in that year, the modern science of *radio* was introduced to the ancient capital city of Luxembourg. Little by little, the *Radio Luxembourg* wavelength became a favorite rendezvous for listeners of all European countries. The number and variety of the programs and the international scope of the transmitter rapidly increased, until by 1939 no less than 18 different languages figured in the regular broadcasts of what had, by this time, become one of the most famous international transmitters in the world.

The station was actively sponsored by manufacturers from nearly all the European countries, and especially by those of Great Britain. These programs quickly became so popular with listeners in the United Kingdom that in an independent survey made during the winter of 1938-39, no one was surprised when Prof. Arnold Plant of the London School of Economics found that during certain hours of the day more people in Great Britain were listening to *Radio Luxembourg* than to all the fourteen stations of the BBC added together. Officials of *Radio Luxembourg* point out that the reason for this preference on the part of the listeners was not hard to find. The programs were designed to appeal to "the Man on the Street," and the manufacturers realizing that the best advertisement for their product was the best artists in the best possible entertainment which production, ingenuity, and experience could provide, adopted this format.

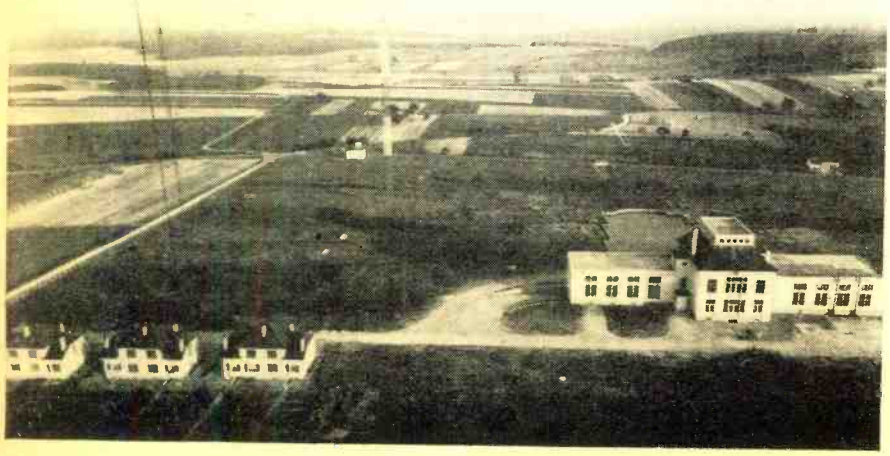
In September, 1938, came Munich—and thereafter, *Radio Luxembourg* worked continuously in the closest possible touch with the British Government in the preparation and the transmission of broadcasts to Germany. In September, 1939, when war was finally declared, all broadcasting from Luxembourg was suspended in order to preserve the country's total neutrality. Nevertheless, in May, 1940, the Germans invaded the territory of the smallest Ally, and occupied the broadcasting station.

Thanks to the careful planning of *SHAEF* and above all, thanks to the patriotism and resourcefulness of the chief engineers of peacetime *Radio Luxembourg* and some of the prewar staff, Luxembourg's liberation on September 10, 1944, meant much more to the United Nations than the gain of a comparatively small piece of territory. The total destruction of the radio installation was avoided, and only twelve days later, those people of Europe, still under German domination, were stirred by the news:

"Radio Luxembourg returns to the air with programs of the United Nations!"

The first announcement was repeated again and again in every Continental language. It was the first time in the history of warfare that an army command had at its disposal a broadcasting station of complete Continental range, capable of firing the strangest ammunition used in the war—*the truth!*

Radio Luxembourg's transmitter and antenna located at the village of Junglinster.



THE NATIONAL COMPANY

Proudly Presents

THE NEW HRO-7

National
EST. 1914

Known and used by hams the world over for 13 years, the old HRO now has a new successor — the HRO-7 — incorporating every one of its strong points and adding a number of modern refinements.

To begin with, the HRO-7 is housed in a streamlined grey cabinet that will enable you to meet the XYL's former objections to bringing your rig into the main part of the house. The whole family can listen when you pick up a French OP talking about the latest UN news.

Two new miniature tubes have been added to further stabilize the receiver. This will enable you to turn the rig off and on again with an absolute minimum of retuning.

As you turn the RF gain control, there'll be no appreciable change in the pitch of code signals and the HRO-7 remains unaffected by normal fluctuations in the voltage sent in by the power company.

We could go on endlessly like this — but why not go down to your nearest National dealer *today* and ask to see and hear the new National HRO-7 for yourself.

- 11 tube (plus voltage regulator) superheterodyne.
- Frequency Range of 50 to 430 and 480 to 30,000 KC.
- AM phone and code reception.
- Accessory Connector Socket makes possible use of wide variety of accessories, such as narrow band FM discriminator, crystal calibrator, etc.
- New double action noise limiter effectively reduces interference caused by external noise pulses.
- A 6 position switch for crystal filter operation.
- Maximum bandspreading of the Amateur bands.
- Streamlined cabinet with attractive grey finish.

National Company, Inc.
Dept. No. 15
Malden, Mass.

MAKERS OF LIFETIME RADIO EQUIPMENT

American, Belgian, Czechoslovak, Dutch, English, French, Luxembourg, Polish, Russian, and even Italian and German broadcasts were heard day and night. Their messages inspired hope and the will to resist among millions of foreign slave-workers still held by the Germans.

In mid-December, *Radio Luxembourg* went off the air for three days when von Runstedt's tanks came within three miles of the transmitter—the last despairing effort by an already defeated enemy. Things soon began to move quickly. The Allied armies crossed the Rhine and eighty thousand Germans were isolated in western Holland. Over *Radio Luxembourg*, General Kirchheim asked Marshal Keitel to give up the lost struggle. Vienna, Nuremberg, Bologna, Berlin fell! Hardly anyone in *Radio Luxembourg* went to bed. They were spreading the news to the world, the best and newest news ever heard over any radio.

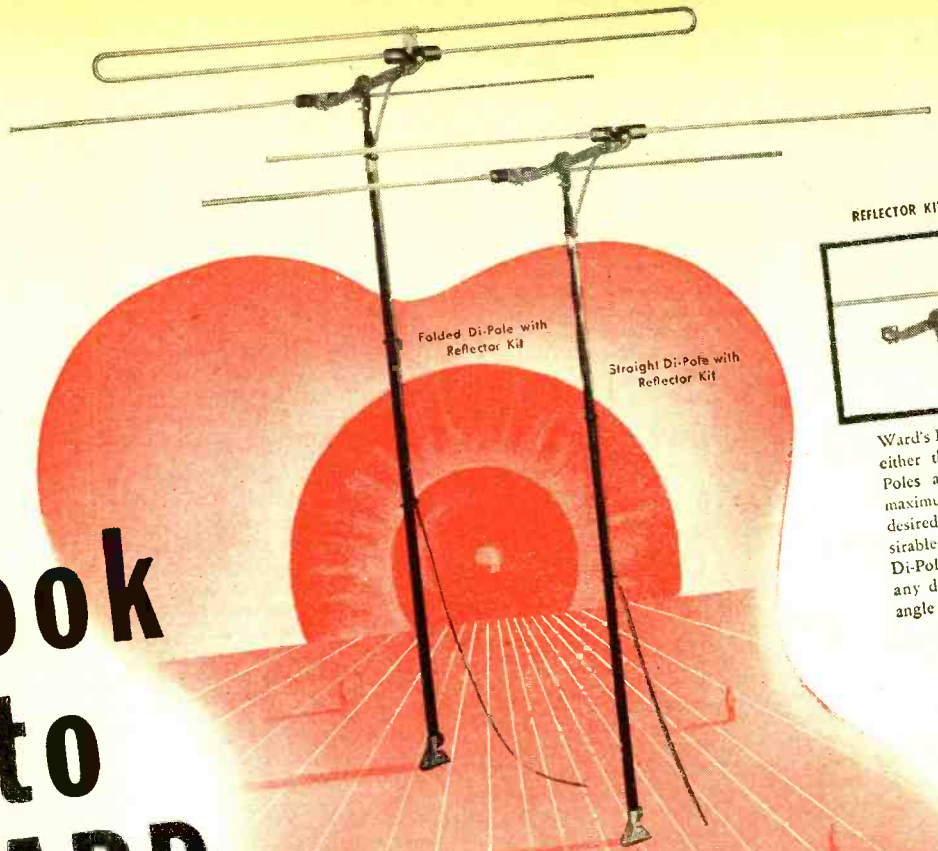
Surrender to Montgomery in North Germany followed surrender in Italy. Finally, twelve men of different nationalities pronounced in twelve languages the sentence the world had waited so long to hear:

"Germany has surrendered unconditionally!"

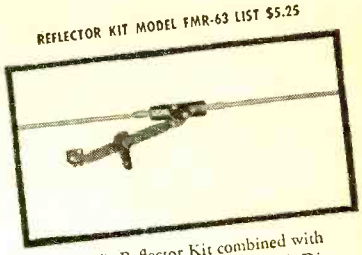
Broadcasting a few minutes before midnight on November 11, 1945, Colonel Clifford Powell, Acting Chief of the American Information Control Division, said: *"Radio Luxembourg* has contributed largely towards the breaking of the morale of German soldiers and civilians and it has helped to organize the repatriation of millions of slave-workers. It has fulfilled its military mission and can now be returned to its original owners."

Radio Luxembourg resumed its independent civilian programs immediately, under the same company and the identical management as in the days before the war. Much damage had been done by the departing Germans in September of 1944, and during the period of Allied Military Control, only temporary repairs had been effected. The central control room had been blown up and entirely destroyed. A great deal of the equipment had been stolen by the Germans or rendered useless. The transmitter and the transmitting antennas at Junglinster (10 miles from the Luxembourg capital) needed complete overhauling and many essential pieces of apparatus had to be replaced. These tasks were rendered more difficult by the shortage of technical equipment available. But gradually, the powerful broadcasting station got under way once more, and the great family of "Men of Good Will" of all the European countries began once again to look to their old friend—*Radio Luxembourg*—for their entertainment.

Regular broadcasts in French (premier Continental language) were, naturally, the first to be resumed. In January, 1946, dial-exploring listeners in Great Britain rediscovered the well-



REFLECTOR KIT MODEL FMR-63 LIST $5.25



Ward's Reflector Kit combined with either the Straight or Folded Di-Poles as shown at left, provides maximum directional gain of the desired signal and eliminates undesirable and interfering reflections. Di-Pole elements can be rotated to any direction and tilted for any angle to facilitate orienting.

Look to WARD for Greater FM Values!

Ward, world's largest producer of aerials, now offers you leading values in FM with antennas completely adaptable to the varying requirements of each installation. They provide maximum electrical efficiency needed for finest FM reception. The ease with which they may be securely installed, plus strong weather-proof construction assures trouble-free operation—and extra profits for YOU!

The Straight and Folded Di-Poles shown at the right operate in a range of 88 to 106 mc. The Folded Di-Pole model provides broader antenna tuning and matched impedance to the 300 ohm transmission line for maximum response and energy transfer.

The Ward Reflector Kit can be combined with either of the two Di-Poles as illustrated above.

Folded Di-Pole Model FM-55 List $10.25

Straight Di-Pole Model FM-60 List $9.00

NOTE ALL THESE OUTSTANDING FEATURES:

- Universal base mounts on any roof or wall angle.
- Sturdy vertical element revolves or tilts in base allowing complete flexibility in orienting Di-Pole for maximum gain.
- Di-Pole element constructed of corrosion-preventive aluminum. All other parts completely weather-proofed inside and out.
- Ring provided for attachment of guy wires assuring secure installation.
- Sixty feet of dielectric 300 ohm colinear transmission line is insulated with polyethylene.
- Stand-off insulators guiding transmission line to receiver are of exclusive design minimizing capacity to ground and eliminating reflections on the line.

WARD TELEVISION ANTENNAS ALSO AVAILABLE

WRITE FOR FREE CATALOG

THE WARD PRODUCTS CORPORATION
1525 EAST 45th STREET • CLEVELAND 3, OHIO

IN CANADA: Atlas Radio Corp., 560 King St., W., Toronto, Ontario, Canada
EXPORT DEPT.: C. O. Brandes, Mgr., 4900 Euclid Ave., Cleveland 3, Ohio

WARD Aerials

known "gong" and the call-up, *"This is Radio Luxembourg,"* which they had always regarded as the "trade-mark" of good broadcast entertainment before the war.

Letters of appreciation and of "welcome back" began to pour in from all countries and have continued to do so, with the result that more and more emphasis is now being laid on the exchange of programs between the countries.

In the days before the war, *Radio Luxembourg,* in the main, addressed adult audiences and the interchange of art and commerce was designed to appeal almost exclusively to the "grown-ups." Since its postwar return to the air, however, an important innovation has been introduced. In cooperation with the headquarters of the Boy Scouts Association, *Radio Luxembourg* has now also become the "Voice of International Scouting," thus adding its far-reaching power to the cause of peace between the nations by encouraging the exchange of ideas and ideals between the citizens of tomorrow.

"Now, more than ever before," say station officials, *"Radio Luxembourg,* a Free Station in a Free Country, is determined to maintain its independence and its impartiality. Furthermore, the station's enormous power and tremendous potentialities in the international field have been pledged by the Direction to the cause and the service of the United Nations."

Full-scale commercial operations were inaugurated this year.

Radio Luxembourg is owned and operated independently by the private "Compagnie Luxembourgeoise de Radiodiffusion."

The long-wave transmitter, 150 kw., operates on 232 kcs. (1293 m.), and is currently scheduled Sundays, 0030-1700; Mondays, Tuesdays, Wednesdays, Fridays, 0045-1700; and Thursdays and Saturdays, 0015-1700.*

The short-wave transmitter, 5 kw., operates on 6.090 (49.26 m.), and runs daily, 1400-1700.

On Sundays, announcements are in French and *English;* German is added on other days.

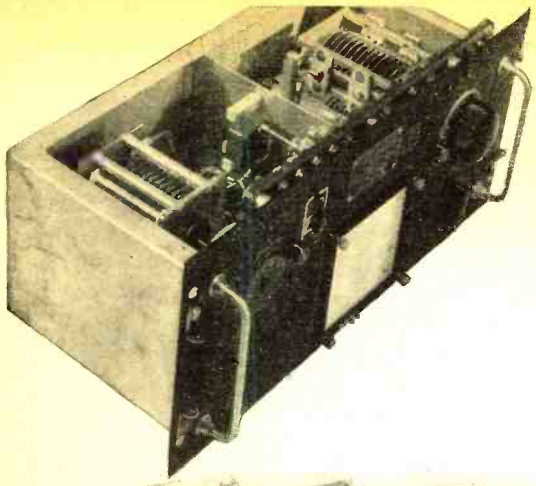
Technical Details

The technical installation consists of a studio block and administration building in Luxembourg City, with the transmitting station in the village of Junglinster, 10 miles away. The two are connected by both underground and overhead cables consisting of two radio channels and two service circuits. In the overhead system, the same facilities exist (for emergency purposes) as in the underground lines.

The broadcasting headquarters—completed in 1939—are situated in the center of the municipal park of Luxembourg and contain, besides the ad-

(*Continued on page* 90)

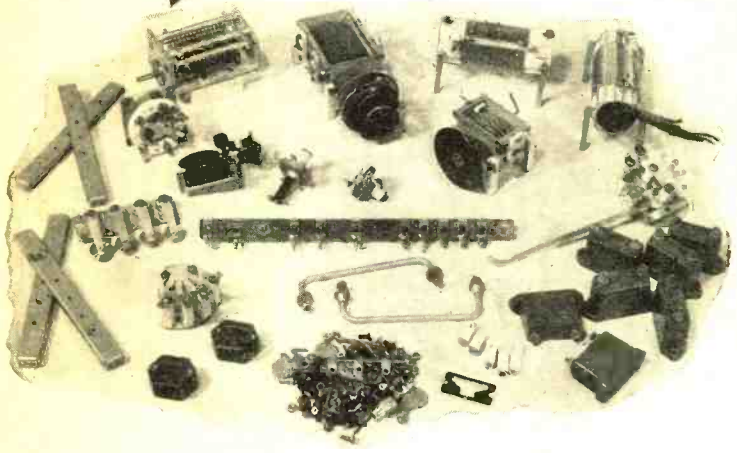
* Unless otherwise indicated, time herein is American EST; add 5 hours for GCT. News refers to newscasts in the English language. All times listed are based on the 24-hour clock.



Words Fail Us!

We Wells people have never liked sensational advertising but when we find a piece of equipment like this G. E. Tuning Unit offered for a tiny fraction of its real value, it's hard to be modest about it. Naturally, these units tune to frequencies outside of the ham bands. But we have yet to see a real Radio Amateur who can't cut a few coil turns to build a useful piece of equipment.

Brand New
G. E. Tuning Units
$2.50 each



Easily Converted to:

MASTER OSCILLATOR TUNER
C. W. TRANSMITTER
RESONANT LINE TUNER

PARTS ALONE WORTH 20 TIMES OUR PRICE

Practically every part in the unit fits right into Amateur requirements. So we suggest that you order extras to be dismantled for spare parts.

Look At These Parts — All For $2.50

1—Aluminum Panel 16¾" x 7¾"
1—Micrometer Drive unit for ¼" shaft
1—GE Planetary Drive unit for ¼" shaft
1—150 MMFD Trans. Plate Tuning Cond. 31 plate, ceramic insulated
1—125 MMFD Trans. Plate Tuning Cond. 25 plate, ceramic insulated
1—35 MMFD Transmitting Plate Tuning Cond. 7 Plate
1—Single pole 6 Pos. Heavy duty Ceramic band switch with knob
2—2 Pole Double Throw Heavy duty Ceramic band switch with knob
3—100 MMFD Transmitting mica cond. 3000 WVDC
1—60 MMFD Transmitting mica cond. 2000 WVDC
3—90 MMFD Transmitting mica cond. 3000 WVDC
2—40 MMFD Transmitting mica cond. 2500 WVDC
2—Ceramic coil forms 5" long, 2" dia. wound with No. 14 wire
1—Micalex strip 12" x ¾" x ¼" with Banana Plug jacks
1—Gang of 4 transmitting neutralizer condensers
2—Aluminum handles 5" long, 1¼" dia.
2—Ceramic flexible shaft couplings
15—Ceramic standoff insulators. Tapped ends
8—Aluminum standoffs tapped ends
Brackets, screws, lugs, misc. wire and ventilated case, lock washers, etc.
1—5 millihenry 300 MA choke RF
1—6 millihenry 300 MA choke RF
1—15000 ohm 5 watt resistor

Two Models Available:

TU 5B 1.5 to 3 Mc — $2.50 each
TU 10B 10 to 12.5 Mc — $2.50 each

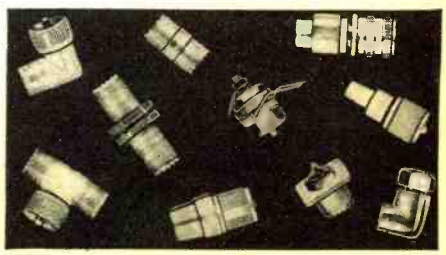
Black crackle dustproof cabinet for above — 50c each

These tuning units may be ordered directly from us or through your local Jobber.

We Think We Have Enough for Everybody

CO-AX CONNECTORS

We carry large stocks of all "83" series connectors in stock. Write for listing 100A or order from your Jobber.



Write for Amateur Radio Catalog H200-A

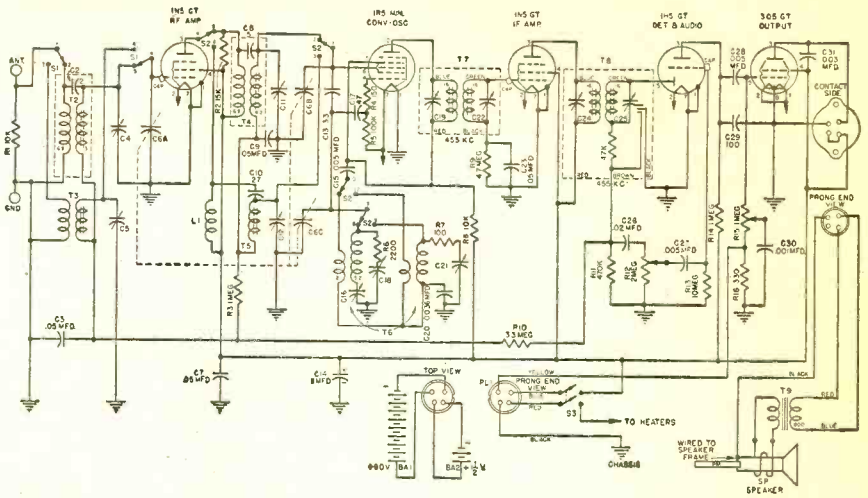
WELLS SALES, INC.

320 N. LA SALLE ST., DEPT. R-8, CHICAGO 10, ILL.

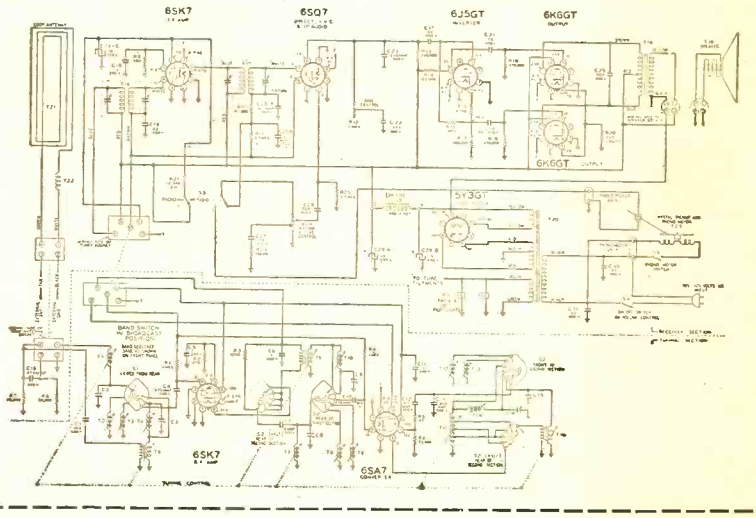
the RN CIRCUIT PAGE

(FOR PARTS LISTS SEE PAGE 86)

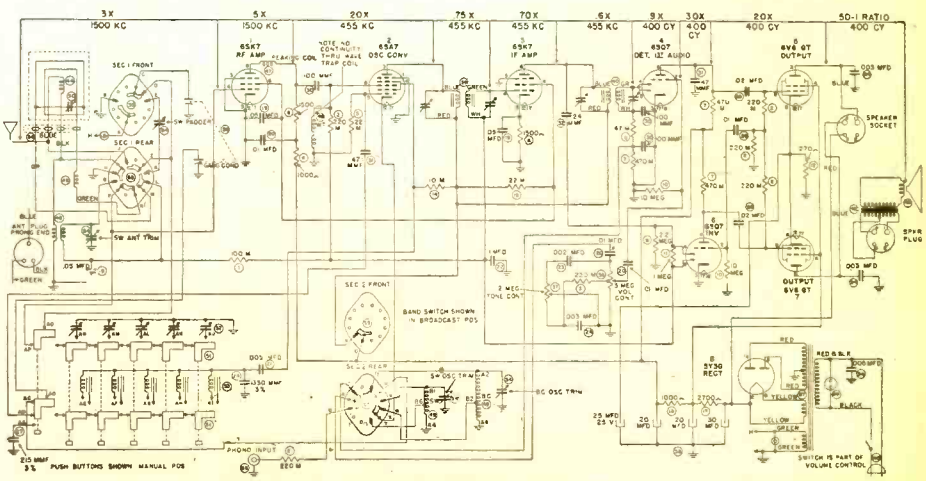
RADIO NEWS, AUGUST, 1947 — GENERAL ELECTRIC MODEL 280



RADIO NEWS, AUGUST, 1947 — TRUETONE MODELS D1747, D1748

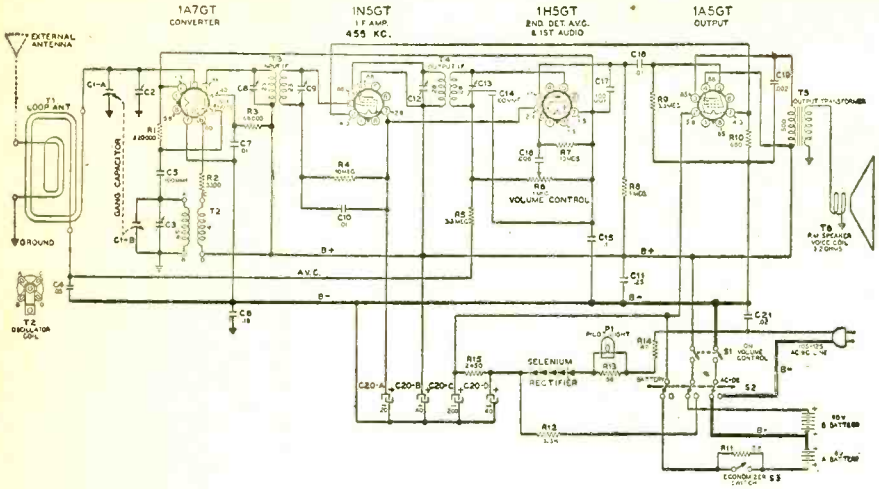


RADIO NEWS, AUGUST, 1947 — FARNSWORTH MODELS EK-081, EK-082, EK-083, EK-681

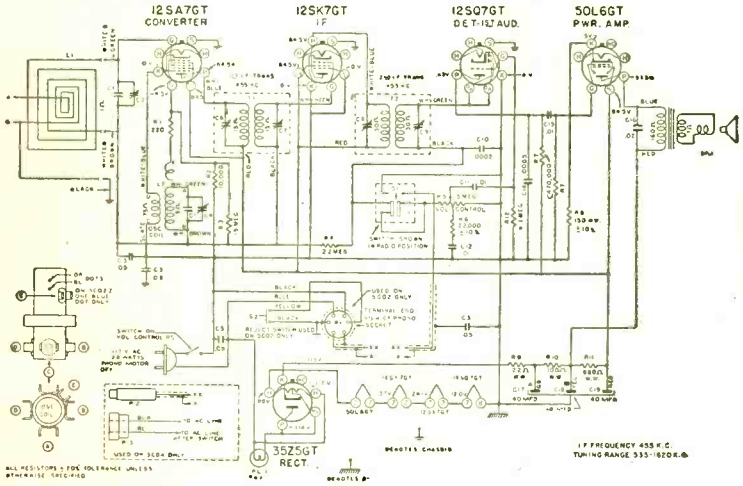


Here, and on following pages, are circuit diagrams and parts lists of many new postwar radio receivers. Radio News will bring to you other circuits as quickly as possible after we receive them from manufacturers.

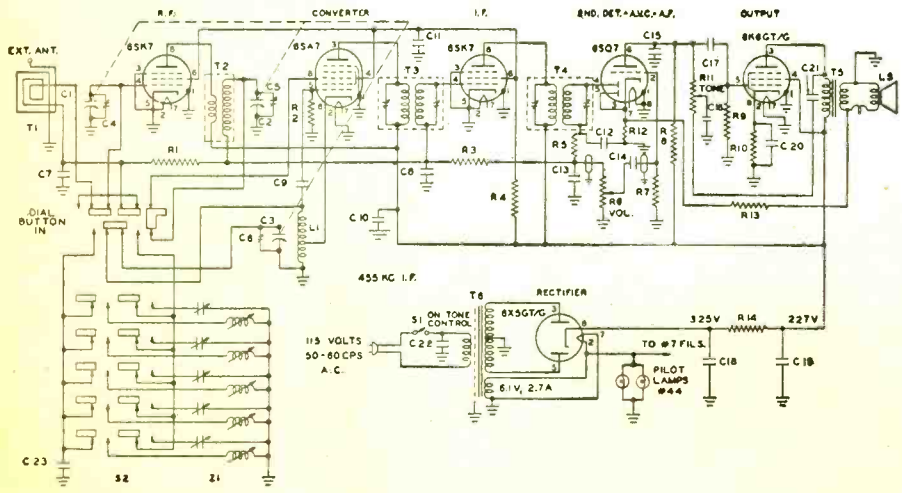
RADIO NEWS, AUGUST, 1947 **WARDS MODEL 74BR-1055A**



RADIO NEWS, AUGUST, 1947 **ZENITH MODELS 5R080, 5R086**



RADIO NEWS, AUGUST, 1947 **HOFFMAN MODEL A301**



What's New in Radio

NEW FILTER

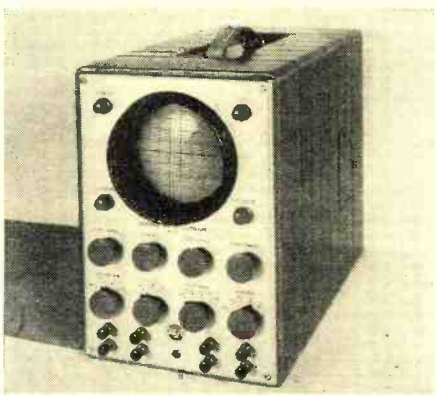
Burnell & Co. of Yonkers, New York, has recently added a new scratch filter to its line of filters and equalizers.

Designed to give a flat response within the passband and to provide sharp attenuation above the cut-off frequencies, this unit is adaptable to all types of recordings by means of three different cut-off frequencies which have been provided. They may be utilized by moving a single connection. This circuit feature facilitates the use of an ordinary single circuit switch for rapid changeover.

Additional details will be furnished by *Burnell & Co.*, 45 Warburton Avenue, Yonkers 2, New York.

NEW RCA SCOPE

The Test and Measuring Equipment Section of *Radio Corporation of America* has recently introduced a versatile new cathode-ray oscilloscope which



will permit the use of three different types of cathode-ray tubes.

This new oscilloscope, the Type WO-60C, is a general purpose instrument which has been designed especially for industrial applications. The unit will handle input voltages as high as 850 volts peak-to-peak. The low frequency response permits the observation of waveforms of .5 to 300,000 cycles.

Although furnished with a medium persistence cathode-ray tube, for the lowest frequencies a long-persistence flickerless screen may be used. A third tube having a short-persistence, highly actinic screen is available for photographic recording.

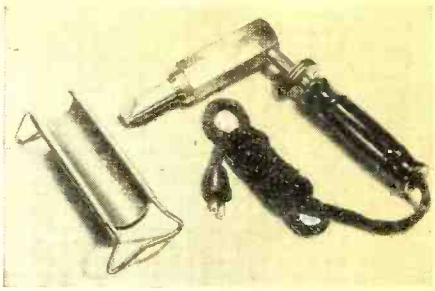
Full details on the new oscilloscope may be secured from the Test and Measuring Equipment Section, *Radio Corporation of America*, Camden, N.J.

HATCHET IRON

Especially designed to eliminate operator fatigue, the *Hexacon Electric Company* has announced the newest addition to its line of soldering equipment, the hatchet type soldering iron, Number 300 H.

The balanced unit rests easily in the operator's hand without the necessity for gripping or clutching the iron tightly. The special hatchet design permits soldering of hard-to-reach spots on the radio chassis.

The special hexagonal barrel allows this unit to be clamped in a vise for



easy tip removal without danger of injuring the heating element.

A request to *Hexacon Electric Company*, 119 West Clay Avenue, Roselle Park, New Jersey will bring full details on this iron.

PORTABLE PHONOGRAPH

Sarvi Electronics Mfg. Co. of Brooklyn has recently released the first of its line of phonographs to the trade.

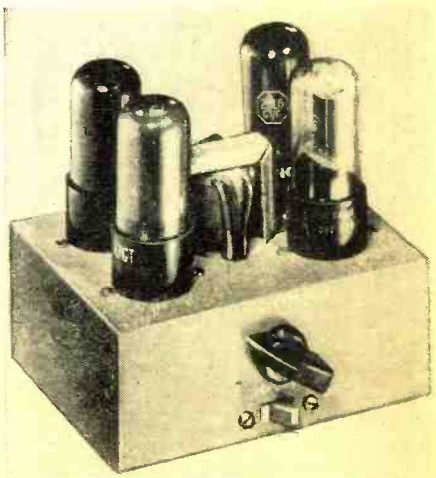
The Model PH-52 is a portable unit which operates on a.c. and weighs ten pounds complete. The unit is housed in a three-toned leatherette covered case and contains an amplifier with three miniature tubes, a 5" Alnico PM speaker, tone and volume controls, pilot light, and a featherweight crystal pickup.

Additional information about this unit can be obtained by writing to the *Sarvi Electronics Mfg. Co.*, 297 Broadway, Brooklyn 11, New York.

PHONO-AMPLIFIER

A new phono-amplifier, specifically designed for record reproduction has been announced by *Allied Radio Corp.*

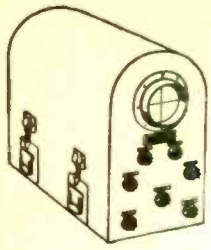
This new unit has an inverse feed-



back circuit for wide frequency response and 4 watts of output which provides sufficient drive for an 8 or 10 inch speaker. The amplifier will op-

"ARROW" Leads Again with LOW PRICES!

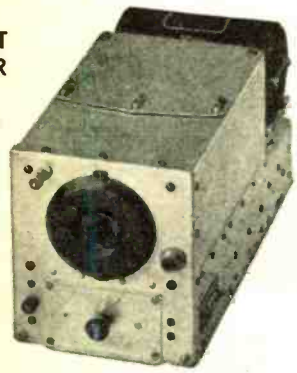
BC-612



Modified BC-412, 5" Radar Oscilloscope; ideal for first class laboratory instruments; 110V 60 cycles, complete with tubes and power supply brand new in original cartons.

Each...$49.95

ARMY AIRCRAFT RECEIVER Model BC-946-B



Broadcast band from 520 to 1500 kc. Tube complement: 3—12SK7, 1—12SR7, 1—12A6, 1—12K8. Designed for dynamotor operation, but is easily converted to 110 or 32 volt operation. Has two I.F. stages and three gang condenser. Comes packed in sealed carton complete with tubes and instruction manual, but less dynamotor.....$12.95

RADIO RECEIVERS

BC-454-A; 3-6 mc complete with tubes...$3.95

BC-453-A; 190-550 kc complete with tubes$4.95

BC-455-A; 6-9 mc complete with tubes....$3.95

Used, in A-1 condition.

ARA NAVY RECEIVER

1.5 to 3 Meg.....$6.95

Used, in A-1 condition. Complete with 6 tubes.

DYNAMOTOR

DM 32A. Each 95c, 3 for.....$2.00

MODULATOR UNIT

BC-456-A.....$2.95

REMOTE CONTROL BOX

BC-450-A.....$1.95

ARB AIRCRAFT RADIO RECEIVER

The ARB is a six tube, four band, superheterodyne 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.....$19.95

AN18/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

ART-13 TRANSMITTER

Used, in good condition, complete with tubes and calibrating crystal, freq. range 2,000 Kc to 18 mc; A-1, A-2, A-3 type transmission; power output 100 watts.....Each $75.00

RAX-1 3-RECEIVER COMBINATION

No. 1—4 bands, tunes from 200-1500 kc. ea. $15.00

No. 2—4 bands, tunes from 1500 kc to 900 mc. ea. 15.00

No. 3—5 bands, tunes from 7 to 27 mc...ea. 19.95

Each receiver complete with tubes and 24 V Dynamotor. Used, A-1 condition. 3 Receiver combination.....complete $34.95

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

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

BC-348 RECEIVER

Brand New in original cartons.....$49.95

used $39.95

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

BC-404-C VHF RECEIVER

Frequency range 102-110 Mc; complete with 12 tubes, 110V 60 cps, power supply included. Brand new in original cases.....$19.95

used $10.95

NAVY GLIDE PATH RECEIVER

Bolt type, complete with 3 6C6 tubes and tunes from 90 to 95 Mc, operates from 12 or 24V.....Brand new $3.95

RANGER MODEL 114-C AIRCRAFT RECEIVER

Combination Interphone, Amplifier and 6-Tube Superheterodyne Receiver designed to operate directly from a 24V aircraft battery. Tuning range 200 kc to 550 kc. complete with mounting rack, jackbox and cords. This unit is used as range receiver and interphone amplifier.

Brand new.....$14.95

GF12 and RU 17 NAVY RECEIVER and TRANSMITTER

Complete with receiving and transmitting coils, junction box, control boxes, plugs, power supply, instruction manual and spare parts which include tubes. Brand new in original carton.

A real buy.....$24.95

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.....$49.50

HAND-TYPE MICROPHONE RS-38

Carbon type, with PL-68 plug, brand new....$1.95

Used.....1.00

MICROPHONE AND RECEIVER P-60

Dynamic type, 50-ohm impedance; mike and phones interminate in 5-wire male plugs, 3-ft. cord.....$1.49

OXYGEN MASK MICROPHONE T44C

Used with SCR-522, magnetic type complete with JK-26 and PL-179. NEW...Ea. $1.29

Wholesalers, dealers, institutions and other quantity purchasers . . . Write, Wire, Phone for Quantity Prices. All Shipments F.O.B. Chicago—20% Deposit Required on all orders. Minimum order accepted $5.00. Write for our complete catalog.

APN-9

Self-contained power supply, complete with 29 tubes and 3 inch scope tube, 110 V. 400 cycles, used but in excellent condition.

Each.....$24.95

Power supply for the APN-4 complete with 16 tubes 110 V. 400 cycles.

Each.....$14.95

SETCHELL CARLSON RADIO RECEIVER

BC-1206-C

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.

Used A-1 cond.$4.95

BRAND NEW in original carton 7.95

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.....$15.00

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—28D7, and including three crystals 6497KC, 6522KC, 6547KC units are in A-1 condition for ONLY.....$9.95

SCR-522 TRANSMITTER and RECEIVER

The standard very-high frequency airborne receiver transmitter. 100 to 156 megacycles. 4 channels selected from remote control box. Used, in good condition—"Complete with Tubes" ONLY.....$19.95

BC-625

VHF transmitter, frequency range 100-156 Mc; four channels. Part of the SCR-522. Complete with tubes less crystals.

Used, good condition.....ea. $12.95

BC-624

VHF Companion receiver for above transmitter. Complete with tubes less crystals. Used, good condition. Diagram with either unit included.....ea. $9.95

VEEDER-ROOT METER AND CASE

Counts up to 1000.

Each.....95c

WESTON OUTPUT METER No. 687

3 scales 0-50.

A-1 Condition.....ONLY $8.95

ARROW SALES, INC.

59 WEST HUBBARD STREET • CHICAGO 10, ILLINOIS

Telephone: SUPERIOR 5575

erate with any high-impedance crystal pickup and 110 volt phono motor.

The amplifier is only 4" wide, 5¼" long and 4¾" high with tubes inserted and can thus be combined with a speaker and turntable in a small cabinet.

Complete information will be supplied by *Allied Radio Corporation,* 833 West Jackson Boulevard, Chicago 7, Illinois.

LOW-PRICED INTERCOM

Lyman Electronic Corporation of Springfield, Massachusetts is offering a new 6 station intercom, the "Callmaster," which provides many features generally found only in higher priced units.

Among the features of this unit are

a high gain circuit capable of picking up the normal voice at 50 feet, full sized 4" speaker, pilot light, privacy of communications, and six-station call when desired.

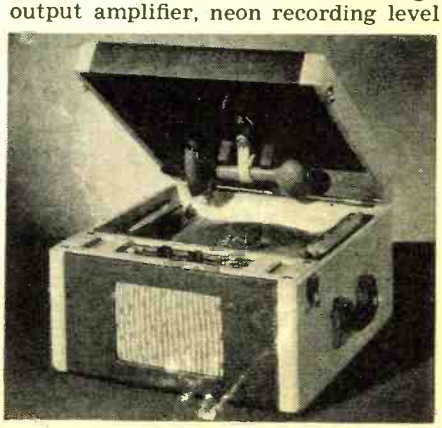
Housed in a mahogany plastic cabinet, this unit takes only 7x5½x3½ inches of desk space.

Lyman Electronic Corporation, 12 Cass Street, Springfield, Massachusetts will supply complete details on request.

PORTABLE RECORDER

Audar, Inc. has announced the availability of a new portable disc recorder which incorporates many characteristics of a studio type unit.

This Model RE-8 includes a high output amplifier, neon recording level



indicators, 6½" heavy duty PM dynamic speaker, and a hand microphone with seven feet of cable.

All switching from recording to playback is governed by a single control which automatically makes the

(*Continued on page* 98)

$175 AND 25 MONOSETS GIVEN

To Winners of This

EASY CONTEST!

RADIO AMATEURS

Just write 50 words or less telling us why you like the TELEX MONOSET *better than old style earphones.*

WIN:

$100 and a Monoset

$50 and a Monoset

$25 and a Monoset

PLUS TELEX MONOSETS to 22 Runner-ups!

HERE'S ALL YOU DO:

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2. In 5 minutes you'll get at least half a dozen good, WINNING ideas. Be sure to get *all* the facts and an OFFICIAL ENTRY BLANK.
3. Then write 50 words or less telling us "Why the TELEX MONOSET is Better than Old-Style Earphones." Clearness and sincerity will count most.
4. Print or type your answer on the OFFICIAL ENTRY BLANK your jobber will give you.

Mail direct to: TELEX, INC., Telex Park, Minneapolis 1, Minnesota, before Midnight October 15, 1947.

FIRST PRIZE: $100.00 cash and a TELEX MONOSET
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THIRD PRIZE: $ 25.00 cash and a TELEX MONOSET

TELEX MONOSETS to the 22 next best opinions. In case of a tie, *duplicate* prizes will be awarded.

Employees of Telex, Inc. and their advertising agency not eligible to enter this contest.

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CONTEST CLOSES MIDNIGHT OCTOBER 15, 1947!

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3. Excellent fidelity. Clear, natural reception of sound.
4. Reliable performance assured by TELEX precision engineering.
5. Exclusive, TELEX designed, volume control—permits individual adjustment of volume.

HEARING AT ITS BEST

TELEX INC.
ELECTRO-ACOUSTIC DIVISION
TELEX PARK
Minneapolis, Minn.

Decision of impartial judges will be final. All entries become property of Telex, Inc. Winners will be notified by mail approximately November 1, 1947. Contest subject to all state and federal regulations.

Remember, wherever a headset is used— TELEX MONOSET will do the job better.

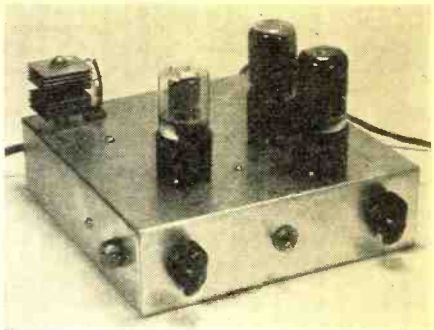
For the EXPERIMENTER

PHONO AMPLIFIER AND POWER SUPPLY

Frequently the experimenter has need of a small amplifier of reasonable power output to use with a record player. Many simple designs are possible but they usually have the disadvantage of high distortion plus insufficient output, especially when records having wide dynamic range are played.

The simplest manner of obtaining greater output is the use of a push-pull output stage. If an a.c.-d.c. type amplifier is used, the maximum output that may be expected is in the vicinity of four watts. This is adequate for some applications, but for maximum usefulness the output should be from six to eight watts. This ordinarily requires the use of a transformer type power supply. With the advent of the new selenium rectifiers, a tubeless voltage doubling circuit may be used, and due to the increased voltage available considerably greater output may be obtained.

The amplifier shown in the photographs uses a 12SL7 as a combination voltage amplifier and phase inverter to drive a pair of 50L6's as push-pull amplifiers. An output of over eight watts is thus easily obtained with low distortion. Sufficient gain is provided for almost any pickup, as only one quarter volt is needed to drive the amplifier to full output.

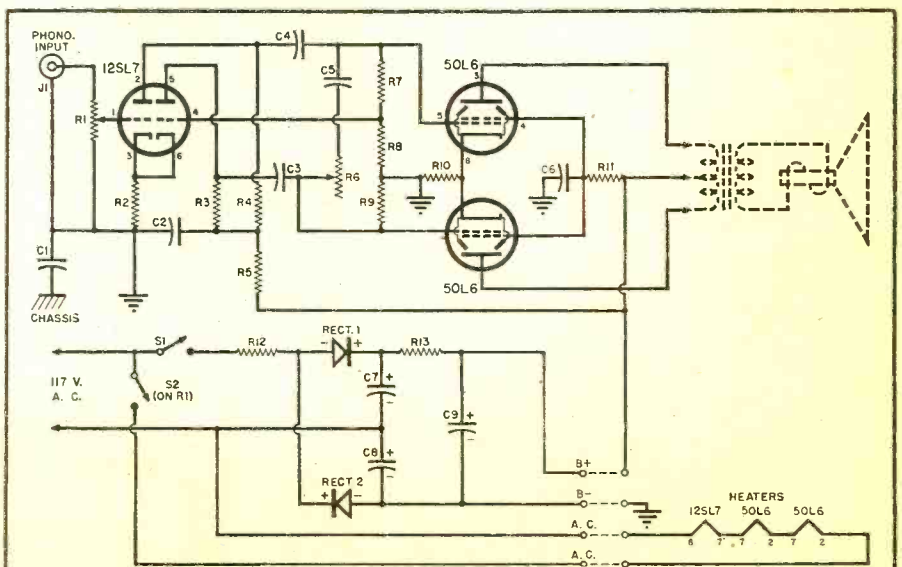


Top view of low-cost amplifier.

A tone control circuit, consisting of R_6 and C_5, is included. This control is useful in reducing needle scratch and gives the effect of boosting the bass response of the amplifier.

The power supply may be used to power other equipment by opening the links shown in the diagram. A voltage of 190 volts is available at a current drain of 100 milliamperes.

Schematic diagram. Power supply is connected through terminal strip to audio stages. It can be disconnected easily and used to operate other equipment.



R_1, R_6—250,000 ohm pot.
R_2—10,000 ohm, ½ w. res.
R_3, R_4—250,000 ohm, ½ w. res.
R_5—27,000 ohm, ½ w. res.
R_7, R_9—470,000 ohm, ½ w. res.
R_8—12,700 ohm, ½ w. res. (See text)
R_{10}—140 ohm, 2 w. res. (100 ohms and 40 ohms in series)
R_{11}—10,000 ohm, 1 w. res.
R_{12}—20 ohm, 2 w. res.
R_{13}—500 ohm, 10 w. wirewound res.

C_1—.05 μfd., 400 v. cond.
C_2—10 μfd., 200 v. elec. cond.
C_3, C_4—.01 μfd., 400 v. cond.
C_5—.002 μfd. mica cond.
C_6—8 μfd., 150 v. elec. cond.
C_7, C_8—50 μfd., 150 v. elec. cond.
C_9—16 μfd., 250 v. elec. cond.
J_1—Microphone connector
$Rect_1$, $Rect_2$—100 ma. selenium rectifier
S_1—S.p.s.t. toggle sw.
S_2—S.p.s.t. sw. (on R_1)

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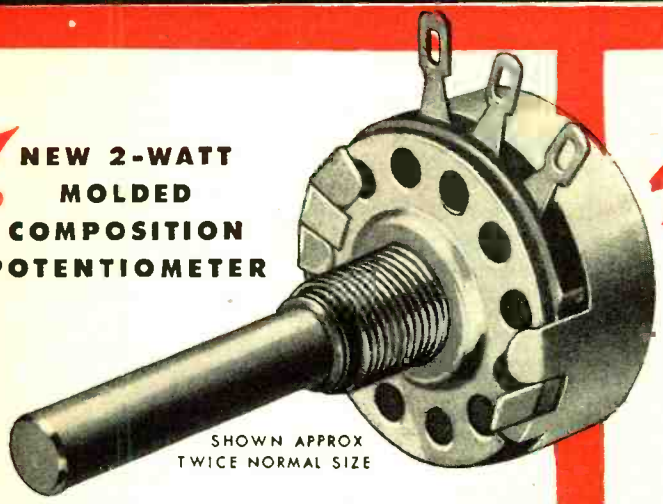

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2. NEW ± 5% TOLERANCE LITTLE DEVIL COMPOSITION RESISTORS

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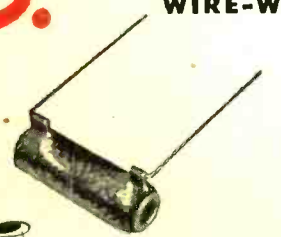
3. NEW 5-WATT BROWN DEVIL WIRE-WOUND RESISTORS



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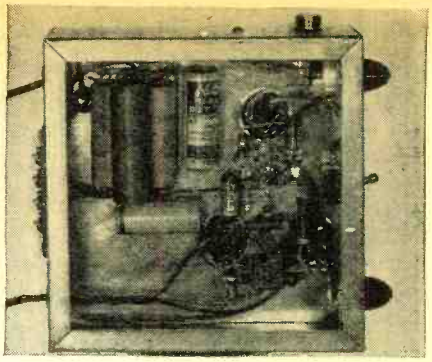

Under chassis view. A permanent magnet speaker, connected externally to the amplifier, is required. A dynamic speaker with a 450 ohm field may be used by substituting the field in place of filter resistor, R_{13}.

Due to the resistance-capacity filter used, the output voltage will vary depending on the load, increasing to about 230 volts at low current drains. The s.p.s.t. switch S_2 serves to turn off the heaters of the audio amplifier when the power supply is being used for other equipment.

Protection for the rectifiers in the event of overload is provided by means of the 20 ohm resistor, R_{12}. The use of this resistor is not absolutely necessary but its inclusion is recommended.

The components for the audio section are mounted along the front half of the chassis with power supply section at the rear. The two rectifiers are fastened together by means of a bolt and mounted above the chassis to provide proper ventilation.

The input to the amplifier is through a microphone connector, insulated from the chassis by means of fiber washers. All ground returns are made to a common bus, bypassed to the chassis by means of a .05 μfd. condenser, C_1.

The precaution of not having the chassis connected to one side of the line must be observed if the chassis is to be safe to the touch.

Shielded wire is used for the lead from the input connector to the gain control.

No output transformer was included with the amplifier, as many speakers come equipped with transformers. In the event an output transformer must be provided, the one selected should be designed for a plate-to-plate load of 4000 ohms. Use of any other load will result in either low output or distortion.

In any event, the speaker must be capable of handling at least eight watts if the maximum benefit from the amplifier is to be realized. This requires the use of a heavy duty speaker of at least the eight inch size.

R_8 consists of a 10,000-ohm and a 2700-ohm resistor in series. This particular value was selected to give equal drive to the grids of the two 50L6's. If an oscilloscope or vacuum tube voltmeter is available, the value of this resistor may be adjusted to

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give exactly the same drive to both grids. However, this is not necessary, as the values given will provide satisfactory operation.

VOLTAGE AMPLIFIER GAIN

The simple resistance-coupled audio voltage amplifier is a very widely used and highly useful electronic circuit. Many times it is helpful to be able to calculate the voltage gain of such an amplifier, that is, the ratio of the output voltage to the input voltage.

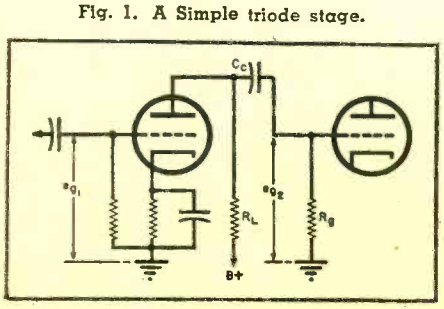
For this discussion, we will consider only the gain at mid-frequency, say in the region of 1000 cycles, as the gain at the high and low audio frequencies is complicated by various factors such as stray capacity, coupling and bypass condensers, and will be discussed in a later article.

The *gain* of a stage is determined primarily by the *amplification factor* of the tube used. Therefore, it is perhaps advisable to explain briefly what is meant by this particular tube characteristic. Amplification factor is a measure of the amount of control that the grid voltage has over the plate current. It is possible to change the plate current either by changing the grid voltage or by changing the plate voltage, and the amplification factor is defined as the ratio of the plate voltage change to the grid voltage change required to produce a given change in plate current. For example, suppose that for a given tube, a plate voltage change of 10 v. is required to change the plate current 1 ma., and a grid voltage change of only 1 volt will produce the same plate current change of 1 ma. The amplification factor then is $10/1 = 10$. The symbol for amplification factor is the Greek letter mu, written μ.

A simplified circuit of a triode voltage amplifier stage is shown in Fig. 1. The over-all gain of such a stage is equal to the voltage available at the grid of the next stage divided by the input voltage to the grid of the stage under consideration. Thus, in Fig. 1, the gain A of the stage is given by e_{g2}/e_{g1}.

The output voltage of the tube shown in Fig. 1 may be considered as equal to the input voltage times the amplification factor in series with the tube's plate resistance, r_p, as shown in the equivalent circuit of Fig. 2. At mid-frequencies, the coupling condenser C_c will have a reactance which

Fig. 1. A Simple triode stage.



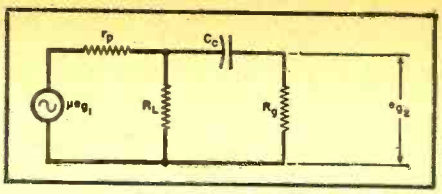


Fig. 2. Equivalent circuit.

is small compared with the values of R_L and R_g, so for our purposes may be considered as shorted. The output voltage e_{g2} then will be the voltage appearing across the parallel combination of R_L and R_g. This parallel combination is called the equivalent resistance, R_{eq}, and is given by the following equation:

$$R_{eq} = \frac{R_L R_g}{R_L + R_g}$$

The voltage μe_{g1} appears across the series combination of r_p and R_{eq}. The fraction of this voltage (e_{g2}) which appears across R_{eq} then is given by:

$$e_{g2} = \mu e_{g1} \frac{R_{eq}}{r_p + R_{eq}}$$

Since the gain has already been defined as the ratio of e_{g2}/e_{g1}, the gain is given by:

$$A = \frac{e_{g2}}{e_{g1}} = \mu \frac{R_{eq}}{r_p + R_{eq}}$$

Let us follow through an example to show how this equation was used. Assume a typical amplifier using a type 6C5 triode tube, a load resistance (R_L) of 50,000 ohms, and a grid resistance in the following stage of 1 megohm (R_g). From the tube manual, we find that the 6C5 has an amplification factor of 20 and a plate resistance of 10,000 ohms. R_{eq} (R_L and R_g in parallel) is then

$$\frac{50{,}000 \times 1{,}000{,}000}{50{,}000 + 1{,}000{,}000} = 47{,}600 \text{ ohms.}$$

The gain is now given by:

$$A = 20 \times \frac{47{,}600}{47{,}600 + 10{,}000} = 16.5$$

The gain of pentode stages can be computed in much the same way, although many times it is more convenient to use a tube characteristic called *transconductance*, written g_m. This is equal to the tube's amplification factor divided by its plate resistance. The gain is then equal to the transconductance times the parallel resistance of R_L and R_g, or $A = g_m R_{eq}$.

It can be seen from the above that the gain can never be greater than the amplification factor with this type of amplifier, and in general, the higher the load resistance R_L, the higher will be the gain. However, this load resistance cannot be made too high, as the d.c. voltage drop across it will be excessive, requiring an excessively high d.c. voltage supply. A compromise is usually reached in triodes wherein the load resistance R_L is from 3 to 5 times the plate resistance r_p. In pentodes, the load resistance is made as high as practicable.

-30-

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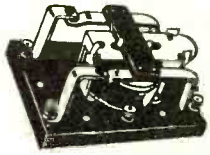

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3 Cm. Plumbing

"T" Sections ..... $ 5.50
Wave Guide Sections 2.5' long, silver plated with choke flange 5.75
Wave Guide 90 deg. bend E plane 18" long 4.00
Wave Guide 90 deg. bend E plane with 20DB directional coupler.. 4.75
Wave Guide 18" long S curve 2.00
Feedback Dipole Antenna, choke input 4.50
Rotary Joint wave guide in/out choke to choke 6.00
Rotary Coupler choke input; round guide output 5.25
S-Curve Wave Guide 8" long cover to choke 2.50
Wave Guide 2.5' long, silver plate, 180 deg. bend choke to cover 5.95
Duplexer Section using 1B24 ..... 10.00
Wave Guide with slotted section and rotary joint. 4.00
Wave Guide 5' length, per foot 1.50
Pick-up loop with adjustable tuning section, used in duplexer 1.50
3 cm. Absorption Type Wavemeter, Maguire 20.00

1.25 Cm. Plumbing

Wave Guide Section 1" cover to cover $2.00
"T" Section choke to cover 4.50
Mitred Elbow cover to cover 3.00
Mitred Elbow and "S" sections choke to cover.. 3.50
Flexible Section 1" long choke to choke 3.00
Tunable Cavity with coax input and output 6.00

Transmitter-Receivers

RC-145 & 148

1KW pulse output on 154 to 186mc. 117 VAC power supply. Can be converted to CW or Voice operation without difficulty and easily lowered to 144-148mc band. 5 stagger tuned receiver IF stages make for ready adaptability to FM or TV. Can be used as a low power Radar set.

RC-145, NEW complete with instruction book, including indicator unit $98.00
RC-148, used, complete 47.50

Transmitter BC375

Air Corps version of the famous BC-191. Used condition. Supplied with one tuning unit. Meters, coils, condensers, etc. Special for quick sale $9.95

Microwave Tubes

Magnetrons

3J31 (1cm) $20.00
Magnet 8.00
2J26 (10cm) 25.00
2J32 (10cm) 25.00
2J38 (10cm) 25.00
Magnet 10.00
700A (L band) 35.00
720HY (S band 1000kw) 20.00
Electro-Magnet 12.50

Klystons

2K25/723ab $7.75
2C40 Lighthouse tube 2.50

ARC-5 ACCESSORIES

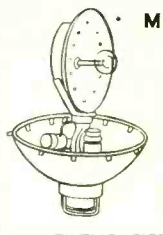
Mounts $1.00
Double Mounting Rack 1.65
Shock Mounts ..... .95

All parts interchangeable with SCR-274-N

DIRECTION FINDER

Designed for Marine Use—(Navy DP 12). Covers broadcast and marine frequency bands, 100-1500-KC. Complete installation with accessories and spares. Operation: 115V AC or battery pack. Loop can be operated remotely **$195.00**

MICROWAVE ANTENNAS



Relay System Parabolic reflectors aprx. range: 2000 to 6000 Mc. Dimensions: 4.5'x3'. New $85.00
Dipole for above 5.00
TDY "Jam" Radar rotating antenna. 10 Cm., 30 deg. beam, 115V AC drive. New. Mfg. Raytheon $75.00
SO Surface Search Radar rotating antenna. 10 Cm., complete with drive and selsyn motors. 24" dish. New $90.00
Used 45.00

SONAR SOUND DETECTION UNIT

Ideal for detecting underwater 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 for three times as much sensitivity as the SD-1 ..... $12.50

RG 9U Coax GE, silver coated copper, 51 ohm surge impedance. Sold in 100 ft. lengths and 500 ft. reels at $.07½ per ft.

U. S. ARMY LIGHT WEIGHT HEADSETS

New Insert Type—Comfortable, lightweight efficient 500 ohms impedance. .85 output trans. to match 500 to 8000 ohms extra ONLY $0.35
Headgear—Dynamic mike and headset combination, sound powered, moving coil type. Mike and earphones complete. From B19 Tank Transmitters. $1.85

RCA 12 TUBE SUPERHET

100 to 1500KC. 115V AC operation Dim. 24"x18"x13". Used: in excellent condition guaranteed $29.95

NAVY RCA-RAK-7 RECEIVERS

500kc band, 115 VAC operation, complete with spares $69.50

SPECIALS

SO13 10Cm. Surface Search Radar

250Kw peak power input to 2J27 magnetron. Trans.-Rec. $150.00
Plan Pos. Indicator using 5FP7 ..... 100.00
Spark Gap Modulator, and motor alternator pwr. unit 75.00
Rect. Pwr. Unit for rec 25.00
Rotating Antenna: New 90.00
Used 45.00

Send for quotation on complete sets new or used.

Power Pair—Transformer 470V CT @ 60ma: two 6.3V windings @ 1.65A and two 5V @ 2A—Primary. 115V 50 to 1200 Cy. PLUS a 6 Hy, 50ma choke. Both $1.99

Feed Thru Insulator—3" cupped shaped pair with flexible whip ant. mtg. Can be used either for feed thru or as whip ant. mast base.. $2.10

Antenna Grounding Switch—A MUST FOR EVERY SHACK. Rated 100 amps 2500 volts Silver ball contacts $2.49

Vibrator Transformer — Primary: 6, 12 and 12V; secondaries: (2) 120V @ 175ma. (1) 11V. Dimensions: 3.25"x3"x3" $1.00

All merchandise guaranteed. Mail orders promptly filled, prices F.O.B. N. Y. C.
Send Money Order or Check. Shipping charges only sent C.O.D. Send for Flyers. Rated Concerns send P.O.

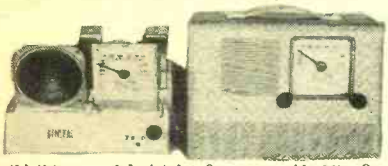
COMMUNICATIONS EQUIPMENT CO.

131-N LIBERTY ST., NEW YORK 7, N. Y. TELEPHONE WH 4-7658

PERSONAL PORTABLE KIT, $10.95

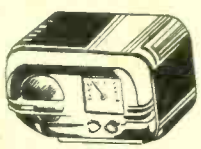
PERSONAL PORTABLE KIT MODEL K-PX. Small size leatherette covered case 8x6x7. Easy to build. Operates on self contained B and A batteries. Rec. Broadcast 550 to 1600 K.C. Incorporates a standard superhet circuit with avc. Has 3 inch Alnico five PM speaker. Priced complete with batteries, pictorial diagram 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, $17.95



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 **$17.95**

BEAUTIFUL PLASTIC KIT $9.95

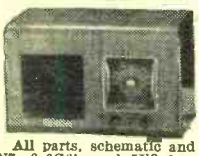


Kit Model P-85. We have finally been able to achieve our goal. Here it is. A good 5-tube broadcast AC DC superhet radio receiver for less than ten dollars. The beautiful 10 inch plastic cabinet is made of the finest material. The chassis is of the standard accepted superhet design. 456 KC ifs AVC and 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 12K8, 12SK7, 12SQ7, 50L6 and 35Z5. Nothing else to buy. You can't go wrong on this value. Kit Model P-85 .....Net **$9.95**
SUPERHET. 4-Tube. 1½—90 Volt FARM RADIO KIT complete, less 1000-hour battery; similar cab. to Model P-85. Model PB-48.....Net **$9.95**

NEW SUPER MIDGET KIT, $12.95

OUR SUPER VALUE

Build this new super Midget Broadcast Radio. Has beautifully made. highly polished walnut cabinet. Size 7½ x 4½ x 5½. Attractive slide rule dial. Incorporates a standard superhet circuit with 456 KC IFS & AVC. Has 2 gang condenser and loop ant. Every part including Alnico V. P.M. speaker and tubes. 12BE6. 12BA6. 12AT6, 50B5 & 35W4. Furnished as well as photo and easy to follow diagram. Weight 5 lbs.



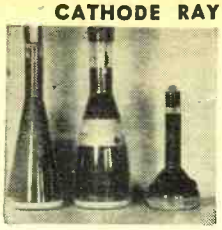
KIT K-7A. Easily assembled into a fine working, attractive, transformer type AC, broadcast receiver; 550 to 1700 KC. Has push-pull audio, tone control and 6½" Alnico 5 PM speaker. Beautifully made 14" walnut cabinet. Incorporates a standard superhet circuit, with AVC and loop antenna. All parts, schematic and tubes 6SA7, 6SK7, 6H6, 6SN7, 2-6G6's and 5Y3 furnished. Nothing else to buy. Wt. 17 lbs.
Dealers Net **$19.95**

DELUXE AC-DC KIT J-D5
Beautiful walnut cabinet and all the parts to build a broadcast 5 tube AC-DC radio. Superhet with slide rule dial, 2 gang tuning condenser and loop aerial. Everything furnished; includes speaker and tubes 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6 and diagram.
Kit J-D5. Wt. 10 lbs.....Net **$14.95**
KIT K-5D. Similar cabinet to above J-D5 except it is AC Trans. type and has 6 volt tubes. ...Net **$16.95**

20-WATT UTILITY AMP. KIT, $17.95

Build this 20 watt utility 110 volt AC, 20 Watt power amplifier. Ready punched aluminum 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, controls, transformers and easy-to-follow diagram furnished, including tubes: 2-6SN7, 6J5. 2-6L6GA. 5Z3. Kit Model 20-LX. Net.....**$17.95**
12" 12 watt Alnico 5 PM speaker, $6.95 extra. Astatic crystal mike and desk stand, $7.95 extra.

CATHODE RAY TUBE SCOOP



All New—Factory Cartoned

3BP1....Net	**$2.95**
5CP1....Net	**3.95**
5BP1.....Net	**3.95**
5FP7....Net	**3.95**
7BP7....Net	**4.95**
9LP7....Net	**4.95**

RADIO TUBE SCOOP!

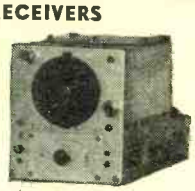
ALL—NAME BRANDS OR JAN SOME ARE CARTONED EVERY TUBE GUARANTEED

12A6	35Y4	12SL7	1L4	**49c**
12H6	50A5	6F8	3A4	
12SH7	6V6ST	26	1R5	
1631	6SN7ST	27	12AT6	
1632	30	6H6	12BA6	
9001	76	6SH7	12BE6	
12SA7	37	56	35W4	
12SQ7	5Y3	80	50B5	
12SK7	5Y4	6J5		
35Z5	1633	9003		
50L6	1644	1S5		
14A7	12SN7	1T4		
14Q7	6SD7	3S4		
6C5	6V6gt	12SK7	0Y4	**59c**
6F6gt	6K7	35L6	12SJ7	
6SA7	41	50L6	12SR7	
6SK7	42	35Z5	6C6	
6SQ7	6A8gt	6K6	6D6	
12SA7	12J5		77	
12SQ7			78	
6SC7	7Q7	7B7	35A5	**79c**
6SL7	7A8	7C5	117Z6	
7A7	7B8	7C6		
7A4	7Y4	7E5		
7B4	7Z4	7F7		
7A6		7N7		
7B6				

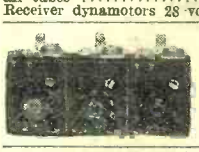
1½ Volt Loctal Tubes..... 1LD5, 1LN5, 1LH4. 1LA4. 1LB4, 1LC6, 1LA6, 6L6. **99c**

SCOOP
1000 JAN. OZ4 Each **69c**

AIRCRAFT RECEIVERS



The Army Aircraft Receiver BC-454 covers 3 to 6 MC. Has 3 gang tuning condenser and two stages of 1415 KC. intermediate frequency. By removing plates from the gang and re-winding the Ant., R.F. and osc. coils you can have a red hot 10 meter receiver. We have plenty of these in the original factory carton. Priced less the 28 volt dynamotor. Has 3—12SK7, 12SR7, 12K8, and 12A6.
Near new BC-454-B 3 to 6 MC receiver with all six tubes .....Net **$3.95**
Near new BC-455-B 6 to 6 MC receiver with all six tubes .....Net **$3.95**
Brand new factory cartoned BC-454-B 3 to 6 MC with all tubes **$5.95**
Brand new factory cartoned BC-455-B 6 to 9 MC with all tubes **$5.95**
Receiver dynamotors 28 volts.....Net **$0.95**



Triple remote control head for SCR-274 (BC-453-B, BC-454-B, BC-455-B) **$1.95**
Flexible cable for tuning SCR-274 ..... **$0.79**
Mounting Rack for three receivers **$1.95**

AIRCRAFT TRANSMITTERS

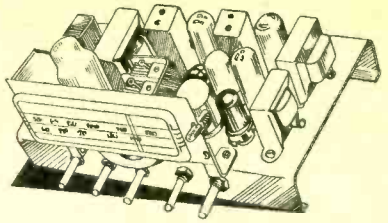
BOTTOM VIEW

This really fits the ham's dream. Ideal for a 55 watt transmitter with 575 volts at 250 MA plate supply, or VFO to drive a high power rig. It's a companion unit to the 454-455-453 series aircraft receivers. Made by Western Electric and really rugged. The oscillator will hold the frequency, even under rough operating conditions. Has 12J5 M. O. and 2—1625 (807) in parallel as final P. A.; or buffer to feed into a high power rig. Built-in crystal dial calibration checker. Antenna loading inductance.
Near new BC-457-A Transmitter 4 to 5.5 MC. Complete with 4600 KC crystal and tubes.
Your Cost **$3.95**
Near new BC-458-A Transmitter 5.3 to 7 MC. Complete with 6200 KC crystal and tubes.
Your Cost **$5.95**

Scr-274 (AN/ARC-5) SCOOP!
Brand new, factory cartoned transmitters BC-457-A 4 to 5.3 MC with tubes and crystal.....**$9.95**
Brand new, factory cartoned transmitters BC-458-A 5.3 to 7 MC with tubes and crystal.....**$9.95**
Brand new, factory cartoned trans. BC-459-A 7 to 9 MC with tubes and crystal.....**$9.95**

EVERY KIT COMPLETE

8-TUBE RADIO AMP. KIT $29.95



Build this High-Fi Radio Amplifier

- Beautiful 8" Slide Rule Dial.
- Standard Superhet Circuit covering Broadcast 550 to 1700 K.C.
- 2-Gang Tuning Condenser.
- Offered with 12 or 15 in. PM Speakers. Push-pull 6V6 Output stage giving 15 watts of full range audio.
- Dual Tone Controls (Bass and Treble).
- Inputs for both Mike and Phono pick-up.

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.....Net **$29.95**
PRK-10X Radio Amp. Kit with 15 In. $30.00 value Cinnaudagraph P.M. speaker.....Net **$42.95**
If you desire a more powerful Audio section in the above kit we offer either the PRK-10 or PRK-10X with a full 200 mill power transformer and push pull 6L6 tubes in the final giving 25 watts of full range audio for $10.00 extra on either kit.

DELUXE REC. CHASSIS $22.95

DeLuxe broadcast receiver chassis kit model AB-4 this kit is offered those who want a good receiver to install in their cabinet. The design is of the accepted type; standard superhet. Has power transformer push-pull 6V6's output tubes; tone control; 2 gang condenser and 8 inch deluxe slide rule dial; similar in appearance to our PRK-10 kit; shown above; except it has no provision for mike. Offered with a 12" 15 watt Alnico 5 PM speaker. Priced complete with diagrams, photos and tubes 6SA7, 6SK7, 6SQ7, 6SN7, 2 6V6 and 5Y3. Kit model AB-4.....Net $22.95

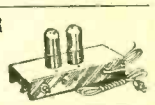
PORTABLE RADIO RECORDER KIT $49.95

RADIO RECORDER KIT MODEL G-30. Here is the last word in kits. We furnish you everything to make this attractive good working radio and recorder. Has a beautiful alligator covered portable case. General Industries 12445 78 RPM recording play back mechanism. The 6 tube superhet receiver and power amplifier is all on one chassis. With this unit you can record directly for your popular radio station or from any crystal or dynamic mike. Push pull output tubes assures good recordings and the best in tone quality. Furnished complete with easy to follow diagram. Photos and tubes 12SA7, 12SK7, 12SQ7, 12SL7 and two 35L6. Dry disc. rectifier. Heavy duty 6 in. Alnico 5 PM. speaker. Priced complete nothing else to buy.
Kit model G-30.....Net $49.95
Crystal mike with desk stand $6.95 extra.
G-30 With Dual Speed Cutter.....$4.45 extra.

G.I. RECORDER MECHANISMS

Latest 1947 General Industries recording assemblies with 4 ohm magnetic cutters and crystal play back
Model 12445—78 RPM. Net.....**$24.50**
Model 13700—33 and 78 RPM. Net..... **28.95**
Model 13810—Automatic changer with cutter, 78 RPM. Net..... **40.10**

2-TUBE PHONO-OSCILLATOR



Complete, wired and tested. 800 to 1500 KC. Model B-4. Has audio gain stage for proper power output. Complete with tubes ready to operate.....**$3.69**

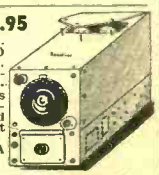
MIKE-OSCILLATOR

800 to 1500 KC
Mike Oscillator model C-4. Not only does the unit work as a phono-osc., but has added gain stage for a crystal mike. Priced complete, wired and tested with 3 tubes and fader control.
Net **$4.95**. Crystal Mike.....**$4.90** extra

DELUXE MIKE OSCILLATOR

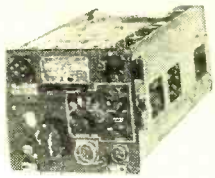
800 to 1500 KC Phono-Mike Oscillator. Makes any receiver a PA system. Record player or Recording amplifier. 3 stage high output unit with power transformer for AC operation only. High gain input stage for crystal or dynamic mike. Control on panel for fading recording to voice, simulating an actual broadcast station. Model DL-5 Complete with 3 tubes, wired and tested.
Net $7.95. Crystal Mike.....$4.90 extra

BROADCAST REC., $12.95



Army Aircraft Receiver BC-946-B. Broadcast band from 52 to 1500 KC. with tubes: 3—12SK7, 12SR7, 12K8 and 12A6. Designed for dynamotor operation, but is easily converted to 110 volt operation. Has two I.F. stages and 3 gang condenser. Complete with tubes and instructions; less dynamotor. Net $12.95. Good condition.
Dynamotor for above receiver DM-32A $0.95 each.

NAVY ARB RECEIVER, $19.95



You can convert this over, easily to a good ham receiver. It's one of the hottest values in surplus receivers. 28 volts DC input. Covers 4 bands. 195 kc to 9 mc. This is a deluxe type superhet receiver, note that the frequency coverage includes the standard broadcast band. Has 4 gang tuning condenser; can be converted to a 110 volt AC receiver. Priced complete with tubes: 12SF7, 12SA7, 3-12SF7 and 12A6. Has dial built on front of chassis. Electric driven or manual band change switch. Weight 28 lbs. Size 6x7x15 inches.

ARB Near new condition, with tubes and dynamotor.....Net **$19.95**
ARB Brand new, factory cartoned, with schematic.....Net **39.95**

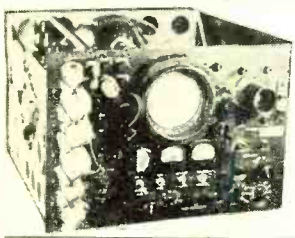
New remote control for ARB. **$12.00** extra.

GLIDE PATH RECEIVER, $9.95

R-89/ARN-5 Glide Path Receiver 11 tube superhet. Formerly used for blind landing. Adaptable for many uses. Receives 326 to 335 MC. Contains six relays. 11 tubes 7—6AJ5, 12SR7, 2—12SN7, 25D7. Size 13x5x6. Weight 12 lbs. A beautiful piece of equipment. Has three crystals. Priced complete with xtals and tubes.

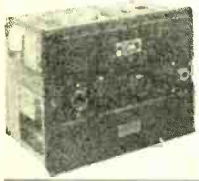
R-89/ARN-5 Near new condition .....Net **$ 9.95**
R-89/ARN-5 Brand new, factory cartoned .....Net **14.95**

APS-15 RADAR SCOPE, $39.95



APS-15 RADAR—Aircraft Radar Range Scope. This unit is so dynamic in its operation that it is impossible to describe it in an ad. Originally used to receive radar signals and indicate range. Has a 5 in. scope tube, a 2 in. scope tube and 43 other tubes such as 7—6L6, 6SN7, VR, etc. Vert. amplifier, video amplifier. Blower motor. Rotary sweep, electro magnetic deflection yoke. Marker pip osc. sweep generator, etc. Originally cost the government thousands of dollars. Size 24x15x28. Weight 65 lbs. **Scoop Price with all tubes.....$39.95**

SCR-522 TRANS. REC., $19.95



SCR-522 You are all familiar with this 100 to 156 MC Transmitter, receiver. These 522's that we have are in rough looking cases and some of the outside connectors have been damaged. However, we guarantee that if you separate the transmitter and receiver and remove the case, you will have usable merchandise. There are not many more of these units available; we have just 100 to sell.

PACKARD BELL PRE-AMP., $1.99

Housed in a handy aluminum case 5x4x5, priced complete with tubes 6SL7, 28D7, has many usable parts. Relay and control PL68 plug and patch cord.

VEEDER-ROOT METER AND CASE

Counts number of feet of trailing wire antennae; number turns when winding on coil; applicable for many uses; beautiful bakelite case, jeweled dialite, pilot light enclosed, 3 position switch, counts up to 1000.

Each **95c**

KEYS—49c

Brand new keys. Factory cartoned. While they last, **$0.49 each** 10 for $3.95

BC-1366 Jack Box 11 bank banana plug jack and socket with 5 position single deck switch and control. 2 phone jacks. Scoop price **.59 2 for $1.00**

SCOOP $1.99

Heavy Duty Vibrator is made for replacement in 6/110 volt amplifiers. The frequency is 60 cycles. Will run stand. Phono motor.

NAVY GLIDE PATH, $3.95

Navy model ZA Glide path receiver. Has 3—6C6 tubes; several controls, transformer and handy case; size 6x7x12 inches. Ideal for salvage, near new condition **$3.95**. 2 for.....**$6.95**

SYNC. VIBRATOR UNIT, 99c

MALLORY SYNC. VIB. UNIT. This is a standard type 6 volt vib. unit. Has long leads. Easily installed in the old case. A red hot item if we ever had one.

ARMY PARTS SALVAGE SCOOP!—$2.49 EACH

TWO FOR $4.49

BOTTOM VIEW

Another red hot value in salvage. All kinds of good useable parts in this unit. Con. Res. Relays, Modulation trans. and tubes VR150, 12J5 and 1625. Brand new and in factory carton. Originally designed to modulate the BC 457 W.E. Transmitter. You can find many uses for this. BC-456 Modulator scoop, price.....**$2.49**

G.E. SERVO-AMP. SALVAGE

$1.95 EACH

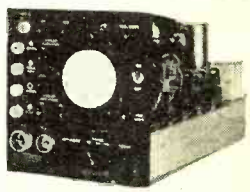
Two for $3.50

G.E. Servo amp Salvage Scoop. This item is ideal to tear up for the pieces, General Electric Servo amplifier, has 14 octal tube sockets, 5 small neon lamps. Lots of condensers, resistors and controls. Salvage value more than the purchase price of this unit. Weight 15 lbs. Brand new. Priced less tubes **$1.95 2 for**.....**$3.50**

SWITCH-POT. SALVAGE, 99c

A real salvage scoop. Has 3 toggle switches, 1 band switch, 6 standard size carbon controls, knobs, etc. Scoop price **.99. 3 for**.....**$2.50**

BC929 RADAR, $14.95



BC-929 A Radar Indicator Scoop. This unit could be rebuilt into a fine test scope. It is an ideal size. 8x9x14 priced with tubes 2—6SN7, 2—6H6, 6G5, 6X5 and 2X2. This is a red hot buy. However you will have to change the power trans. for 60 cycle use. Guaranteed to be in good condition.

Scoop Price **$14.95**
Weight 20 lbs. Has 3 in. Cr Tube.

BC-654 TRANSMITTER RECEIVER $12.95

GUARANTEED TO BE IN GOOD CONDITION

7-Tube Superhet Receiver and 6-Tube Trans. with 25 Watts Power.

Order Now at this Scoop Price. Covers 3800 Kc. to 5800 Kc.

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—1H5GT 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; set of tubes installed, 5 spare tubes and 3 spare pilot lights. Less power supplies. These units are used but in good condition. Shipping weight 50 lbs. Net price with all tubes and spares **$12.95**; 2 for..**$25.00** Send your order to our Kansas City store. This unit will be shipped from our Chicago warehouse. Immediate delivery. You can hardly tell they are used. BC-654 Less all tubes and crystal.....**$7.95**

BC-645, $14.95 Each Two for $29.00

Made by General Electric. Factory printed Conversion Diagram. New, factory cartoned. 15 tubes. Covers 450 mc.

ARMY BC-645 I.F.F. UNIT. Early in the war when radar picked up a plane, there was no way of knowing whether it was friendly or not. That was before BC-645 was invented. BC-645 sent out a signal that identified the plane as American. It probably saved more lives than any other piece of electronic equipment made. With some modifications the set can be used for 2-way communication, voice or code, on the following bands: ham band 420-450 mc., citizens radio 460-470 mc., fixed and mobile 450-460 mc., television experimental 470-500 mc. Equipment capable of doing the jobs of the modified set sells for hundreds and hundreds of dollars. The 15 tubes alone are worth more than the sale price. 4-7F7, 4-7H7, 2-7E6, 2-6F6, 2-955 and 1-WE316A. It now covers 460 to 490 mc. Each BC-645 is shipped with a Belmont factory printed conversion diagram, showing how to make AC power supply modulator and how to make Transmitter and Receiver changes. Most Hams and experimenters already have the few parts necessary. New BC-645 with tubes less power supply. Shipping weight 25 lbs. Extra WE316A Tubes $1.29 each. 12 Volt Dynamotor **$4.95**

Parts Lists

(FOR CIRCUIT DIAGRAMS APPEARING ON PAGES 72 AND 73)

TRUETONE MODELS D1747, D1748

Part No.	Code and Description
C-9B1-31	R_1, R_4—1 megohm, ½ w. res.
C-9B1-55	R_2—270 ohm, ½ w. res.
C-9B1-70	R_3—4700 ohm, ½ w. res.
C-9B1-46	R_5—47 ohm, ½ w. res.
C-9B1-79	R_6—27,000 ohm, ½ w. res.
C-9B1-21	R_7, R_8—22,000 ohm, ½ w. res.
C-9B1-59	R_9—560 ohm, ½ w. res.
C-9B1-23	R_{10}—47,000 ohm, ½ w. res.
C-9B1-34	R_{11}—3.3 megohm, ½ w. res.
125180	R_{12}, S_3—1 megohm tone control & sw.
C-9B1-27	R_{13}—220,000 ohm, ½ w. res.
C-9B1-86	R_{14}, R_{17}—100,000 ohm, ½ w. res.
C-9B1-31	R_{15}—1 megohm, ½ w. res.
C-9B1-70	R_{16}—4700 ohm, ½ w. res.
C-9B1-29	R_{18}, R_{19}—470,000 ohm, ½ w. res.
C-9B2-56	R_{20}—330 ohm, 1 w. res.
10662	R_{21}—12,500 ohm, 3 w. res.
C-9B1-20	R_{23}—15,000 ohm, ½ w. res.
A-10A-10586	R_{24}, S_4—500,000 ohm vol. control & sw.
C-9B1-35	R_{25}—4.7 megohm, ½ w. res.
B-8F-10767	C_1—.002 μfd., 500 v. cond.
124143	C_2, C_3—Dual broadcast (67-123 μμfd.) and 9 mc. (95-175 μμfd.) ant. trimmers
B-8F3-121	C_4, C_{10}—470 μμfd., 500 v. cond.
C-8D-10771	C_5—.1 μfd., 200 v. cond.
C-8D-10760	C_6, C_{13}—.1 μfd., 400 v. cond.
B-8F5-101	C_7—10 μμfd., 500 v. cond.
A-8G-7205	C_8—120-220 μμfd. broadcast r.f. trimmer
A-8G-7206	C_9—60-110 μμfd., 9 mc. r.f. trimmer
B-8F3-109	C_{12}—47 μμfd., 500 v. cond.
B-8F-10763	C_{13}—200 μμfd., 500 v. cond.
124145	C_{14}—7-35 μfd., 9 mc. osc. trimmer
124144	C_{15}—15-27 μμfd. broadcast osc. trimmer
C-8F3-12	C_{16}—470 μμfd. mica cond.
C-8D-10774	C_{17}, C_{19}—.02 μfd., 400 v. cond.
C-8D-10771	C_{18}—.1 μfd., 200 v. cond.
129165B	C_{20A}, C_{20B}—Dual 50/50 μμfd. mica cond.
C-8D-10813	C_{21}—.05 μfd., 400 v. cond.
C-8D-10935	C_{22}—.005 μfd., 600 v. cond.
C-8F3-10	C_{23}—220 μμfd. mica cond.
C-8D-10770	C_{24}—.05 μfd., 200 v. cond.
C-8D-10788	C_{25}—.004 μfd., 600 v. cond.
C-8D-10992	C_{27}—.03 μfd., 200 v. cond.
C-8D-10785	C_{28}—.006 μfd., 600 v. cond.
119109	C_{29A}, C_{29B}, C_{29C}—15/15/10 μfd., 450/450/350 v. elec. cond.
C-8J-11321	C_{30}, C_{31}—.02 μfd., 600 v. cond.
111195	T_1—Broadcast ant. coil
111191	T_2—12 mc. ant. coil
111192	T_3—15 mc. ant. coil
111189	T_4—6 mc. ant. coil
111190	T_5—9 mc. ant. coil
10959	T_6—9 mc. r.f. coil
10962	T_7—Broadcast r.f. coil
10960	T_8—12 mc. r.f. coil
10961	T_9—15 mc. r.f. coil
10958	T_{10}—6 mc. r.f. coil
110157	T_{12}—9 mc. osc. coil
110159	T_{13}—15 mc. osc. coil
110158	T_{15}—12 mc. osc. coil
110156	T_{14}—6 mc. osc. coil
110161	T_{16}—Broadcast osc. coil
108177	T_{16}—Input i.f. coil
108176	T_{17}—Output i.f. coil
B-12C-10234	T_{18}—Output trans.
C-18B-12676	T_{19}—8" electrodynamic speaker
104202B	T_{20}—Power trans.
B-20A010964	S_1—Antenna bandswitch
B-20A-10965	S_2—Osc. & r.f. bandswitch

GENERAL ELECTRIC MODEL 280

Part No.	Code and Description
URD-073	R_1, R_8—10,000 ohm, ⅓ w. res.
URD-077	R_2—15,000 ohm, ⅓ w. res.
URD-121	R_3, R_{14}—1 megohm, ⅓ w. res.
URD-029	R_4—150 ohm, ⅓ w. res.
URD-097	R_5—100,000 ohm, ⅓ w. res.
URD-057	R_6—2200 ohm, ⅓ w. res.
URD-025	R_7—100 ohm, ⅓ w. res.
URD-137	R_9—4.7 megohm, ⅓ w. res.
URD-133	R_{10}—3.3 megohm, ⅓ w. res.
URD-113	R_{11}—470,000 ohm, ⅓ w. res.
RRC-5000	R_{12}—2 megohm vol. control
URD-145	R_{13}—10 megohm, ⅓ w. res.
RRC-5002	R_{15}, S_3—1 megohm tone control & sw.
URD-037	R_{16}—330 ohm, ⅓ w. res.
UCC-011	C_3, C_9, C_{28}—.05 μfd., 200 v. cond.
RCY-5000	C_5, C_{18}, C_{21}—Osc. trimmers (broadcast & s.w.)
RCT-5000	C_{6A}, C_{6B}, C_{6C}—Tuning cond.
UCC-028	C_7—.05 μfd., 400 v. cond.
UCU-1014	C_{10}—27 μμfd. mica cond.
RCU-5000	C_{13}—3.3 μμfd. mica cond.
RCE-5001	C_{14}—8 μfd., 150 v. elec. cond.
UCC-039	C_{15}, C_{27}, C_{28}—.005 μfd., 600 v. cond.
RCY-5001	C_{16}—Broadcast osc. padder
UCU-1020	C_{17}—47 μμfd. mica cond.
UCU-2065	C_{20}—3600 μμfd. mica cond.
UCC-041	C_{26}—.02 μfd., 600 v. cond.
UCU-1028	C_{29}—100 μμfd. mica cond.
UCC-035	C_{30}—.001 μfd., 600 v. cond.
UCC-037	C_{31}—.003 μfd., 600 v. cond.
RLA-5000	T_2—Broadcast ant. coil
RLA-5002	T_3—Short-wave ant. coil
RLB-5000	T_4—Broadcast r.f. coil
RLB-5002	T_5—Short-wave r.f. coil
RLB-5000	T_6—Broadcast & sw. osc. coil
RTL-5003	T_7—First i.f. trans.
RTL-5000	T_8—Second i.f. trans.
RTO-5001	T_9—Output trans.
RSW-5000	S_1, S_2—Band change sw.
RLI-5000	L_1—Short-wave r.f. coil

WARDS MODEL 74BR-1055A

Part No.	Code and Description
BEC-9B1-27	R_1—220,000 ohm, ½ w. res.
BEC-9B1-16	R_2—3300 ohm, ½ w. res.
BEC-9B1-84	R_3—68,000 ohm, ½ w. res.
BEC-9B1-37	R_4, R_7—10 megohm, ½ w. res.
BEC-9B1-34	R_5, R_9—3.3 megohm, ½ w. res.
BE101-258	R_6, S_1—1 megohm vol. cont. & sw.
BEC-9B1-31	R_8—1 megohm, ½ w. res.
BEC-9B1-60	R_{10}—680 ohm, ½ w. res.
BEC-9B1-42	R_{11}—22 ohm, ½ w. res.
BEC-9B1-68	R_{12}—3300 ohm, ½ w. res.
BEC-9B2-47	R_{13}—56 ohm, 1 w. res.
BEC-9B2-46	R_{14}—47 ohm, 1 w. res.
A-9D-12776	R_{15}—2450 ohm, 6 w., w. w. res.
BEB-8A-10113	C_{1A}, C_{1B}—Two gang var. cond.
	C_2—Ant. trimmer (on gang)
	C_3—Osc. trimmer (on gang)
BEC-8D-10770	C_4—.05 μfd., 200 v. cond.
BEC-8F3-8	C_5, C_{17}—100 μμfd. mica cond.
BEC-8D-11111	C_6—.180 μfd., 400 v. cond.
BEC-8D-10761	C_7, C_{10}, C_{18}—.01 μfd., 400 v. cond.
	C_8—53-97 μμfd. pri. trimmer on input i.f. trans.
	C_9—53-97 μμfd. sec. trimmer on input i.f. trans.
BEC-8D-10775	C_{11}—.25 μfd., 200 v. cond.
	C_{12}—39-71 μμfd. pri. trimmer on output i.f. trans.
	C_{13}—39-71 μμfd. sec. trimmer on output i.f. trans.
	C_{14}—100 μμfd. trimmer (part of T_4)
BEC-8D-10771	C_{15}—.1 μfd., 200 v. cond.
BEC-8D-10785	C_{16}—.006 μfd., 600 v. cond.
BEC-8D-10784	C_{19}—.002 μfd., 600 v. cond.
BE119-126	C_{20A}, C_{20B}, C_{20C}, C_{20D}—20/40/-200/40 μfd., 150/150/10/-150 v. elec. cond.
BEC-8D-10774	C_{21}—.02 μfd., 400 v. cond.
BEB-13E-10240	T_1—Loop antenna assembly
BEA-13D-10239	T_2—Osc. coil
BE108-201B	T_3—Input i.f. trans. with trimmers
BE108-200B	T_4—Output i.f. trans. with trimmers & C_{14}
BE105-132	T_5—Output trans.

FARNSWORTH MODELS EK-081, EK-082, EK-083, EK-581

Part No.	Code and Description
77214	1—100,000 ohm, ½ w. res.
77216	2—220,000 ohm, ½ w. res.
77262	4—1000 ohm, ½ w. res.
77266	5—22,000 ohm, ½ w. res.
77263	6—1500 ohm, ½ w. res.
77217	7—470,000 ohm, ½ w. res.
77213	8—47,000 ohm, ½ w. res.
77270	9—2.2 megohm, ½ w. res.
77274	10—10 megohm, ½ w. res.
77218	11—1 megohm, ½ w. res.
77189	12—270 ohm, 2 w. res.
77013	14—10,000 ohm, 2 w. res.
77069	15—22,000 ohm, 1 w. res.
77304	16—1000 ohm, 2 w. res.
77243	17—2700 ohm, 4.7 w. res.
25196	19—.05 μfd., 600 v. cond.
25194	20—.01 μfd., 600 v. cond.
25183	21—.005 μfd., 600 v. cond.
25215	22—.1 μfd., 600 v. cond.
25185	23—.002 μfd., 600 v. cond.
25184	24—.003 μfd., 600 v. cond.
25195	25—.02 μfd., 600 v. cond.
25212	27—2.5 μμfd. mica cond.
25213	28—1350 μμfd. silver mica cond.
25188	30—100 μμfd. mica cond.
25193	31—47 μμfd. mica cond.
25192	32—24 μμfd. mica cond.
25031	34—.005 μfd., 600 v. buffer

Jensen

Bass Reflex CABINETS

Three types—six models to accommodate 6"*, 8", 12" and 15" speakers

TYPE B Bass Reflex Cabinets are manufactured in sizes for 8", 12" and 15" speakers. A superior new wood composition in outer walls and panels assures distinguished appearance at a modest price. Finish is an attractive, baked-on hammerloid, trim is of chromium and aluminum.

Meeting the high engineering and appearance standards which for years have been a Jensen hallmark, these new Bass Reflex cabinets provide acoustically correct enclosures for Jensen speakers. They are particularly suitable for Jensen Coaxials.

All of them (except the J-61) employ the widely heralded Jensen Bass Reflex principle. This, together with special acoustical treatment, assures maximum extension of low frequency response, and freedom from objectionable "boom" or resonance.

See these new cabinets today at your dealers—or write for full information and prices.

ABOVE RIGHT: New Type D Deluxe Bass Reflex Cabinets are available for either 12" or 15" speakers. Exterior styling is by a noted designer; construction by one of the nation's foremost furniture manufacturers. All hard woods are of selected striped walnut. Finish is natural walnut rubbed to a satiny smoothness.

JENSEN MANUFACTURING COMPANY

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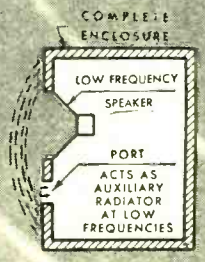
BASS REFLEX PRINCIPLE: Through exact acoustical proportioning of the completely enclosed cabinet, and the use of an auxiliary port, the port is made an auxiliary radiator at low frequencies. This controlled use of what otherwise would be waste energy increases efficiency.



*TYPE J PERI-DYNAMIC (Model J-61) CABINET is a wall-mounting style which takes any standard six inch speaker. Handsomely styled of a textured composition material, it is complete with mounting bracket. A five-lug terminal board facilitates installation.

Jensen
FINE ACOUSTIC EQUIPMENT

Jensen

Designers and Manufacturers of Fine Acoustic Equipment

25214	35—20/20/30 μfd., 25/25/450 v. elec. cond.
78057	36—Vol. control
78072	37—Tone control
26194	38—Gang capacitor
38485	39—First i.f. trans.
38486	40—Second i.f. trans.
94195	42—Output trans.

ZENITH MODELS 5R080, 5R086

Part No.	Code and Description
63-579	R_1—220 ohm, ¼ w. res.
63-589	R_2—10,000 ohm, ¼ w. res.
63-976	R_3—15 megohm, ¼ w. res.
63-600	R_4—2.2 megohm, ¼ w. res.
63-1348	R_5—.5 megohm vol. control
63-644	R_6—22,000 ohm, ¼ w. res.
63-597	R_7—470,000 ohm, ¼ w. res.
63-686	R_8—150 ohm, ½ w. wirewound res.
63-1219	R_9—22 ohm, ½ w. wirewound res.
63-1220	R_{10}—100 ohm, 1 w. wirewound res.
63-1221	R_{11}—680 ohm, 1 w. wirewound res.
63-602	R_{12}—4.7 megohm, ¼ w. res.
22-1419 or 22-1356	C_1—2-gang variable cond.
	C_2—Broadcast ant. trimmer (on C_1)
22-829	C_3—.05 μfd., 200 v. cond.
	C_4—Broadcast osc. trimmer (on C_1)
22-1017	C_5—.05 μfd., 200 v. cond.
	C_6—First i.f. trans. pri. trimmer (on T_1)
	C_7—First i.f. trans. sec. trimmer (on T_1)
	C_8—Second i.f. trans. pri. trimmer (on T_2)
	C_9—Second i.f. trans. sec. trimmer (on T_2)
22-953	C_{10}—.0002 μfd., 600 v. cond.
22-669	C_{11}—.01 μfd., 600 v. cond.
22-826	C_{12}—.01 μfd., 200 v. cond.
	C_{13}—Omitted
22-854	C_{14}—.0005 μfd., 600 v. cond.
22-196	C_{15}—.01 μfd., 600 v. cond.
22-1379	C_{16}—.02 μfd., 400 v. cond.
22-1381 or 22-1552	C_{17}, C_{18}, C_{19}—40/40/40 μfd., 150/150/150 v. elec. cond.
95-919	T_1—First i.f. trans.
95-906	T_2—Second i.f. trans.

HOFFMAN MODEL A301

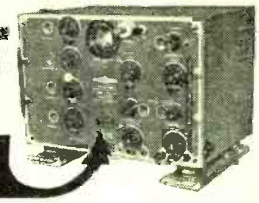
Part No.	Code and Description
4500	R_1, R_8—.22 megohm, ½ w. res.
4501	R_2—22,000 ohm, ½ w. res.
4502	R_3—2.2 megohm, ½ w. res.
4503	R_4—10,000 ohm, 2 w. res.
4504	R_5—47,000 ohm, ½ w. res.
4804	R_6—.5 megohm vol. control
4505	R_7—10 megohm, ½ w. res.
4506	R_9—.47 megohm, ½ w. res.
4507	R_{10}—560 ohm, ½ w. res.
4805	R_{11}—.25 megohm tone control & sw.
4508	R_{12}—47 ohm, ½ w. res.
4509	R_{13}—330 ohm, ½ w. res.
4701	R_{14}—1500 ohm, 10 w. wirewound res.
4400	C_1, C_2, C_3—338/338/180 μμfd. 3-section var. cond.
	C_4, C_5, C_6—Trimmers (Part of C_1, C_2, C_3)
4100	C_7, C_8—.05 μfd., 200 v. cond.
4000	C_9, C_{12}, C_{13}, C_{15}—100 μμfd. mica cond.
4101	C_{10}, C_{11}—.05 μfd., 400 v. cond.
4102	C_{14}, C_{16}—.005 μfd., 600 v. cond.
4103	C_{17}—.01 μfd., 600 v. cond.
4200	C_{18}, C_{19}, C_{20}—20/20/20 μfd., 450/450/-450 v. elec. cond.
4104	C_{21}—.001 μfd., 600 v. cond.
4105	C_{22}—.01 μfd., 600 v. cond. (metal can)
4004	C_{23}—500 μμfd. mica cond.
5200	L_1—Osc. coil
5201	T_1—Antenna loop
5202	T_2—R.f. coil (shielded)
5203	T_3—Input i.f. trans.
5204	T_4—Output i.f. trans.
5100	T_5—Audio output trans.
5000	T_6—Power trans.

—30—

"Whew! Beat that ol' Lie Detector again!"

Sun Radio
FOR THE HOTTEST VALUES IN Surplus Parts

BENDIX 100 WATT TRANSMITTER

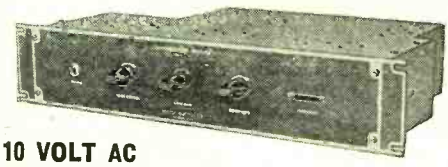


ONLY THIS SWITCH USED TO CHANGE 10-20-40-80 METER BANDS

FOUR SEPARATE ELECTRONIC COUPLED OSCILLATORS: These can be easily converted to 20-40-80 meters. Crystal required for 10 meters. Each electronic coupled oscillator dial has 3000 divisions enabling quick precision shifting. This transmitter was constructed of the highest quality of precision parts, with laboratory precision. 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 35½ lbs. Complete, simple instructions for conversion furnished. Uses three 807, four 12SK7 tubes; one 2 inch 5 amp. R.F. meter.

A complete coverage transmitter, for the new or experienced amateur.

A TRUE HAM VALUE—BRAND NEW, complete with tubes..... **$49.95**



110 VOLT AC
SUPERHETERODYNE RECEIVER

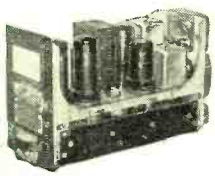
This crystal fixed frequency receiver comes with full conversion instructions for variable tuning of all ham bands and broadcast. A highly selective superheterodyne receiver, 110 V. A.C. power supply built in. Uses the following tubes: 6K7 RF Amplifier; 6K8 Mixer and Oscillator; 6K7 I.F. Amplifier; 6F7 Detector and A.V.C.; 6C8 Output and Noise Suppressor; 80 Rectifier. Dimensions 3½ x 19 x 11½ inches. Comes complete, Brand New, with one set of coils and two sets of tubes..... **$16.95**

Extra set of coils **$2.95**

Low Frequency Receiver BC—344

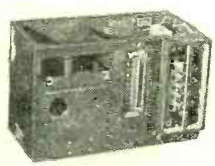
Just a very few left . . New, operates on 110v AC complete with 19 tubes . . . tunes 150-1500 kc . . . Your last chance to get one of these "hot" low frequency receivers at this spectacularly low price..... **$69.95**

Speaker.....$7.50



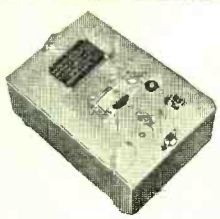
SPERRY AMPLIFIER

Brand new servo amplifier containing two beam power output tubes (1632) similar to 25L6, two twin triodes (1633 and 1634) similar to 6SC7, two mica condensers, dozens of color coded half watt resistors, two dual and four section bathtub condensers, three transformers, two wafer switches, one volume control, four octal sockets. Easily convertible..... **$3.95**



BC—684 F.M. 35 WATT TRANSMITTER

Brand new, complete with eight tubes, crystal control, 10 channel pushbutton, 27-38.9 mc, non-lenier modulation coil ...less coverplate, crystal, and power supply **$17.95**



V. H. F. TRANSMITTER

Here is one of the greatest offerings in war surplus! Hundreds sold at $20.00 and now closed out at an amazingly low price. Brand new. Battery operated (67½v B and 1½v 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**

MICROPHONE

Brand New single button carbon hand microphone.

Please enclose 30 cents in stamps or money order to cover mailing and handling

$1.79

R.F. TUNING UNITS

Still the best buy on surplus . . . Beautiful black crackled aluminum cabinet with two variable transmitting condensers and two vernier dials, one heavy duty ceramic four position wafer switch, mica condensers, 2,500 working volts and coils wound on porcelain ribbed forms. Available TU5B (1500-3000 kc), TU7B (4500-6200) TU8B (6200-7700 kc) and TU10B (10000-12,500 kc). Please specify model... **$3.89**

D. C. Milliammeter

Brand new General Electric 2" round panel meters. 0-300..... **$2.97**

NEW NAVY SPEAKERS

(A) Navy type waterproof speakers Stromberg-Carlson and RCA 4½ ft. re-entrance trumpet with 25 Watt PM drive unit and line matching transformer. $125 value for..... **$32.50**

(B) 25 Watt PM driver unit with line-matching transformer and waterproof projector mounted in a heavy duty round metal baffle. At the lowest price ever offered! **$14.95**

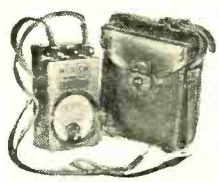
ANTENNAS

(A) Small four-section telescopic aerial ideal for portable receivers, transceivers or test equipment.

99c

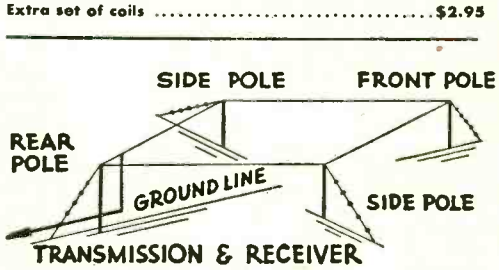
(B) 22" tapered high frequency aerial covering 150 to 200 mc. Complete with coax cable connector.

$1.69



OHM METER WESTON No. 689

A beautiful instrument for accurate work. Scale 0-10 ohm and 0-1000 ohm scaled to read 1/20 ar an ohm with ease. This 2¼" round meter is housed in a black bakelite case 1¾" x 2¾" x 5". Complete with heavy duty felt lined leather case and lack. Special **$14.95**



RHOMBIC ANTENNA KIT

CONSISTING OF:

- **2200 ft. wire, No. 14, AWG. Copperweld**
- **9 spacer insulators**
- **10 strain insulators**
- **1 lightning arrester protector (Viso Glow)**
- **50 ft. 2 wire cable, 200 ohm transmission line**
- **12 wire rope clips**
- **3 sheave pulleys**
- **24 ft. flexible wire, tiller rope**
- **50 ft. wire, 5/16" messenger, G.S.**

Plus—Many other items, including steel thimbles, ground rod wire; guy clamps, thimbleye nuts, curved washers, anchors, anchor rods, bent eye bolt, staples, machine bolts, round washers, line support turn block, porcelain tube, line support insulator, galvanized iron shield, lag screws, screw eye insulator. The present market cost of this aerial exceeds $150.00. Our price complete less poles..... **$24.95**

All items F.O.B. Washington, D.C. Orders $30.00 or less, cash with order. Above $30.00, 25 percent with order, balance C.O.D.

SUN RADIO
OF WASHINGTON, D. C.

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

International Short-Wave

(*Continued from page 70*)

ministrative services of the company, the studios and technical installations for program control.

The broadcasting of programs is assured by two transmitters housed in a modern and superbly equipped building situated in the highlands of Junglinster, 1000 feet above sea level. The long-wave transmitter is capable of radiating with 200 kw., making it one of the most powerful stations in the world. The antenna system, supported on five steel pylons of cantilever construction, each 600 feet in height, is of the umbrella or spider web type. This assures the widest possible range of transmission coverage.

The second transmitter, now operating on 6.090 with an antenna power of 5 kw., in the near future will be increased to a maximum of 25 kw. so as to ensure radio communication with the entire world. Station officials announce: "We shall, in the near future, broadcast in the 31-, 25-, and 19-meter bands on frequencies of 9.527.5, 11.782.5, and 15.350.

* * *

Facts About Luxembourg

As a Grand Duchy, Luxembourg is governed under the Constitution of 1868, as modified in 1910. Legislative power rests with a Chamber of Deputies which is elected by universal suffrage. Executive power is held by a Minister of State and a Cabinet comprised of four or five ministers. The country is ruled by Grand Duchess Charlotte, who succeeded on the abdication of her sister, Marie Adelaide, January 9, 1919, was married on November 6, 1919, to Prince Felix of Bourbon-Parma. Heir is Prince Jean, born January 5, 1921; other children include four daughters and another son.

Luxembourg is a country of small landowners; 430,000 of the 500,000 acres devoted to agriculture are farmed by resident owners.

As we take our leave of *Radio Luxembourg,* we quote this statement from the station's management:

"Today, the whole world has begun to associate itself with the European listeners to *Radio Luxembourg* programs . . . Once again, from the highlands of Luxembourg on the central plateau of Junglinster, the 600-foot aerial masts of *Radio Luxembourg* have become a potent factor *in support of the cultural, political, and economic well-being of the world at large.*"

* * *

Swedish List

Arne Skoog, Swedish DX-er, has compiled a list of short-wave stations for the official Swedish program-weekly, *"Roster i Radio,"* which is available to DX-ers abroad.

Manne Ginsburg, editor, has promised to send a copy of the issue containing the list (published in June) to anyone sending in a request *accompanied by an IRC.* Should the demand be too great, requests will be filed until the list is published again (presumably in November or December of this year).

Mr. Skoog's list contains full information concerning frequencies, wavelengths, call-signs, locations, output, times, slogans, and owners "of all actual short-wave stations of the world," he says. It is assumed the list will be in Swedish but should be easy to translate, as have been other lists prepared by Mr. Skoog in the past.

* * *

Verification Data

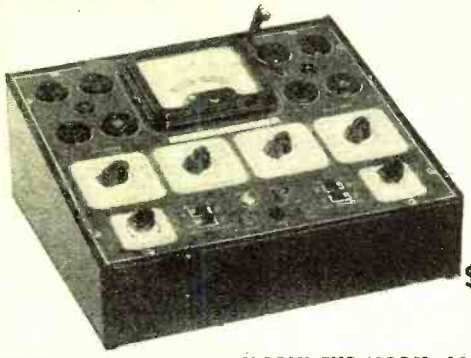
Short Wave News, London, founder of the International Short Wave League, is starting a campaign for *better reporting.* In its lead editorial recently, the publication pointed out:

"Letters received by us from broadcasting stations indicate that far too many SWL reports fall well below the standard required to be of any practical value. Too many listeners send reports of utter uselessness and too many think that 'veries' are the only things worth considering in short wave listening." After quoting examples of some of the "worthless" reports received by *Radio Australia,* the editorial continues: "Nauseated? So are

OUR POLICY We do not advertise any unit which is not available for immediate shipment from stock • Less flowery adjectives, more detailed specifications. • All units are sold subject to one year guarantee except when components are damaged through misuse. • We do not solicit orders for any unit that does not meet our requirements for accuracy and honest value. Any item purchased from us is sold with the understanding that it may be returned for full refund after a 10 day trial.

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

The New Model 60-T TUBE and SET TESTER



A COMPLETE TUBE TESTER

Tests all tubes including the new post-war miniature loctals such as the 12AT6, 12AU6, 35W4, 50B5, 117Z3, 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.

$49.85 NET PRICE

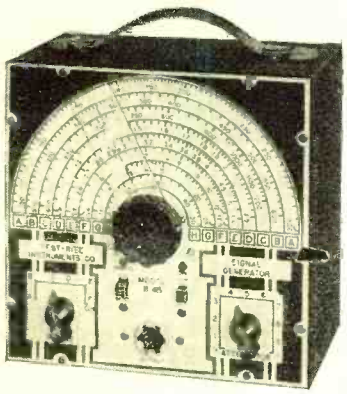
Model 60-T operates on 90-120 Volts 60 Cycles A.C. Housed in sloping leatherette covered cabinet. Comes complete with test leads, tube charts and detailed operating instructions.

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 Mo. 0 to 1.5 Amps.
- Low Resistance Ranges: 0 to 2,000 Ohms (1st division is 1/10th of an ohm.)
- 2 Medium Resistance Ranges: 0 to 20,000/200,000 Ohms
- High Resistance Range: 0 to 20 Megohms
- 3 Decibel Ranges: −10 to +38, +10 to +38, +30 to +58 DB.

EXTRA: WE CAN NOW SUPPLY THE MODEL 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

The New Model B-45 SIGNAL GENERATOR

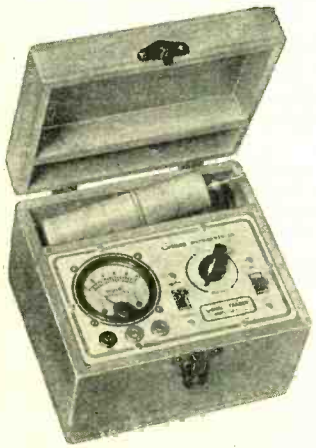


Self-modulated — provides a highly stable signal. RF frequencies from 150 Kc. to 12.5 Mc. on Fundamentals and from 11 Mc. to 50 Mc. on Harmonics. Modulation is accomplished by grid-blocking action — equally effective for alignment of amplitude and frequency modulation as well as for television receivers Self-contained batteries. All calibrations are etched on the front panel, permitting DIRECT READING.

Model B-45 uses a beautifully processed dualtone front panel. Comes housed in a heavy-gauge crystalline steel cabinet complete with shielded test lead, self-contained batteries and instructions.

COMPLETE, READY TO OPERATE **$27.75**

The New Model CA-11 SIGNAL TRACER



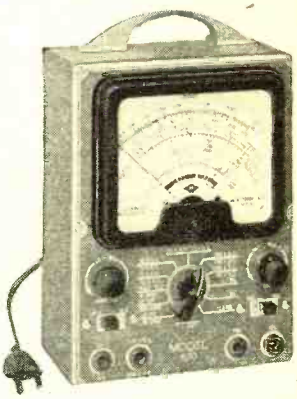
SIMPLE TO OPERATE . . . BECAUSE SIGNAL INTENSITY READINGS ARE INDICATED *DIRECTLY ON THE METER!*

- ★ SIMPLE TO OPERATE — only 1 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.
- ★ COMPLETELY PORTABLE —weighs 5 lbs. and measures 5″x6″x7″.
- ★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.
- ★ Provision is made for insertion of phones.

THE MODEL CA-11 COMES HOUSED IN A BEAUTIFUL HAND-RUBBED WOODEN CABINET. COMPLETE WITH PROBE, TEST LEADS AND INSTRUCTIONS. **$18.75**

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**

The New Model 450 TUBE TESTER

Speedy operation—assured by the newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

SPECIFICATIONS

• Tests all tubes up to 117 volts. • Tests shorts and leakages up to 3 Megohms in all tubes. • Tests both plates in rectifiers. • New type line voltage adjuster. • Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes • Noise Test detects microphonic tubes or noise due to faulty elements and loose internal connections. • Uses a 4½″ square rugged meter. • Works on 90 to 125 volts 60 cycles A.C.

EXTRA SERVICE—May be used as an extremely sensitive condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute. **$39.50**

GENERAL ELECTRONIC DISTRIBUTING CO.

Dept. RN-8, 98 Park Place NEW YORK 7, N. Y.

we. What value is such drivel to any station—except to fill the waste paper baskets. One would gather from the attitude of these 'experimental listening stations' that the sole object a station has in going on the air is to enable it to distribute QSL cards to all and sundry. Most stations know they are getting out, but a large number of SWL's seem to think it a miracle of science that they hear such stations on their '3 valve communications receivers.' Many of the powerful stations have been good friends of the SWL in the past but frankly this attitude is on the wane. This undisputed fact must be faced squarely: *If reports generally do not undergo a pronounced improvement then the day is in sight when QSL cards for the listener will be discontinued.* In other words, a selfish section of the fraternity is jeopardizing the SWL's hobby, and it is up to every one of you to make sure your reports are up to the mark, otherwise . . .

"Far from opposing reporting, regular readers know us as energetic champions of the SWL's, but we are greatly distressed by the increasing evidence of mass-reporting—the cause of scrappy information—in our midst. Some readers may say that they only send brief reports but get back a fair number of cards. That may be so, as most BC stations either verify or they don't. The fact remains that such reports are still useless. Many stations have now ceased to verify due to the reports received not justifying the expense of providing cards. How many other stations will follow suit? That matter rests entirely with the SWL's."

The editorial suggests that one should "always send a sufficiently detailed extract of program to enable station log to be accurately checked. If you *must* send a SWL card, then send a *real* report as well. *The information contained on a SWL card is totally inadequate.*"

Paul Kary, Pennsylvania, supplies the following QRA's which will be helpful to those wishing to verify commercial stations operated by these companies:

Transradio Internacional (LSX), San Martin 329, Buenos Aires, Argentina; Regie T.T. (ORP), Radio Electrisch-Centrum, Ruiselede-Post Beernem, Belgium; Cable & Wireless (West Indies), Ltd. (VPO-8, VPO-10), B.M.L.A. Buildings, Beckwith Place, Bridgetown, Barbados, B.W.I.; Institute National Belge de Radiodiffusion (RNB), 18 Place Eugene Flagey, Brussels, Belgium; Chinese Govt. Radio Administration (XGT-2), Sassoon House, Tien-Chih Road, Shanghai, China; Marconi Radio Telegraph Co. of Egypt S.A.E. (SUV, SUX, SUP), Box 795, Cairo, Egypt; Postes Telegraphes et Telephones, Rue Freiuevaux, Paris, 14eme, France; West Indies Telephone Co. (HHT), P. O. Box A-53, Port-au-Prince, Haiti; Press Wireless (MCD-3), 8, Rue Edouard-VII, Paris 9eme, France; Banco Nacional de Mexico, S.A. (XBHX), Isabel la Catolica 44, Apartado 14 Bis, Mexico, D. F., Mexico; Companhia Portuguese Radio Marconi, Rua de S. Juliao, 131, Lisbon, Portugal; RCA Frequency Bureau, RCA Building, 30 Rockefeller Plaza, New York 20, New York (for RCA stations in U. S. or Hawaii); Cable and Wireless of South Africa, Ltd. (ZSS, ZSS-3), Box 962, Capetown, South Africa; Philippine Press Wireless, Inc., 2nd Floor, Soriano Building, Plaza Cervantes, Manila, Philippines; Cable and Wireless, Ltd. (SVM), Leoforos Vassilissis Sofias 2, Athens, Greece.

Elwood Deibert, Pennsylvania, reports verification from NTMU, of the *U.S.S. Philippine Sea* (Byrd Antarctic Expedition) on 17.840, signed by E. Schiller, LCDR, U.S.N.R., Communications Officer, *U.S.S. Philippine Sea* (CV-47), Fleet Post Office, New York, New York, U. S. A.

From the Director, Direction de la Radiodiffusion D'Etat, Sofia, Bulgaria (Bulgarie), comes this data: "The research work about the reception of our transmissions abroad is carried on by our Liaison Department which sends out questionnaires to our listeners regularly. The information obtained from the replies is being systematized and handed over to our Technical Department. The verifications are sent to all persons who send us the report of reception; and International Reply Coupons are welcome."

Short Wave News, London, suggests QRA of *H.M.S. Vanguard* as probably The Admiralty, London, or direct to the Chief Radio Officer, H.M.S. Vanguard, % port of call in Britain (presumably Plymouth).

Some weeks ago, in Moscow's North American beam, the woman announcer greeted several listeners who had written to *Radio Moscow,* including the SW editor of a prominent radio club, said editor being promised a verification. However, we have no report that verification has been forthcoming. Some listeners have reported writing Moscow in the Russian language with nil results. (*We are tempted to offer a prize for the first verie received from the Soviet Union!*)

QRA for Lusaka is The Broadcasting Officer, Information and Public Relations Office, P. O. Box 209, Lusaka, Northern Rhodesia. (Harrison)

Hamburg's new 50-kw. station on 6.115, answered by letter from Nordwestdeutscher Rundfunk, Sender Hamburg-Elmshorn, Rothenbaumchaussee 132-134, Hamburg 13, Germany (British Zone). (Bergstrom)

* * *

Annuals Available

Due to so many requests for a SWL's guidebook, I have contacted the Amalgamated Short Wave Press, Ltd., 57, Maida Vale, Paddington, London, W.9, England, with regards to the availability of *The Short Wave Listeners' Annual.* W. Norman Stevens, official of the organization, replies that "the stock we now have on hand is

(*Continued on page* 96)

SPRAGUE TRADING POST

SWAP—BUY OR SELL!

FOR SALE—QST, March 1946: 10-meter rig modulator and power supply complete; 2 meter hand talkie; Shure 707A mike; 2 meter mobile transceiver; 2 meter xmitter-receiver complete; used 274N 6-0.1 m.a. xmitter; 10 meter two element beam; Bc603 tank f-m. tech book; A1 Popwell W2QNB, 370 Convent Ave., New York 31, N. Y.

SELL OR TRADE—Motorola #109—K-1, 10-tube home receiver, with automatic tuning. Tuning range .55 to 18 mc in 3 bands. Need any kind of ham equipment. Harry P. Keeley, Jr. W9CRV, 1206 West Acre Road, Joliet, Ill.

WANTED—500 ma. swinging choke. Will sell 2000v c.t. transformer U.T.C., S-46, $10. Dynamotor PE73-C, 1000v., 400 ma., $15; assorted quality transmitting mica and variable condensers. D. Victorson, 255 E. Parkway, Brooklyn, N. Y.

FOR SALE—Code oscillator with speaker, place for phones and key. Used only 1 month $8.50. John S. Hall, 6011 Pearidge Road, Huntington 2, W. Va.

SELL OR TRADE—Back numbers several radio magazines, 1922-1930. Felix Januss, 511 E. 6th Street, Los Angeles 21, Calif.

SELL OR TRADE—New signal corps recorder BC-1016. Records code on tape at speeds up to 300 W.P.M. contains 7 tubes. A handy addition to any shack. Sell: or swap for communications receiver in excellent condition. James W. Craig, Jr., 239 Preston Ave., Lexington 27, Ky.

FOR SALE—Bateman Pro 12" overhead recording mechanism with Astatic x-29A crystal cutterhead. Very good condition $15. Jack Hartley, 88 Diamond Bridge, Hawthorne, N. J.

WANTED—Ideas developed by hams in converting surplus BC-375-E transmitter to amateur use. Will exchange information I receive other than QST article. George J. Murray, 133 Riverbank Ave., Wyandotte, Mich.

FOR SALE—Hallicrafters 15-tube receiver. SX-28; 550 KC—42 MC including matching Hallicrafters—Jensen bass-reflex cabinet with 12" speaker. Excellent electrical and mechanical condition. $220. F.O.B. Otto Pollei, Jr., 2122 Edgeland Ave., Louisville, Ky.

WANTED—Panoramic adapter. 10-meter transmitter. Have sound powered phones, EC-8 phone sets, Sky Buddy, laboratory decade bridge, LM-15 with cal. book, 3885KC handy-talkies, many new tubes, galvanometers, microammeters. G. H. Amber, W8TLI, 15889 Princeton, Detroit 21, Mich.

WANTED—Receiver and Modulator diagrams for the army SCR-274-N. Will borrow or buy. Urgently needed. A. L. Oliviera W1PWL, 94 Potomska Street, New Bedford, Mass.

FOR SALE—Hallicrafter SX-16 less speaker with new tubes. Perfect condition. Leon D. Held, W1KLD, 3047 Brighton, 13th Street, Brooklyn 24, N. Y.

WANTED—BC610 or HT9 transmitter or any similar type. Describe fully. Edward M. Muska, P. O. Box 425, Iselin, N. J.

WANTED—Medium Power transmitter either Meissner 150B, HT-O or any others. Carl J. Buh, Amsterdam Road, R #2, Ludlow, Ky.

SELL OR TRADE—Portable radio, $15; 12" dynamic, $5; 8" dynamic, $3. Used about 3 months. 1A7—1N5, 60c; 1D8, $1; 1171.7, $1.25; 2 transformers $1.50 ea. 6.3v, 700 plate. Norman Crawfis, 2054 Franklin #2, Toledo, Ohio.

WANTED—Ham gear; various meters, transformers, etc. Also beam rotator and indicator. What have you? Eddie Howell, 501 W. Harden Street, Graham, N. C.

SELL OR TRADE—Pair 807's, National HRO dial and gear assembly, six tube 1.4v superhet (Lucy) 2-12 mc. Want plate transformer 1000 to 1400v d-c @ 200 mills, filament transformer 10v @ 4 amps. R. A. Williams, W6UYP, 1616 Ohio St., Redlands, Calif.

SELL OR SWAP—450-watt C.W. rig ECO, 807, PP-40's, 3 power supplies, coils up to ten meters. Need ham receiver, camera, or what have you? Fred Hinson, 118 West Broadway, Elk City, Okla.

FOR SALE—BC-348-Q receiver converted to 115v a-c with speaker and 10 meter converter in matching black wrinkle cabinets, complete with tubes. $75. C. L. Nelson, W/TPM, 1207 Lincoln Drive, Grand Forks, North Dakota.

WANTED—Xmitter. CW/fone, semi-portable with or without power supply. Must cover 80, 40, and 20 meters. State price. Cash. RDO VO2AR, care D. R. Walker, 204 Elm Road, Inwood, Long Island, N. Y.

FOR SALE—Model SA-3. Type T-200 panoramoscope. Excellent condition. $70. Also 2-meter coaxial line HY-75 oscillator. $15. G. R. Bachand, 32 Fremont St., Bloomfield, N. J.

SELL OR TRADE—Hallicrafter S-20-R. Fine condition, all new tubes, $80 or will trade with cash for HQ 120-129 or similar receiver. J. Dubinsky, W2LVR—9404 Astoria Blvd., Jackson Heights, Queens, N. Y. C.

FOR SALE—New BC-610E, complete with speech amplifier. Modified for 10 meters, $720. W7IVH, Box 383, Kirkland, Wash.

WANTED—Stancor model 110C, 60N or 69 transmitter in kit form or wired, cash. Have for sale Instructograph, Jr. with built-in osc., Morse tapes, $25. Will swap Weston 3" O-5 amp, R.F. meter for 3" O-250 d-c ma. meter or what have you? John C. Bonse, W2PGE, 13 Ardsley St., Kingston, N. Y.

FOR SALE OR TRADE—12 each following tubes: 12SK7, 12SR7, 12K8, 1629, 12A6, VR-150-30. Need several 6SK7, 6SQ7 or what have you? A. L. Oliveira, W1PWL, 94 Potomska St., New Bedford, Mass.

FOR SALE—3 home-built Hi-Fi amplifiers, 14-watts output, 2 amplifiers assembled only. Also many new tubes, transformers, chokes, 3 Jensen speakers, sound cabinet, 1 AM tuner and 1 FM Motorola tuner, old band. Asking fraction of cost; giving up hobby. Paul Stieglitz, 4455 Broadway, New York 33, N. Y.

WANTED—HT-9 Hallicrafters transmitter in good condition. State price. Paul P. Graves, W1JJF-WDRC—65 Adam Street, Hartford, Conn.

WILL TRADE—Abbott 2 meter TR-4 transmitter-receiver complete with tubes. Need 2 6' trumpets or what have you in p.a. equipment? Julius B. Pilger, 22-11 120th St., College Point, Long Island, New York, N. Y.

FOR SALE—Hallicrafter S-20R Sky Champion communication receiver, one of last sold. Perfect condition. Bill Lamp, Box 171, Jackson, Tenn.

WANTED—Used S-20R or other good communications receiver. Will pay cash. Russell Thompson, 8 E. Morgan Street, Shawnee, Okla.

WILL TRADE—New Kodak bantam, anastigmat special f/4.5 lens stops down to f/16. Focuses 2½ ft. to inf., shutter speeds 1/25, 1/50, 1/100, 1/200 sec., time and bulb exposures. Bud CPO Code practice osc. Want commercial built ECO, George Alich, 339½ E. Winifred, St. Paul, Minn.

FOR SALE—New Navy RAK-7 low-frequency receiver, power supply, tubes in original case—$57. RCP multitester, model 414, perfect condition, $30 prepaid. Wm. D. Beal, Jr., W1PNR, 37 Circuit Road, Chesnut Hill, Mass.

SWAP—Nearly new Oahu electric Hawaiian guitar, case etc. less amplifier for RME69 or Breting 12 RCUR. Arthur Filkins W2ISX, Box 13 Fly Creek, N. Y.

WANTED—Xmitter 25 to 100 watts. Must be compact, phone /CW and complete for all band operation. S/SGT Donald B. Rogers, 66th A.A.C.S. Group, APO 863, c/o Postmaster New York, N. Y.

FOR SALE—Meck T60 Transmitter in perfect condition, $100. Used four weeks. Shelly Meyerson, W2SIQ, 3831 Cannon Place, Bronx 63, N. Y.

FOR SALE—QST's, 1932 to 1946 inclusive in binders, $4 per year. Proceedings of IRE 1939-1946 inclusive $6 per year. Sell in series only. C. A. Draper, W8KLP, 1273 Andrews Ave., Lakewood, Ohio.

WANTED—Wire recorder unit with playback, coils and motor. Bob Creason, Ehfaula, Okla.

FOR SALE—2-meter Airadio transmitter-receiver. 20-watts, 6-volt vibrator power supply. Ideal for amateur mobile use. $55. WOJVJ, G. Petersen, 610 Brown Street, Pueblo, Colo.

FOR SALE—Transmitter, Meissner 150-B, 150-watts on fone and CW. Used 8 hours, excellent condition, complete with tubes, coils ECO, key mike and manual. $225. W2RLM, Don Reiser, 2709 Edgemere Ave., Far Rockaway, N. Y.

SELL OR TRADE—Master teleplex with extra tapes. Want sky buddie, S20R or similar small receiver or what have you? W5KUG, 2504 Music Street, New Orleans 17, La.

WANTED—Recording lathe for 16" turntable; power transformer 400 m.a. at 2,500v and a 60-cycle, 1000-watt, 110v. generator. Fred Olinger, 46 Gahl Terrace, Cincinnati 15, Ohio.

FOR SALE—Millen exiter foundation unit chassis, $10. M. Bardfield, 4 Brinsley St., Dorchester, Mass.

SELL—Speed-x chrome bug, $8.00; Weston O-100 Thermo-galvanometer, $10. Advance type 400, 110v a-c relay, $4. SW3—4 sets coils, phones, $12. W9KHF, 912 W. 151st St., East Chicago, Ind.

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The Sprague Trading Post is a free advertising service for the benefit of our radio friends. Providing only that it fits in with the spirit of this service, we'll gladly run your own ad in the first available issue of one of the six radio magazines in which this feature appears. Write CAREFULLY or print. Hold it to 40 words or less. Confine it to radio subjects. Make sure your meaning is clear. No commercial advertising or the offering of merchandise to the highest bidder is acceptable. Sprague, of course, assumes no responsibility in connection with merchandise bought or sold through these columns or for the resulting transactions.

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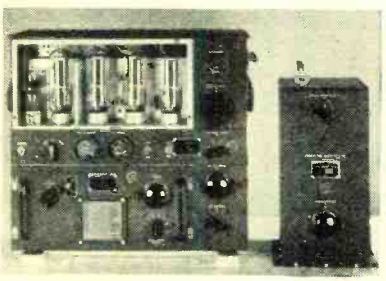
This relay-controlled transmitter includes a 115V, 60 cycle power supply, protected by 3 magnetic circuit breakers, that alone is worth more than the price we are asking for the whole rig, even on today's surplus market. On the front panel are six 3½" GE or Weston meters, including 250 MA, 50 MA, 1000 MA, 150V AC, and 1500V DC at 1000 ohms per volt for screens and plate. The rack-type 21"x15"x36" unit contains six amplifier and rectifier tubes aggregrating over $60.00 at WAA current wholesale prices. Western Electric's price to the government was $1500.00. Shipping weight 500 lbs. Your cost, as is, only $69.95.

ARMY BC 312 COMMUNICATIONS RECEIVER

This receiver covers the frequency range of 1.5 MC to 18 MC in six direct reading bands. The dial, that is driven with split gears to prevent backlash, has 4500 logging divisions per band with approximately 600 divisions on the 20 and 40 meter ham bands and 1000 divisions on 80 meters. Two stages of RF before the converter in this set give it a very high signal to noise ratio and maximum sensitivity. Outstanding features of this receiver are: BFO with pitch control, send-receiver relay, jacks on the front panel for headphones and speaker output and mike and key input, all tubes are standard 6 volt types. This receiver was designed to withstand rough usage in the field and for operation from vehicles while in motion, so it is ruggedly constructed and contains a dynamotor power supply.—Your cost $49.95. Conversion kit to 110 VAC is available for $6.50.



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 milliameter, 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: 21½ x 23 x 9¼ 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 and are guaranteed to be in perfect condition.

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 an 80 to 110 Mc. FM broadcast receiver, as a Facsimile transmitter or receiver, as an amateur television transmitter or receiver, for remote control relay hook-ups, 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.

6-BAND COMMUNICATIONS RECEIVER BC-348

Featuring coverage from 200 to 500 Kc. and 1500 to 18000 Kc. on a direct reading dial with the finest vernier drive to be found on any radio at any price—high sensitivity with a high degree of stability—crystal filter—BFO with pitch control—standard 6 volt tubes. Contains a plate supply dynamotor in compartment within the handsome black crackle finish cabinet, the removal of which leaves plenty of room for installation of a 110V, 25 or 60 cycle power supply. These receivers, which make any civilian communications receiver priced under $200.00 look cheap and shabby by comparison, are only $44.50. Power supply kit for conversion to 110V, 25 or 60 cycle, is only $8.50 additional.

AIRCRAFT AMPLIFIER CI—This unit is housed in an aluminum case that is 9x8x7 inches and contains 1-7Y4, 3-7N7, 3-7F7 and six 5000 ohm sensitive relays. This unit is brand new and in its original packing—$9.95.

BC-654 TRANSMITTER-RECEIVER—Brand NEW with 17 tubes, key, microphone and calibrating crystal—$39.95.

C-144 Transmitter, 2 type 826 tubes as oscillator in lecher line tuning circuit that resonates between 150 and 200 megacycles contains 3 DC power supplies that operate from 110v 60 cycles. This unit is easily converted to the 2 meter ham band, may be neutralized and operated as a high power final amplifier. Your cost—$49.95.

SERVICEMEN

Check This Column for Lowest Prices on Quality Parts

TUBES; all types in stock, 60% off on all tubes if ordered in lots of 10 or more.

POWER TRANSFORMERS — Half-shell type, 110V 60 cy. Centertapped HV winding. Specify either 2.5 or 6.3 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 2.5... 2.35
For 8-9 tube sets—700V-90MA; 5V-3A; 2.5V-3.5A; 2.5-10.5A 2.85
For 9-11 tube sets—700V, 100MA. 5V & 6.3 or 6.3V-4A.. 2.85
For 9-15 tube sets: 600V, 150MA; 5V & 6.3V..... 2.95

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.

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 150—35c; 30/20 150v—46c; 50mfd 150v—43c; 8mfd 475v—34c; 16mfd 350v—65c; **OIL CONDENSERS**: 4mfd 600v—49c; **BATH TUB TYPE CONDENSERS**: 3X.1mfd—20c. **RESISTORS**: All types in stock at the lowest prices; Resistor Kits—100 2 watt resistors—$1.95.

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; "Meissner 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.

SPEAKERS-PM dynamic type-4"—$1.55; 5"—$1.55; 6"—$1.95; 8"—$3.95; 10"—$5.95; 12"—$7.50.

HEADPHONES—Highest quality Signal Corps headsets with 12" cord and plug $1.25. 5' rubber covered patchcords with phone plug & socket—45c.

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.

LINE FILTERS—110V—each unit contains two 2 mfd. oil filled condensers and a 15 amp. iron core choke. This filter has innumerable uses such as oil burner line filter, etc. A ten dollar value for 98c.

WILLARD rechargeable 2v storage batteries for portable radios or any other purpose—$2.95.

PUBLIC ADDRESS AMPLIFIERS—25 watts peak output. This unit has separate input circuits for microphone and phono. The gain of the microphone circuit is 122 db. The phono circuit has a gain of 82 db. The frequency response is flat from 50 to 12000 cycles. A $65 value for only $32.

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.

ATR battery eliminator. Handy for servicing car radios or any other purpose requiring 6 or 12v at 14 amps. Net price—$36.00.

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AUTOMATIC WIRE STRIPPERS will strip up to 1000 wires per hour, a handy tool for any service job—$3.52.

Six Foot Asbestos Insulated Flat Iron Cords, one end has a male plug, the other end has a standard flat iron socket. Your price—70c each or 10 for $5.

SPECIAL! THIS MONTH ONLY. A FREE CRYSTAL PICK-UP WITH THE PURCHASE OF EACH PHONO MOTOR AT $4.95.

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; 2 gang—79c; 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.
TRANSMITTING RF CHOKES, 4 PIE, 350 Ma.—25c or 5 for $1.00.
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.
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REMOTE CONTROL UNIT: Aluminum case 4x3x2" containing 2 potentiometers, triple pole switch, 4 knobs, gear mechanism, counter and phone jacks—59c.
MODULATION TRANSFORMERS: 10 watt, metal case—98c; 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.

Minimum order $3.00—All prices subject to change.—25% deposit with C.O.D. orders

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the 1947 Edition (revised); price is 61 cents (American) each; if anyone cares to send one dollar (either by International Money Order or a one-dollar bill), we will send him a copy of the Annual; a year's enrollment in the ISWL; and a sample copy of *Short Wave News.*"

* * *

Club Notes

Finland—HESA is the name of a new radio club in Helsinki; officers are Wolf von Harpe, president; Martti Lindberg, secretary; Tor-Bjorn Falck, treasurer. The group is composed chiefly of students "who now have more time for DX-ing during vacation," Mr. von Harpe writes.

Germany—Borst Miers, Berlin, informs us that there are now two radio clubs in Germany—WBRC in the American Zone; and the Arbeiter Radio-Bund in the British Zone. Another club, HRC, is to be founded shortly in the American Zone, while another group, NRAC, is to begin functioning soon in the British Zone. "There are no amateur clubs in Berlin," Mr. Miers writes. "Unfortunately, all unpolitical societies are prohibited here."

* * *

This Month's Schedules

Albania—ZAA, 7.852, Tirana, 1300-1630, except Wednesday when carries additional French period to 1645. (Pearce)

Algiers—Relay of "The Voice of America in North Africa" ceased operations on June 1. (Shore) THA, 12.116, operates 0045-0545. (BSWL) French outlet on 11.835 has news in French at 0130. (URDXC) Heard signing on in French at 0129 with fine level. (Harrison)

Anglo-Egyptian Sudan—Radio-Omdurman is inaudible in New York now daytime; heard yet is the 2310-2345 transmission on 9.65 and 13.32, latter with bad QRM. (Beck) The *English* period on these frequencies is now Fridays, 1230-1300. (Pearce-Gillett)

Angola—A letter received by Mervyn Laubscher, South Africa, from Radio Clube de Malanje, Caixa Postal 83, Melanje, Angola, lists call of CR6RE, 7.14 (41 m.), power of 50 watts; scheduled weekdays, 0700-0745, 1430-1530, Sundays, 0200-0300, 0730-0830. "Our transmitter was constructed by amateurs and operates from 100 volt a.c. supply. A shortage of material does not permit us to improve our radiation and modulation conditions, while lately we have been trying to overcome certain faults due to a shortage of 8- and 12-microfarad condensers which we are unable to obtain on the market. Also, we do not have a good pick-up and we have noted a distortion of the bass notes." Laubscher says frequency has drifted to about 7.165. If anyone is lucky enough to pick up CR6RE, an IRC should be sent with report.

Laubscher reports that some time ago at 1400, during a break in the amateur QRM in the 41-m. band, he heard an announcement in Portuguese, mentioning "CR6AA." CR6AA is listed as Robito, Angola, on a frequency of 7.177; has been reported "inactive" for some time, but may be back on schedule.

Australia—Radio Australia's "evening" beam to Eastern North American is now carried 1900-2015 over VLC, 15.200, while VLA10, 17.84, is used in dual but beamed to *South* America. News at 1930. The 15.200 channel has a nice signal in West Virginia while VLA10 (100 kw.) is buried beneath Moscow which recently sat down on about (unannounced) 17.839.

Austria—Latest list of short-wave transmitters operating in Austria is: Wien I, 300 w., 6.155; Wien II, 250 w., 7.175; Wien III, 250 w., 9.665; Wien IV, 11.785, all in Vienna. Sendergruppe West (French Zone), Dornbirn-Innsbruck, 200 w., 6.145 (a later report says back on 6.005). Sendergruppe Rot-Weiss-Rot (American Zone), 1 kw., 9.563. (Kary) The 9.563 one is scheduled 1015-1800 except Sundays when schedule is 0100-1800. (Radio Australia) *Radio Wien* lists this station as Salzburg-Linz-Vienna and on a frequency of 9.575. (Pearce)

KOFA, 7.22, Salzburg, heard with news at 0030 and 0500. (Harrison) Very strong signal in Britain at 0000. (Pearce)

Belgian Congo—Leopoldville's 17.77 appears scheduled 0500-0700 and to British Isles, 1530-1645, news at start. *Radio Australia* reports the 9.745 channel used 1030-2300. This one *does* beam to North America, 2100-2300, news at start and around 2245.

News has been heard on 17.77 at 1630-1643. (Sutton) May be on 1355-1645 in European beam. A late flash from Carl Beck, New York, says that recently 9.745 has been used again in (*English*) transmission beginning at 1530; may be back here again from around 1300 on.

Borneo—Pontianek, 6.650, reported 0800-0845. (URDXC)

Burma—Radio Australia gives Rangoon schedules for *English* periods as 2015-2045, 0115-0200, 9.543; 0840-1015, 6.035; news at 2030, 0130, 0845, 1010; on Mondays *only English* period is 0840-1015. (NOTE: *It is possible these schedules have been set forward one hour for summer.*)

Canada—Canada's International Service has been heard afternoons on 21.710. (Sutton) Call is listed as CHLA. Latest schedules at hand are: To Great Britain and Europe—CKNC, 17.82, 0900-1800 daily; CKCX, 15.19, 0900-1100 daily; CKCS, 15.32, 1105-1800 daily. To Caribbean and Latin America — CKNC, 17.82, 1820-1935 daily, 1820-2105 on Sunday; CKRA, 11.76, 1820-1935 daily, including Sunday.

Canary Islands—Radio Club Tenerife, 7.558, Santa Cruz de Tenerife, is heard well 1700-1801. (Sutton via NNRC)

Cape Verde Islands—Direct from the Director of Radio Club de Cabo-Verde, Praia, cames this data: "In

(*Continued on page* 129)

SURPLUS ELECTRONIC EQUIPMENT

MANUFACTURERS
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The War Assets Administration, through its network of Approved Distributors, is offering electronic tubes, devices and equipment which were declared surplus by the Armed Forces. Take advantage of this great opportunity to fill your present and future needs at fraction-of-cost prices. Most inventories still permit wide selection.

Purchasing of this equipment has been simplified to a high degree. The WAA Approved Distributors listed at right were appointed on a basis of their ability to serve you intelligently and efficiently. Write, 'phone or visit your nearest Approved Distributor for information concerning inventories, prices and delivery arrangements. You'll find you can "Save with Surplus."

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What's New in Radio

(*Continued from page 76*)

proper tone compensation adjustments. The entire unit is housed in a two-tone leatherette carrying case which measures 15⅞"x17⅝"x9¾".

Additional information on this recorder may be secured from *Audar, Inc.*, Argos, Indiana.

NEW MONOSET

The new *Telex* "Monoset" unit recently announced by the *Electro-Acoustic Division* of *Telex, Inc.* features the addition of a volume control unit which will permit the user to control the tone level as desired.

The "Monoset," incorporates an under-chin type of construction which re-

sembles a doctor's stethoscope. It is lightweight and may be used wherever individual receivers are required. Removable, clear plastic eartips which can be easily cleaned make it practical for use in public installations such as hospitals, theaters, churches, and music stores.

The unit is also being used with electronic dictating machines which permits the stenographer to wear the headset without ear pressure or head fatigue.

Additional details of this new unit will be provided by the *Electro-Acoustic Division* of *Telex, Inc.*, Minneapolis, Minnesota.

BEAM ROTATOR

The *Rex L. Munger Company* of Chicago has recently announced the availability of a new "Electro-Beam Rotator" for amateur applications.

This remote-controlled, electric drive rotary beam, complete with direction indicator, has been designed to operate efficiently in any weather. The unit operates on 115 volt, 60 cycle current and uses heavy, cadmium plated steel gears and Oilite bearings. All of the steel parts are cadmium plated while the aluminum parts are anodized. Torque is adequate to turn ten meter beams. The indicator is calibrated in both degrees and direction and incorporates a fuse post, pilot light, "on-off" switch and a clockwise-counter clockwise switch with "off" position.

Full details and price will be furnished upon request to *Rex L. Munger Company*, 4701 Sheridan Road, Chicago 40, Illinois.

SOLDERING IRON STAND

A new soldering iron heat control stand, known as the "Tip-Saver," has been introduced to the radio service field by *Beyer Manufacturing Co.* of Omaha.

This unit adapts itself to fit all sizes and makes of irons by tilting slightly when the barrel of the iron is placed on the fins of the stand. The fins of the control stand absorb and radiate the excessive heat of the iron, maintaining a lower temperature at the tip when it is not in use and lying on the stand.

Beyer Manufacturing Co., 2866 Farnam Street, Omaha 2, Nebraska will supply additional details on the "Tip-Saver" upon request.

"FLASH-O-TEST"

Sterling Electronic Company of Pasadena, California has recently announced a new combined tester and flashlight, known as the "Flash-O-Test."

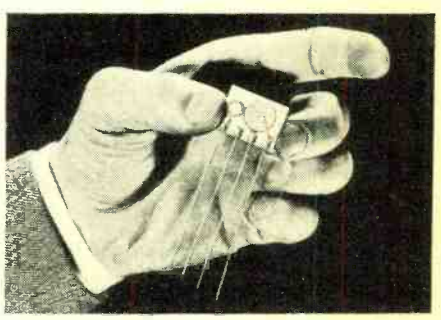
Designed to serve a double purpose, the new model enables the user to make simple and rapid continuity checks and when not used for this purpose the unit may be employed as a flashlight in test work.

Sterling Electronic Company, 166 N. Sierra Bonita Avenue, Pasadena 4, California will furnish additional details on this new product on request.

"THE COUPLATE"

Centralab, Division of Globe Union, has announced the first commercial application of the Printed Electronic Circuit—a new interstage coupling plate known as the "Couplate."

The "Couplate" is an integral assembly of two capacitors and two



resistors closely bound to a steatite ceramic plate and mutually connected by means of metallic silver paths.

According to the manufacturer, the "Couplate" requires only four soldered connections instead of the usual eight or nine required to complete the coupling of two audio stages with standard components. This unit consists of a .01 μfd. coupling condenser, a 250 μμfd. plate r.f. bypass condenser, a 250,000 ohm, 1/5 watt grid resistor, in a single assembly.

These component values were selected because they are suitable for

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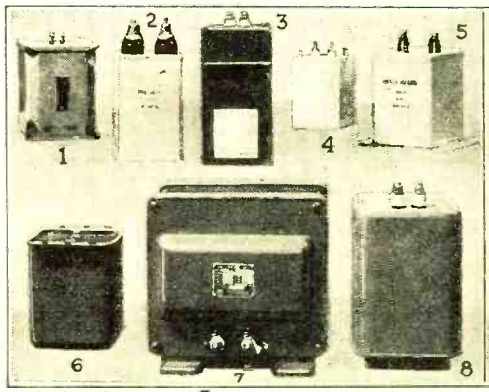
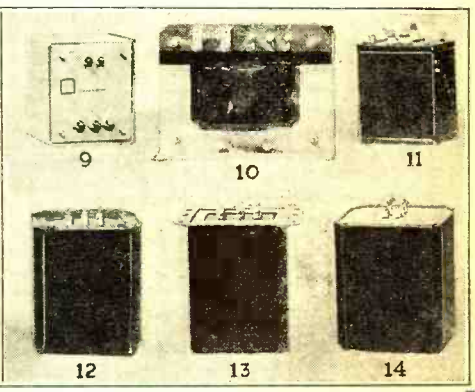
Your trade-in's worth more at the Walter Ashe Store. Yes, you'll be amazed at Walter Ashe's liberal allowances on your used Test Equipment or Receiver. All the big-name brands in stock ready for your selection. Phone, wire or write today.





BRAND NEW ARMY SURPLUS KEY
Large Coin Silver Contacts. Bargain at $0.98

SELSYN MOTORS
115 VAC 60 CY. Matched pairs, one transmitter, one repeater. Heavy brass case, exceptionally heavy duty type. No. 806, per pair..... $12.50

GOING, GOING FAST!
Just a few left, dynamotor power supply, type PE 103 500 VDC at 160 MA, 6 or 12 VDC input, BRAND NEW in original overseas shipping box $9.95

BRAND NEW!
Throat mikes, 200 ohm carbon. In original box $0.35

BRAND NEW!
T-17 hand mikes single button carbon. Push to talk. in original boxes.... $1.49

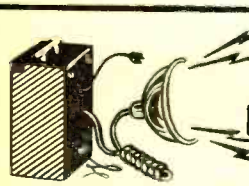
ICA 2 and 3 GANG VARIABLE CONDENSERS
No. 531. 2 gang 350 MMFD, per sec..... $2.59
No. 531. 3 gang 350 MMFD. per sec..... 3.79

ARMY SURPLUS HEADPHONES
BRAND NEW Army surplus phones, Type HS-23, 8000 ohm imp. Complete with leather headband and rubber cushions, in original factory boxes..... $1.29

MILLEN R9'er
Less tube with 10 Mtr Coil. $24.75
6 or 20 Mtr. coil, E. $3.15
6AK5 tube for above.. $0.90

SOLAR POWER LINE FILTER
Rated 20 Amps 115 volts..... $1.79

As always, typical Walter Ashe Service . . . and that means shipment the same day your order is received. Write today for your free copy of the Walter Ashe Bargain Flyer.



HI POWER FOTO FLASH KIT

THOROUGHLY PROVED AND TESTED

1. Uses AMGLOW 54R4X 200 watt second flash tube.
2. Uses parallel bank condensers. 25% safety factor. No costly replacements.
3. Synchronizer adjustment control.
4. Light Weight, Heavy Duty, Army Surplus, High Voltage Transformer.
5. Unit can be fired every 3 seconds if necessary.
6. Neon bulb charge indicator.
7. 1/10,000 Second exposure.
8. Triggered by hand switch or synchronizer.
9. Sockets for connecting all cables.

Complete Kit including AMGLOW tube, carrying case, etc. with simple assembly and operating instructions. Price subject to change without notice. **$77.50**

Write for detailed description and parts list.

(1) FILTER CHOKE
12 HY @ 200 MA. 200 ohms DC Res. Steel Case..... $3.50

(2) TRANSMITTING FILTER CONDENSER
2 Mfd. 5000 VDC, Dykanol, regular net price $29.63. Our low down bargain price.. $7.51

(3) DUAL CHOKE
12 Hy @ 200 MA per section. 55 Ohms DC res. Steel case with stand-off insulators. No. 2785 ..... $4.95

(4) FILTER CHOKE
4½ Hy. 150 MA. 70 ohms Res. DC. Hermetically sealed in case. Stand-off insulators No. 5209. $1.29

(5) TRANSMITTING FILTER CONDENSER
2 Mfd. 4000 VDC. oil filled. Regular net price $25.44. Our give away bargain price. $4.50

(6) FILTER CHOKE
4 Hy. 300 MA. 40 ohms DC resistance. Hermetically sealed in case, screw terminals. No. 6317... $4.95

(7) HIGH VOLTAGE FILTER CHOKE
6 Hy. at 1.2 Amps., 27 ohms. DC resistance, 12500 volt breakdown insulation. Shielded case and standoffs. No. 6813. A super buy at..... $17.95

(8) FILTER CHOKE
8 Hy. at 500 MA. 55 Ohms DC res. Very high quality. Hermetically sealed. No. 8056. Net.... $11.85

(9) PLATE TRANSFORMER
2500 VCT., 150 MA. Pri. 115 VAC. 60 CY. Steel case with standoff insulators, No. 161919..... $9.95

(10) RCA 1 KW MODULATION TRANSFORMER
Primary will match class "B" tubes up to 10000 ohms plate to plate. Secondary No. 1, 450 MA for beam tube plate. Secondary No. 2, 80 MA for screen grid..... $14.95

(11) SCOPE TELEVISION TRANSFORMER
2100 volts at 10 MA. Pri 115 VAC, 60 Cy. Steel case with standoff insulator. No. ST. 1..... $4.25

(12) PLATE TRANSFORMER
2010 VCT 200 MA Pri. 105-125 VAC 60 Cy. Steel case screw terminals. No. 8275..... $9.95

(13) PLATE TRANSFORMER
1400/1200 VCT at 200 MA. Pri. 115 VAC 60 Cy. Steel Case, screw terminals. No. 4891-N. $7.45

(14) PLATE TRANSFORMER
1400/1200 VCT at 260 MA. Pri. 115 VAC 60 Cy. Hermetically shielded steel case, screw terminals. No. 8931..... $7.95

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Walter Ashe RADIO CO.

1125 PINE ST. • ST. LOUIS, MO.

over 90 per-cent of the radio sets now in use and in present production.

Bulletin No. 943 which describes the features of the element is available upon request to *Centralab, Division of Globe Union,* Milwaukee, Wisconsin.

FREQUENCY STANDARD

Rogers Industries, Inc. are currently releasing their own new RFS-2 frequency standard which incorporates a crystal oscillator employing a precision, low-frequency drift 100 kc. crystal, an r.f. amplifier pentode, and a means of adjusting the frequency to exactly 100 kc. by zero-beating with Station WWV.

The unit is furnished complete and ready for installation in the receiver. Color-coded leads provide easy connection to the receiver's power supply.

Full details, including specifications and price, will be furnished by *Rogers Industries, Inc.,* Communications Division, 49 Bleecker Street, New York 12, New York. —30—

A Two-Tube Intercom

(*Continued from page* 55)

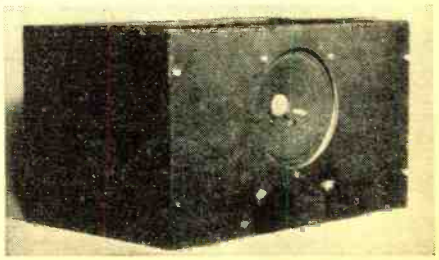
the scope. The v.t.v.m. should measure .38 volt r.m.s. when connected across R_1 and should read 15 volts when connected across C_6, representing a total gain of 1500 for the amplifier. Readers owning oscilloscopes and desiring to check the amplifier for distortion, may proceed as follows:

With the *X* axis connected internally, connect the input of the *Y* axis amplifier across the grid resistor R_2 to which is connected the audio signal generator output. Adjust the output of the generator to .01 volt and increase the *Y* axis gain. A perfect sine wave should be seen on the screen—if not, distortion in the generator is present. Bear in mind that a Class "A" amplifier should reproduce faithfully the wave applied to the input.

Assuming a pure sine wave, connect the scope across R_1. A wave of the same shape as the input wave should be seen, but its amplitude should be 38 times greater, showing gain in the first stage. The input to the *Y* axis should be transferred to the plate of the 50L6 in order to view the output of the 50L6. The amplitude of the sine wave now seen on the scope should be 39 times greater than when viewed across R_1.

Amplitude distortion is the major problem in this type of unit, so we will

Fig. 4. Over-all view of intercom.



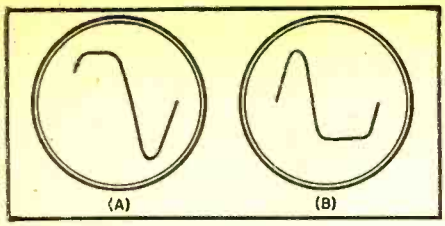


Fig. 5. (A) Should this wave shape be obtained, it would indicate that the grid of the tube under test is being driven positive and drawing current. (B) If the pattern appears as shown in this illustration, it would indicate too much grid bias on tube.

concern ourselves only with this type of distortion. If the pattern on the scope looks like Fig. 5A, the grid of the tube under test is being driven positive and drawing current. To remedy this condition, add more bias by increasing the resistance of the cathode resistor, R_k. If, on the other hand, the pattern looks like Fig. 5B, there is too much bias on the grid and it should be reduced. —30—

6-10-11 Meter Converter

(*Continued from page* 53)

rigidity. The *National* type ACN dial makes it possible for anyone to mark in calibration points for any of the bands the unit will cover.

In adjusting the bandspread of the oscillator dial both the series and the parallel pads have to be very carefully adjusted. If too much bandspread is experienced, where known frequencies are too far apart, tightening or increasing the capacity of the series pads will be required and if too little bandspread is experienced the series pad or trimmer will have to be loosened or decreased in capacity. Naturally each adjustment of a series pad will require a very minor adjustment of the parallel pad to compensate. Unfortunately when the converter is installed in the cabinet and the top cover of the cabinet is raised or lowered this causes a shift in oscillator frequency of approximately 25 kc. The oscillator should, therefore, be adjusted (with the top open) approximately 25 kc. higher in frequency on the dial to compensate for this condition. For those who desire to avoid this procedure, the usual paper scale supplied with the ACN dial may be employed instead of a specially calibrated scale and the additional markings and calibrations added where needed.

Prewar 5 meter men will readily recognize that this unit is merely a modernization of the old converter that was described in the 1939 issue of *"QST."* Only minor changes in values, the new type power supply and tubes, as well as improved mechanical layout are responsible for the smaller size of the new version. To say that this converter is the result of many hours of effort would be putting it mildly. However, it is felt that the results compensated for the time expended. Performance checks indicate excellent

sensitivity, too low to be measured by the average signal generator when the converter is employed ahead of any half-way decent communications receiver. The receivers used in the tests conducted on this unit were the *Hallicrafters* SX-25 and SX-17, *Hammarlund* HQ 129x and "Super Pro." Image ratio measurements and response to spurious frequency are of very high order and it is felt that due to the many variables there is no particular sense in quoting any set of figures as they would not be worth very much under the circumstances.

The output frequency of the converter is adjustable over approximately 4 megacycles with the mid-frequency and suggested i.f. frequency being 5.7 megacycles. When connecting the converter ahead of a receiver, it is suggested that with the converter turned off and the receiver tuned to approximately 5.7 megacycles, the r.f. gain of the receiver be reduced, if necessary, to provide practically no noise level. When the converter is then turned on, it will be found that very little noise level will be added and plenty of sensitivity will be obtained.

The output cable from the converter consists of two wires shielded, with an over-all insulation to provide isolation of the shield of the cable from the converter chassis. The shield is cut short and insulated from the converter chassis. The opposite end which connects to the antenna terminals of the receiver has the shield grounded. This will usually prevent the receiver from picking up all but very strong signals at the i.f. frequency in addition to eliminating noise pickup.

The writer wishes to thank the gang on 6 and 10 meters for the many swell compliments on the old converter previously mentioned and is sure that this new version with its many advantages will be found just as popular. —30—

Robot Telephone

(*Continued from page* 41)

after the fourth ringing tone just as if he were going to make a recording. On hearing the word "Ready?", however, he pronounces twice the word "Hello." (For the sake of simplicity, the checking of the double signal, "Hello, hello," is not shown in the simplified diagram; nor, for that matter, is the complete code key of ten buttons shown since it would needlessly complicate it). If, then, after the operation of cam 7_a already described, a speech impulse acts on relay J through the amplifier E_1 contact J_2 will close, thus preventing, in motor control device C_2 the switching of the latter out of circuit by cam 6_e which would otherwise immediately follow. In this case C_1 remains in circuit and the text of the announcement is modified. This means that instead of emitting the invitation "Please start speaking now!", the sound recording wire successively enumerates the digits of a

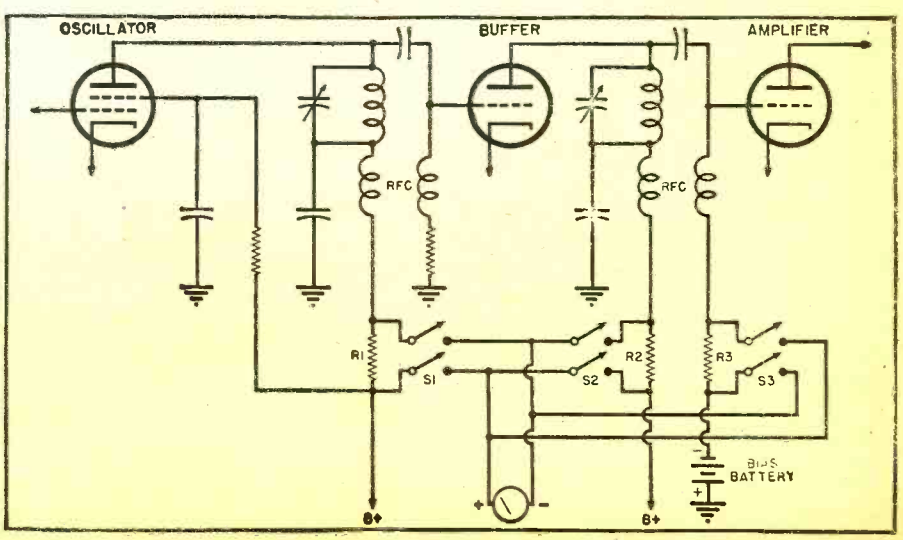
METERING MULTI-STAGE TRANSMITTERS

WHEN using one meter to perform several duties in a multi-stage transmitter it is customary to use a two-deck rotary switch. To eliminate possible operational errors, a double-pole, single-throw switch for each stage should be substituted, as shown in the diagram. Non-locking types should be used to eliminate the possibility of having more than one switch in operation at one time. The switches should be connected across low value resistors which act as meter shunts. These resistors should be of such a value as to give the correct range for easiest reading of the meter.

Since the switches do not break into the circuit across points of high potential difference, high insulation between points is not necessary. Good insulation to ground is necessary, however.

This system takes up less room than the rather bulky rotary switch and provides individual stages with conveniently placed switches. Among the switches that can be used are the Utah jack switch Type 44 or 344 or the Mallory Type 2004 non-locking unit...R.L.P.

Diagram shows method of wiring resistors and switches.



series from 1 to 5. (in the *Ipsophon* itself, from 1 to 10; the principle is the same, however, irrespective of the number of buttons used). After each digit, the relays *H* are excited as a result of the closure of the contacts 7_1 to 7_5, and the amplifiers are switched over to their recording position. The cams of discs 1 to 5 are closed, one after the other, simultaneously with the cams on disc 7. Thus, for instance, the closure of cam 1 results in the negative pole of the battery being shunted on the first winding of relay *G*, through the intermediary of the cam contact and the non-operating contact of button 1. In the absence of speech impulses, however, relay *G* cannot be lifted, as contact J_1 has not effected the transfer. Should the caller emit a speech impulse after the announcement of digit 1, which is not included in the selected code, relay *G* is excited, operating locking relay *S* and thus preventing reproduction. On the other hand, in regard to the button originally pressed by the subscriber to the *Ipsophon*, the closure of cam 3 results in the following circuit being established; negative pole of battery, cam contact, operating contact of button 3, second winding of relay *G*, contact J_1, positive pole of battery, through the closed contact of relay *B*. In this case, in the absence of speech impulses, relay *G* would also be operated and, through the locking relay *S*, prevent reproduction. If, however, the caller speaks, this will switch relay *G* out of circuit, and locking relay *S* will not be excited. This function is made possible by the time delay feature of the two relays, *G* and *S*.

The caller must, therefore, pronounce the word "Hello" twice, each time a digit originally chosen as a code number is announced, and remain silent when the other figures are announced. If this is done correctly, the emitted impulses set in operation the controls corresponding to the series of figures from 1 to 5, the reclosure of the circuit of cam 6_b starts up motor control mechanism C_2 which, in turn, sets motor M_2 (that which controls the text of the announcement) in motion in reverse, and also simultaneously, sets in motion motor control mechanism C_1 which governs the reverse motion of the recording mechanism. Motor M_1 drives spool Y_2, which carries the sound recording wire. This reversal of the movement of the sound recording wire drives spool Y_1, thus bringing about (through the reduction gear P_2) the release of the reverse movement of cams 8 and 9. This reverse movement continues until the cam of disc 9 has closed its contacts and, through motor control unit C_3, switched motor M_4 out of circuit and engaged the forward movement of motor M_3. Cam-disc 8 has been driven by friction in this reverse rotary movement, not having been locked by the pawl. Through the forward feed of the sound recording wire, following immediately, the recordings reach the repeater N_1 through the sound head

Z_2 and the amplifier E_2. The caller then hears, over the service line, all the messages recorded by the *Ipsophon*.

At the end of the reproduction, cam 8 closes its contact, thus switching motor M_3 out of circuit, through the motor control unit C_3. At this moment a short, shrill sound is emitted by unit C_1 through the coupling transformer N_2. This shrill sound notifies the listener that all the recordings on the *Ipsophon* have been reproduced. At the end of this shrill tone, the relays H are switched over—by the same unit C_3—to recording. If, at that moment, two speech impulses are emitted, exciting the impulse relay J through amplifier E_1, the relays H will remain held and motor control unit C_3 will again engage motor M_3 on "feed." Thus, the caller can record messages to the instrument immediately after the end of reproduction.

If, on the other hand, the caller does not avail himself of this facility, a second shrill sound is emitted after three seconds through the repeater N_2, this period of time being measured by the timing device T. If two speech impulses are then emitted, impulse relay J engages the motor control unit C_4, setting motor M_4 in motion in reverse and at the same time exciting the electromagnet Q_1 of the pawl and the cancelling electromagnet Q_2. The result is that cam-disc 8 is held in its initial position (cam contact closed) and cam-disc 9 is driven in reverse until it reaches its position of rest. The electromagnet, Q_2, magnetically cancels the recording from the instrument, and the entire *Ipsophon*, being returned to its initial position, is once more ready for action. If, however, after the second of the shrill tones, advantage is not taken of the opportunity to cancel the recordings, a third shrill tone is heard after an interval of two seconds, informing the caller that the recordings have not yet been erased. After this third shrill tone, the timing device T switches the *Ipsophon* out of circuit again.

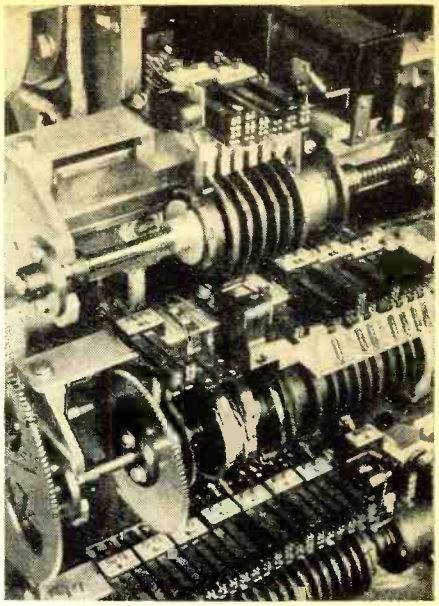
A paramount requirement in a device of this type is, of course, the necessity of making it operate as reliably as the ordinary telephone.

Accordingly, no parts needing periodical attention or replacement have been incorporated in the *Ipsophon*.

Breakdown through faulty manipulation is precluded by the use of automatic switching arrangements and all electro-acoustic commands are performed by coils controlled by relays and contacts similar to those in common use in telephone exchanges all over the world.

Furthermore, manipulation of the *Ipsophon* is simplified to a considerable extent by making the instrument in two separate units, the main operating apparatus and the recording device, as well as the provision for straightforward dialing arrangements, easy-to-read controls, and luminous signal indicators.

Easy to manipulate, foolproof in operation, and absolutely dependable in engineering performance, the *Ipsophon* robot telephone will undoubtedly become, when popularized, a vital link in tomorrow's world-wide system of national and international telephone communications networks.—30—



Cam mechanism for the 1st and 2nd pair of registering coils. All electro-acoustic commands are performed automatically by them.

Spot Radio News

(*Continued from page* 20)

ships and floating objects. He then calls out course changes to a man at the wheel. The image on the *Sperry* radar equipment can be translated into a range to any object, both in yards and fractions of miles of distance and in degrees of bearing. Developed for commercial use since the war, it recently was commended by 92 delegates from 31 nations at the international meeting on marine radio aids to navigation. Also demonstrated was Loran—for locating your position at sea in from three to five minutes—and the *Sperry* Gyro-Compass . . . Sea-going radar is already in practical use on the "Elizabeth" and the "America," as well as a number of Grace liners. Alaskan fishing boats are also using it and the captain reports that is has been installed on a couple of yachts. It costs plenty—$12,000—but the captain estimates that it will save millions in ship losses and an inestimable number of lives when generally used.

ONE FORM OF INTERFERENCE that's easy to fix—if you don't know it already is that coming from fluorescent lights. They have a habit of humming in the middle of your favorite program. Cause; a feed-back of radiation through the wires and tubes of the radio. Cure; move the radio and light farther apart. If this doesn't work, install a filter specially designed for fluorescent lights. —30—

RHS

4" ALNICO "5" P M SPEAKER 79¢

← SPECIALS OF THE MONTH →

G.E.—Rotary Switch, 2 deck—each deck SP3P Mycalex wafers. Can be used in Hi-frequencies up to 250 Mcs. Perfect for band switching in an exciter or final. Heavy silver plated spring contacts. Positive action by spring controlled roller bearing. **$1.29**

TRANSFORMERS—115v 60 cyc

Hi-Voltage Insulation

1600v @ 4ma; 700VCT @ 150ma; 6.3v @ 8a	$8.50
2500v @ 10ma	6.50
3710v @ 10ma; 2.5v @ 3 amp; 2.5v @ 3 amp	9.95
3950v @ 4ma; tap at 1250v @ 1ma	7.50
550-0-550v @ 150ma; 5v @ 3a; 2X-6.3v @ 5a	7.95
6300v @ 4ma	9.95
500-0-500v @ 100ma; 5vct @ 3a	4.95
442-0-442v @ 1000ma	9.95
425-0-425v @ 150ma; 6.3v @ 7.5a; 6.3v @ 3a; 5v @ 3a	5.95
400-0-400v @ 200ma; 5v @ 3a	4.95
350-0-350v @ 150ma; 6.3v @ 6a; 5v @ 3a; 78v @ 1a	4.95
350-0-350v @ 35ma—XLNT for Volt Doubler	1.49
300-0-300v @ 65ma; 2X-5v @ 2a; 6.3v @ 2½a; 6.3v @ 1a	3.49
120-0-120v @ 50ma	2.49
2.5v @ 3a, 15KV test	3.95
2.5v @ 10a, 10KV test	3.25
5v @ 115a	14.95
5v @ 190a	17.50
6.3v @ 6.6a	3.25
6.3v @ 3.1a	1.95
6.3v @ 21.5a; 6.3v @ 2a; 2.5v @ 2a	6.95

FILTER CHOKES— HI-VOLTAGE INSULATION

4 Hy @ 250ma	$1.98	12 Hy @ 300ms	$3.95
10 Hy @ 250ma	2.49	15 Hy @ 100ma	2.95
10 Hy @ 400ma	4.95	15 Hy @ 125ma	3.25
12 Hy @ 100ma	2.95	30 Hy @ 70ma	1.95
.4 Hy @ 600ma	5.95	.1 Hy—5 amps	6.95

SCR-522 100-156 MC. RECEIVER AND TRANSMITTER

Licensed for Railway and Taxicab Use

The ideal all-purpose transmitter-receiver for work in the 100-156 mc. spectrum. Four channel push-button operation, crystal-controlled, AM, phone, mobile or fixed station service. Ideal for amateur, aircraft, marine, railroad, taxicabs, police and experimental. Amplitude modulated—High transmitter output. Receiver has 10 tubes and transmitter has 7 tubes including two 832's. Easily converted to full 110 volt 60 cycle operation. Complete conversion instructions and schematic furnished with each unit.

Tube complement 2—832; 3—12A6; 1—6G6; 2—6557; 1—12J5GT; 1—12C8; 1—9002; 3—9003; 1—12AH7GT and 3—12SG7.

Complete with tubes **$14.95**

BC-348 RECEIVER

Built for continuous duty, this band switching, six band receiver with a freq. range of 200 to 500 kc. and complete 1500 kc. to 18,000 kc. Has automatic noise compensator—constant sensitivity on all bands—output at 300 or 4000 ohms—xtal filter AVC-MVC-BFO; Smooth vernier tuning; 90 turns of tuning for each band Complete with built-in dynamotor for 28 v DC, 8 tubes. Conversion instructions and schematics. Wonderful buy at **$49.50**

Conversion kit for 110v-60 cyc. operation, complete $7.50

'SILVER BALL' ANTENNA SWITCH

100 Amp. 2500 V. Navy Rating

Terrific Buy $1.79

BLOWER

Hi-air blast, designed for transmitting tube service. Motor operates on 100-125v 60 cycle at 7000 RPM. Noise free with self contained chokes and filters. Enclosed in satin finish, aluminum cabinet. Measures 4" high x 2¾x3¼". Many uses.

Super buy at $5.95

PERMALLOY SHIELDS for CATHODE RAY TUBES

3" Shield	$1.49
5" Shield	1.98

TUBES (*Brand New*) Army-Navy Inspected

1B24	$13.95	311	$ 5.95
2AP1	2.25	371B	5.95
2C40	2.79	450TH	44.50
2D21	1.49	703A	1.50
2V3G	1.25	705A	4.95
2X2	.84	715B	4.95
3AP1	3.00	721A	4.95
3BP1	2.95	726/AC	7.50
3E29	2.95	801	1.75
5BP1	3.95	802	1.75
5BP4	4.95	803	8.95
5CP1	3.95	804	9.95
5JP1	9.95	805	3.75
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5R4GY	.98	807	.95
5Y3	.59	808	2.95
6AB7	.99	809	1.50
6AC7	.99	810	3.50
6AG5	.99	811	1.95
6AG7	.99	812	3.95
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6AL5	.99	814	4.45
6AR6	1.29	815	3.95
6B4G	1.29	826	2.25
6C4	.69	829-A-B	3.00
6C5	.49	832	2.25
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6N7	1.39	861	89.95
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6SL7	.89	872A	2.50
6SN7	.69	884	1.10
6SR7	.89	885	1.10
7A4	.95	902	2.25
7F7	1.25	913	3.00
7L7	1.59	954	.75
9JP1	14.95	955	.75
10Y	1.50	956	.75
12X3	1.50	957	.75
15E	1.50	958	.75
24G	1.75	959	.75
28D7	.75	1005	1.98
30	.75	1616	2.95
35T/TG	3.50	1619	.75
VR90	.75	1624	.90
VR105	.75	1625	.75
VR150	.75	1626	.75
100TH	7.95	8001	8.95
100TS	3.00	8003	9.95
211	1.25	8005	4.95
250TH	14.95	8011	3.75
257B	14.95	8016	1.65
304TH	9.95	F128A	75.00

SELENIUM RECTIFIERS

Full Wave Bridge Types

INPUT	OUTPUT		
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.	12.95
up to 36v A.C.	up to 28v D.C.	15 amp.	18.95
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10mfd.	600v	1.15	.1mfd.	2500v	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
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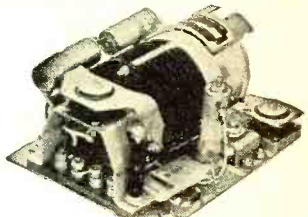

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Technical BOOKS

"MUSICAL ACOUSTICS" by Chas. A. Culver. Published by *The Blakiston Company,* Philadelphia. Second Edition, 215 pages. Price $3.00.

While this second edition of Dr. Culver's book is, like the first edition, designed to assist musicians and music school students understand the problems in acoustics confronting them in their professional careers, much of the material in this text will be of interest to that group of radio technicians and servicemen who are dealing with p.a. work and the recording and reproduction of music.

The entire text is written in language the layman can understand. While a knowledge of music might be desirable for a full appreciation of the book, the non-musical technician will profit by a careful reading of the text.

The author has devoted chapters to a discussion of the nature and transmission of sound, interference, hearing, resonance, vibrating air columns, acoustics of rooms, electronic musical instruments, and the recording and reproduction of music, to mention a few of the topics of interest to the radio technician.

This book is a must for the careful and thoroug. serviceman whose work is concerned with the direct transmission of sound.

* * *

"ELEMENTARY RADIO SERVICING" by William R. Wellman. Published by *D. Van Nostrand Company, Inc.,* New York. 251 pages. Price $3.00.

This book is characterized by a clarity of style which will prove of particular value to the student or novice serviceman.

The author, formerly Service Manager for *Philco,* has broken the servicing operation down into several well defined techniques. Each of these operations is clearly and fully described and there is no valid reason why anyone capable of reading printed instructions and following them should experience any difficulty in the actual servicing of standard types of radio receivers.

No mathematics are to be encountered in this book and, in addition, complete operational procedures for using various test instruments are supplied. To cover this phase of servicing, the author has set up "Job Sheets," the purpose of which is to teach the use of the voltmeter, ohmmeter, signal generator, how to make a voltage analysis of a.c. and a.c.-d.c. receivers, how to read block diagrams, and how to do signal tracing on a superheterodyne, etc.

Separate chapters dealing with the r.f. amplifier, mixer-oscillator, i.f. amplifier, detector and a.v.c. circuits, audio amplifier, power supply, loudspeaker, alignment, miscellaneous troubles, automobile radios, battery-a.c.-d.c. portables, a.f.c., and FM, cover

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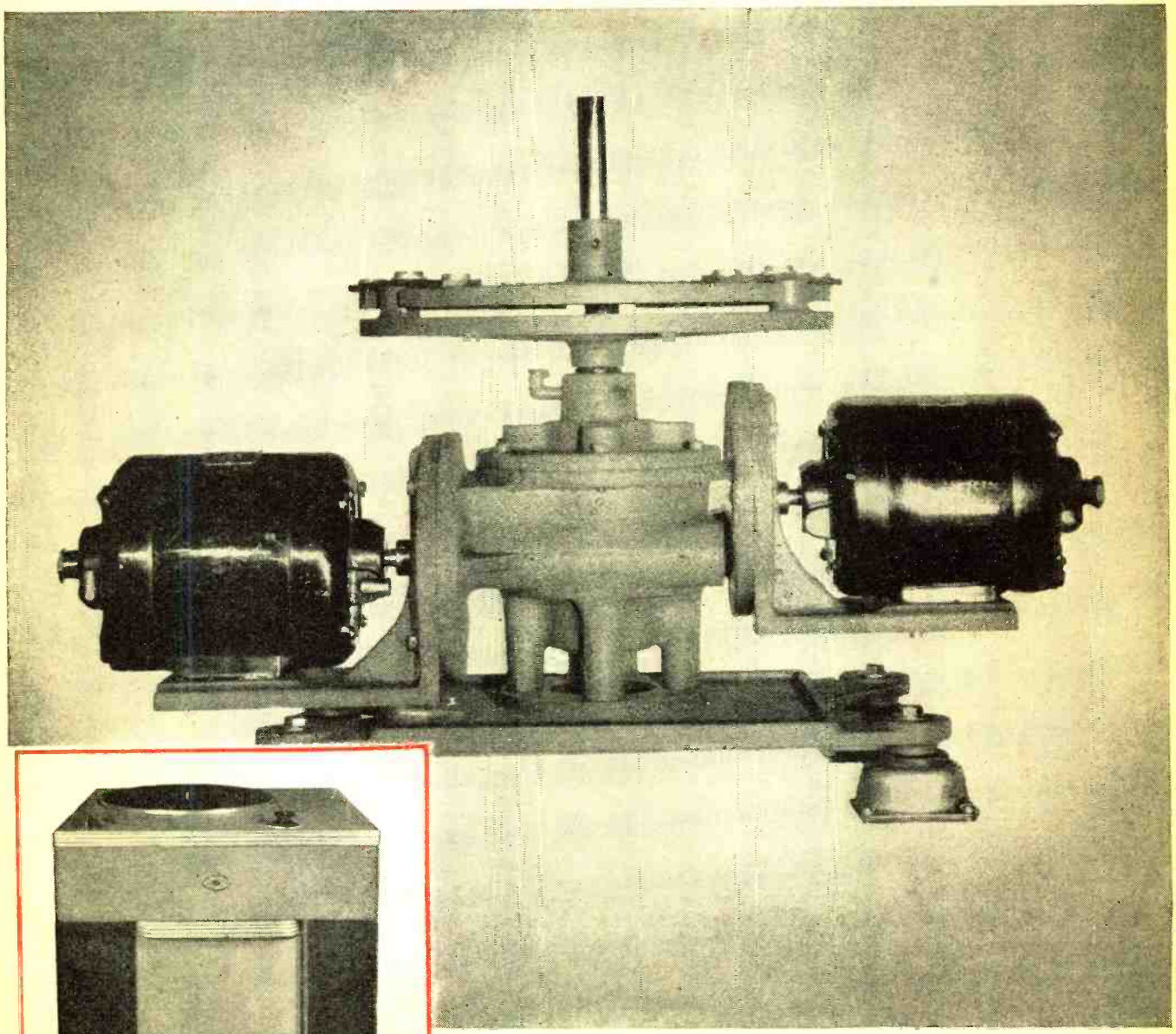

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—30—

Antenna Loading Problems

(*Continued from page 44*)

meters require identical calibration. These meters are expensive and may be easily damaged with overloads. There is another r.f. indicator which, for this particular application, is equally as accurate as r.f. microammeters and costs 5c per indicator. The common panel light bulb meets this requirement. In case of an overload the expense of the damage will be the price of a light bulb.

Installation of R.F. Indicators

For example, let us assume that we are working with a transmitter with an input of 100 watts, and a frequency of 10 meters.

Two wires are soldered to the connections of the light bulb base. These wires should be approximately six inches long. Two such light bulb assemblies are required. Refer to Fig. 1A for proper connection of light bulb assemblies to the antenna.

Tuning Procedure

Load the transmitter antenna by adjusting the pickup coil to the tank circuit of the final. Note brilliancy of light bulbs. Adjust antenna length for maximum brilliancy in each light. When this adjustment is correct, both light bulbs will be equal and at maximum brilliancy, indicating a maximum transfer of power from the transmitter to the antenna. If the impedance of the transmitter pickup coil is unknown, vary the number of turns so that maximum brilliancy of the light bulbs results.

An antenna tuned by this procedure provides a maximum transfer of power from the transmitter to the antenna, which means that the best possible match for the particular application has been achieved. Under such conditions, the standing wave ratio on the transmission line is at a minimum. If such a condition does exist, the addition or subtraction of transmission line to the particular circuit will not affect the amount of power being transferred to the antenna other than the actual loss in the transmission line. Another method of indicating standing waves on a transmission line is to apply water to the transmission line and observe any change in the transmitter loading. A 72-ohm *Amphenol* flat transmission line is relatively unaffected during a rainy season if the line is free of standing waves.

Placing r.f. ammeters in series with the transmission line will not give an accurate indication of maximum transfer of power to the antenna. A standing wave on the transmission line can cause excessive current to flow which would be indicated by the ammeter with a very small percentage of this power actually going into the antenna. If such a condition does exist, the loading of the transmitter can vary radically during a rainy season.

It is possible to have a standing wave on a transmission line and still load the antenna with a fair degree of success. Such a condition exists when an untuned transmission line is cut to length resulting in optimum operating conditions.

The number of amateurs that cut transmission line to obtain the proper transmitter load is surprising.

If the light bulbs exceed their normal brilliancy during the tuning operation the length of wire to each bulb should be reduced equally. The light bulbs will then shunt a smaller portion of the antenna, resulting in less voltage being developed which reduces the brilliancy.

For tuning applications, using low-powered transmitters, it may become necessary to use low current drain panel lights and shunt as much as 18" of the antenna. A 1-kilowatt transmitter will require approximately 4" of lead length for normal brilliancy.

The light bulb method of tuning antennas can be adapted to practically any antenna. To prune an off-center-fed Hertz antenna, the following procedure should be used:

Three lights bulbs are required, one at the center of the antenna, and two light bulbs shunting portions of the feeder. These two light bulbs on the feeder should be spaced approximately 10' apart. Refer to Fig. 1B.

The antenna is connected to the transmitter and the transmitter turned on. The antenna length is then adjusted so that the light bulb in the center is at maximum brilliancy. The next adjustment is to slide the antenna feeder to different positions on the antenna so that both light bulbs on the feeder have the same brilliancy. If the light bulb on the antenna is at maximum brilliancy and the two light bulbs on the feeder are equal, the feeder is a non-resonant transmission line and the antenna is cut to the proper length.

A final check is made by moving one of the feeder light bulbs approximately 4'. After this adjustment has been made, the two feeder light bulbs should remain equal in brilliancy. If there is a difference in brilliancy, the feeder will require additional adjustment at the antenna.

Although the light bulbs make fine power output indicators as well as modulation indicators, it is recommended that they be removed after all adjustments have been made. If the neighbor's radio jumps off the table and these light bulbs light up at the same time, the neighbors undoubtedly will conclude that your transmitter had something to do with their particular problems.

—30—

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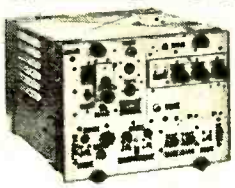

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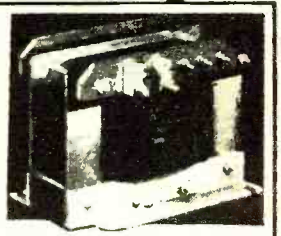

RCA modulation transformer is conservatively rated at 550 Watt audio to modulate that new KW rig. Really rugged construction with protective flashover gaps, which are adjustable. Terminals and gaps are mounted on a "Mycalex" terminal board. The laminations that make up this transformer are of high audio quality and are extremely thin, making it impossible for the core to "chatter or talk".

Audio Watts—550 Sec. #1-450 Mils Sec. #2-80 Mils Turns Ratio—Pri. Sec. #1-1:1 Pri. Sec. #2-5:1 Pri. Sec. #2 Tap-25:1. Impedance Ratio—Pri: #1-1:1 Sec. Pri. Sec. #2-25:1 Pri. Sec. #2 Tap-625:1. DC Resistance—Pri: 135 ohms Sec. #1, 112 ohms; Sec. #2, 99 ohms. Transformers insulation tested: Pri. 8000V.; Sec. #2-2000V. to the rest of the coils and core. Primary center tapped for Class "B" modulators. Secondary #2 will carry 80 Mils to modulate screens of beam power or screen grid tubes. Primary will match any Class "B" tubes up to 10,000 ohms plate to plate, such as 810's, 75T's, 800S's, ZB120's, 203's, HY51Z's, 211's, 813's, 826's, 805's, 2037's. Size 9½" wide, 7½" deep, 7¼" high. Heavy channel iron mounting brackets. Weight approx. 40 lbs.

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VR150	.69	6J6	.95	7BP7	4.45
829	2.45	3AP1	2.45	9LP7	5.45
872	1.95	3BP1	2.45	304TH	6.95

1T4 - 1S5 - 3S4 - 1R5
3Q4-6SN7-6SL7-6SA7 59c each

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20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

A 3-Element Rotary Beam

(Continued from page 63)

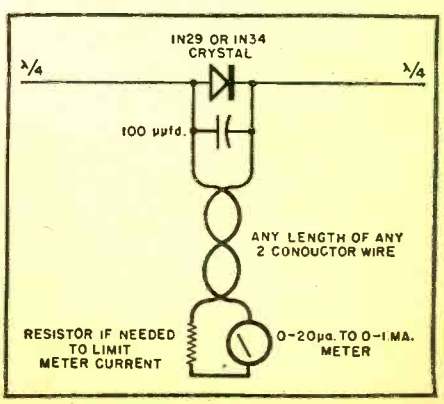
total weight of the array, framework, and pipe on it causing considerable friction. If this friction is too small the antenna will be found to be rotating on "its own" due to the wind; consequently there should be enough friction so that a pull on the control line is the only thing that will turn the antenna. Should there be too much friction, making it difficult to turn, then some grease can be added to the bottom bearing, although this was not found necessary.

A system using purely mechanical control such as this, with no reduction gearing, is not only cheaper, but is also more efficient than one involving gears. Any system which uses a motor to turn the beam must be geared down tremendously due to the high inherent speed of motors. When worm gears are used, and their use becomes almost obligatory due to the number of spurs that would be needed, then the efficiency is even lower and a quite large motor is needed to take care of the increased losses. Therefore a direct mechanical control as heretofore described is certainly the best control system for its cost. If your location does not seem to be as adaptable to control lines as this one, then merely add more pulleys of the "five and ten" clothesline variety and change direction or pass over or around obstacles as necessary.

The elements are spaced $.10\lambda = 98.4/f$ or 3'5" from director to radiator and slightly less than $.15\lambda$ from radiator to reflector or 4'7" in this case. This was shortened slightly because the lumber for the frame was available in eight foot lengths, and the gain is not noticeably affected by so doing.

So much for the mechanical details. Electrically the only new feature is the method of matching the transmission line to the antenna. This is a departure from conventional practice although it is in accordance with the general theory of matching transmission line impedance. Since the impedance of the center of a three element close-spaced array of this type is in the order of 8 ohms, and is normally within the limits of 4 and 16 ohms, and

Fig. 6. Field intensity indicator.



since the 72 ohm, RG-11U, coaxial cable which had been used to feed the dipole was available, it therefore became necessary to devise a matching section which would correctly match these impedances.

The formula for a quarter wave matching section is: $Z_m = \sqrt{Z_o \times Z_a}$ where Z_m is the impedance of the matching section, Z_o is the characteristic impedance of the transmission line, and Z_a is the center impedance of the radiator. Substituting the values of Z_o, 72 ohms, and Z_a, 8 ohms, yields the result of 24 ohms for Z_m, which, luckily turns out to be a value which can be obtained quite easily. It is only necessary to parallel two pieces of 50 ohm coax, RG-8U, cut to a length of: $.66\lambda/4 = 162/f$ or 15'7¼" for the center of the ten meter band. The factor .66 is the velocity of propagation constant in the polyethylene dielectric of the coax, by which the velocity of propagation in free space must be multiplied when this cable is used, as propagation in a cable with a dielectric is slower than in air.

This section will give a perfect match for a center impedance of the radiator of 8 ohms, and values between the aforementioned limits of 4 and 16 ohms will result in a standing wave ratio on the 72 ohm line of less than two to one, which is acceptable. Incidentally the standing wave ratio on the matching section is quite high and only cable having low loss insulation, such as polyethylene, should be used. A standard *Amphenol* tee connector is used to connect the 72 ohm feeder to the two pieces of 50 ohm coax. At the top the two inner conductors and the two outer braids are paralleled and soldered to lugs on each half of the radiator; these lugs are fastened with 6-32 machine screws to clamps on the elements of the type previously described for coupling the elements.

4 lengths (12 ft.) of ½ in. o.d., .035" wall aluminum tubing
1 pc. 2 x 4—13 ft. long
1 pc. 1 x 4—8 ft. long
3 pcs. 1 x 2—4 ft. long
2 pcs. 1 x 2—8 ft. long
1 baseboard about 12 in. x 12 in. x 1 in.
3 blocks about 2 in. x 4 in. x 4 in.
2 blocks to fit bottom bearing about 2 in. x 2 in. x 2 in.
1 ½ in. pipe flange
1 1 in. pipe flange
1 1 in. nipple (short)
1 1 in. pipe cap
100 ft. of clothesline
14 ft. of ½ in. galvanized iron pipe, threaded at one end
3 1 in. pipe straps
1 screen door spring
8 #10 x ¾ in. wood screws
20 #8 x ¾ in. wood screws
18 #10 x 2 in. mach. screws
18 #10 hex. nuts
3 clothesline pulleys
1 3 in. long bolt to fit in place of pulley set screw
10 small ceramic standoff insulators
6 strap type ½ in. diameter condenser clamps
10 "U" type ½ in. diameter condenser clamps
Feeder system if needed
Matching section to suit feed system
1 pulley, about 6 in. diameter, hole to fit ½ in. pipe, with set screw
2 pcs. 2½ in. long metal tubing to force fit into or over ½ in. tubing
2 pcs. 7½ in. long metal tubing to force fit into or over ½ in. tubing
2 pcs. 4 in. long metal tubing to fit snugly into ½ in. tubing
Several feet of bare wire, about #20

Parts required to build beam antenna.

No antenna tuner is necessary with this feed system as the transmission line can be fed directly from a low impedance link of perhaps two turns, whose coupling to the final tank coil can be varied, in order to change the loading. Incidentally, the popular belief that an untuned line should not detune the final tank circuit as coupling is increased, is not true as the link itself reflects reactance back into the main winding despite the fact that its load is pure resistance, and necessitates, therefore, a change in the tuning of the final condenser in order to restore resonance. Therefore do not be misled into thinking standing waves are present by the fact that the tank condenser has to be retuned slightly as you load the final up. It should not, however, have to be adjusted too much to regain a resonant condition.

Tests have been made of the front-to-back ratio, and on a receiver several miles away the "S" meter read 50 db. above S9, when the antenna was beamed toward the receiver and S1, when the beam was pointed 180° away. This shows that the antenna is doing the job for which it was designed, as does the fact that W2NUD gets out now, whenever the band is open. If you want to squeeze every possible bit of gain out of the antenna, the element lengths can be adjusted with the use of a field strength indicator, for

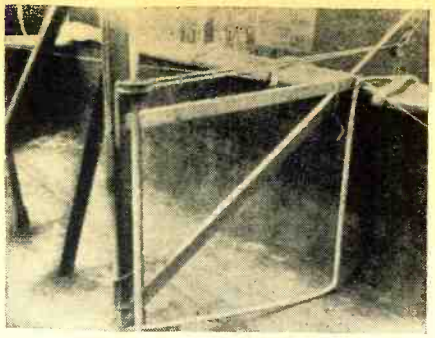


Fig. 7. Mechanical assembly of mast base.

either maximum gain in the forward direction, to put the most signal out, or for maximum front-to-back ratio, if you are interested more in rejecting unwanted received signals from the rear.

Fig. 6 outlines a simple and inexpensive field strength meter which will work nicely, if you want to experiment with element lengths by cut and try methods. However the theoretical values worked out extremely well for the author, and he is therefore content to leave the array as is for the time being at least. Perhaps when more time is available, the lengths will be set for optimum performance by means of field strength measurements.

This antenna system can be adapted for other frequencies very easily by means of the formulas given, and the method of feed can be changed to suit whatever feeders you have available. Another good combination is the familiar 600 ohm line, and a single quarter wavelength section of 75 ohm coax for matching. The new *Amphenol* twin-lead or any 300 ohm line can also be used, in which case the matching section should be a single quarter wavelength piece of 50 ohm coax. The lengths of these matching sections would also be calculated by the formula previously given as long as coaxial cable with polyethylene insulation is used; if the dielectric is some other material, then the correct velocity, which is obtainable from the manufacturer, for that material, must be used in calculating the length of the matching section. The twin-lead makes a cheaper set up if you are starting from scratch, and buying everything new; although it is only fair to warn you that some hams have experienced trouble with twin-lead when wet. The connections for 300 or 600 ohm lines are shown in Fig. 5B under alternate methods.

Many variations of the ideas presented herein are possible, utilizing the many standard feed and matching methods, if you prefer, but it is hoped that this article, containing ideas which have not previously been presented, will serve as a means of simplifying the antenna problem for other hams; and especially for those who, like the author have limited finances and lack the machine tools so often required to build the beams that have been described in the past.

—30—

You Pay Before You Play

(*Continued from page* 56)

often short circuited and blew out the location's lighting system! Frequently a customer's nickel's worth of time ran out in the middle of an exciting program, while the increasing use of commercial announcements blighted radio as a practical source of entertainment.

Coin sets, along with the rest of the radio industry, were hard hit by the tight squeeze of the depression. By 1932 midget models were being marketed, and, retailing for as low as ten dollars, made radio available to every American home. Coin radios lost their novelty appeal and faded from locations before the onslaught of the juke-box. Radio had created a craze for popular tunes, but only the coin-phonograph permitted patrons to select songs they wanted to hear *when* they wanted to hear them.

Meanwhile, during the late 1920's, competition between hotels took the form of providing increased comforts for the public, and one of these services was radio. Slot sets were generally ignored during this development, for first-rate hostelries believed that coin-in-the-slot devices would lower the tone of an establishment.

In the early days, a number of schemes were tried out to provide broadcasts for guests. Several hotels kept a stock of so-called "portable" battery sets on hand, which rented for a nominal fee. However, because of the need for battery renewals and elaborate loop antennas, plus the damages caused by guests' careless manipulation of the receivers, this renting plan proved unsatisfactory. Besides, when loud-speakers operated late at night they annoyed guests in neighboring rooms!

The result was the development of a centrally operated receiver and amplifier system wired to volume-controlled speaker outlets in each room. Operating along the lines of an intercommunication system, this "master-control" movement seems to have taken its impetus from installations of this type made by the Statler hotel chain in 1928. Rival hotel owners discovered that radio-equipped rooms offered a magnetic selling point to prospective guests, and soon hotel advertising all over the country began to feature the slogan "A Radio In Every Room." A few hotels charged guests fees ranging from twenty-five cents to a dollar a day for this service, but for the most part it was offered free. Such systems were expensive, however, and after the wave of bankruptcies, reorganizations, and foreclosures that hit the hotel field in the early 1930's, new radio installations became rare.

But just as the depression had killed off the coin radio and ruined the hotel business, so it was to foster the growth of the tourist cabin and revive

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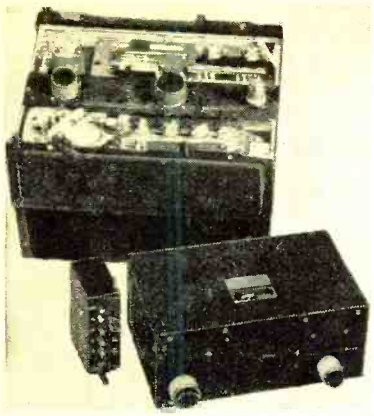

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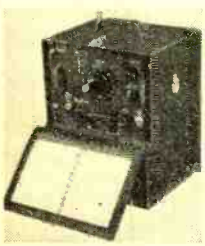

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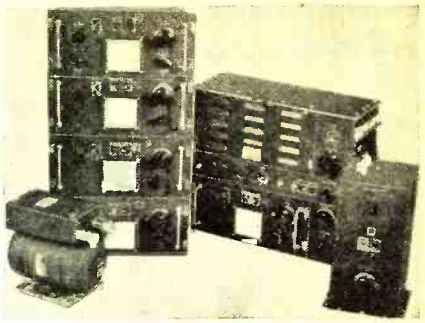

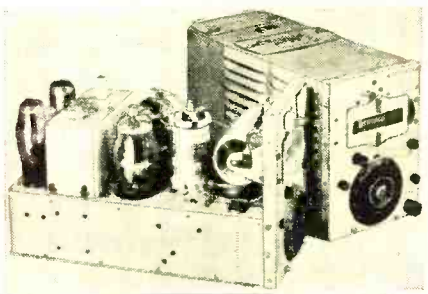

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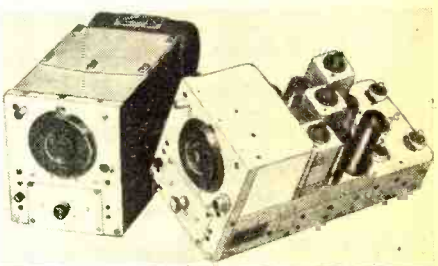

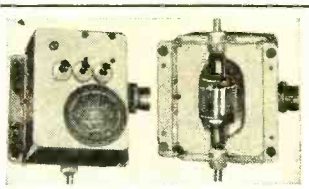

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the slot sets. Tourist courts had grown along with the auto, and by 1930 they began to flourish along transcontinental highways and on the outskirts of towns. As hard times arrived, tourists headed for these economy priced cabins, and a large portion of the hotel trade siphoned off to the "motels."

Soon the auto court was booming into a big business, and by 1935 "motels" began to compete and rival each other for trade with inner-spring mattresses, showers, etc. According to one trade legend, radios were introduced in this competition when one alert tourist court owner noticed that his guests would drive their cars alongside their cabins to listen to a favorite program on the automobile radio going full blast!

Sensing a new potential market for the forgotten coin radio, a California manufacturer dusted off the coin-in-the-slot idea and produced a model which would play for two hours when a quarter was inserted. Lacking the red-plush background of the hotels, the informal tourist courts saw nothing wrong with installing the dividend-paying coin devices, especially when guests welcomed the idea. By 1940, several thousand sets were in use, primarily in West Coast motor courts.

Over this period of time coin-radio construction had undergone many modifications, and models were no longer merely adapted for slot operation but were engineered for it. For one thing, sets had to be given durability, for it is a maxim of auto court operation that the average "motel" room takes more punishment in the way of cigarette burns and liquor stains in the course of a year than the normal home receives in a lifetime. Then the slot mechanisms on sets had to be improved, as a bent quarter would clog a coin chute and render the radio inoperative. Slug detecting devices and pick-proof locks had to be incorporated in the sets, for guests were not above that ever-present human weakness to get something for nothing and "beat the machine." Next, a system had to be devised for either bracketing the cabinets to walls, or building sets into pieces of furniture, as there were occasional instances where a guest became so "attached" to the coin radio that he took it along when he departed. This led one manufacturer to advertise in 1940 that his sets were big enough *not* to a fit in a suitcase!

With the end of the war and reconversion, coin radio production got under way again with a bang, and today more than twenty manufacturers are in the field. Benefitting from war-born improvements in technology, modern slot sets are specifically tailored for trouble-free reception to minimize service calls. The average coin radio is a 5 or 6 tube superheterodyne, housed in a sturdy steel cabinet to resist lighted cigarettes and alcohol. Its coin chute rejects slugs and bent coins, and accepts several quarters at a time to enable a patron to "bank" his quarters in order to keep the radio from shutting off at the expiration of time paid for by one coin. Sets are equipped with built-in aerials, although the steel framework of some hotels requires the use of an additional baseboard antenna. An a.c.-d.c. inverter is also necessary in large city hotels where only 110 volt d.c. power is generated.

One problem that plagues all coin-operated devices is tampering, and several slot sets are now protected by use of a heavy die-stock back plate, reinforced by a steel band riveted around the edge, and secured by a pick-proof lock. A steel dial plate is also used on the front of the cabinet to prevent access to the set through the dial opening. As an additional precaution, the coin-box, formed of hardened steel, is welded to the interior of the cabinet and fitted with a separate lock.

All these safeguards have lowered insurance rates on coin radios, and the sets are now insured against fire, theft and malicious mischief for less than a dollar a year. To illustrate the invulnerability of modern models, the story is told of one larcenous guest who made off with a slot set, its brackets, and part of the hotel room wall. After a day of vainly trying to get into the cabinet, he disgustedly dumped the set back at the hotel with a complaining note: "I can't open this thing, and I have to drop in a quarter when I want to play the radio."

Because of servicing problems, most locations have remained out of the operating end of the coin radio business, turning it over to concerns specializing in the coin field in return for a percentage of the sets' earnings. This means that the location has no capital investment tied up in receivers, no depreciation worries, no obsolescence problem when new models appear, and no insurance headaches. Under such an arrangement, the location's only obligation is to furnish the electricity that runs the radios.

Slot sets operate at varying rates in different sections of the country, ranging from a half hour for a dime to three hours for twenty-five cents. A few models employ dual coin chutes and will accept both quarters and dimes. The most widespread plan of operation calls for locations to normally receive 25% of the receipts derived by these sets under a three year agreement, plus a renewal option for an additional three year period raising the location's commission to 35%. A coin radio is expected to gross a minimum of $52 a year, and the operator installing the slot sets is privileged to remove his equipment in the event they do not average a dollar per week per unit over any three month period.

Having met public acceptance as a goodwill builder for the tourist court, the rival hotel field has lost little time in recognizing the slot set as an asset, and a means towards deriving extra day-to-day revenue from rooms. In

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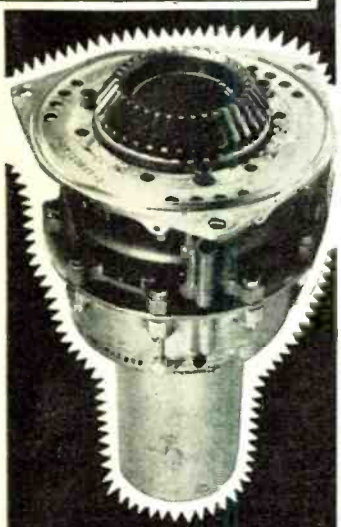

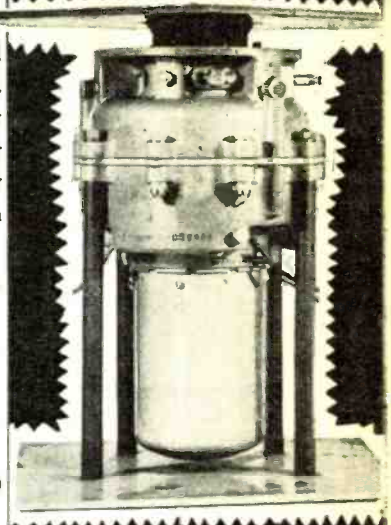

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catering to the hotel trade, cabinets have been smartly designed in several colors to blend with any room's decorative scheme. Another feature of the coin radio is acoustically modulated variable volume which is preset when a set is installed to insure that neighboring rooms will not be bothered by the nighthawk who likes to play his set at 3 a.m. A carefully planned servicing system calls for regularly scheduled coin collections, cleanings, and check-ups.

The best sites for slot sets appear to be locations with a high transiency rate, for experience with guests has indicated "the shorter their stay, the more they play." Hostelries catering to a rapid turnover of guests, such as tourist courts and commercial hotels, are regarded as the most consistent coin-catching locations, in contrast to seasonal resorts, open only for a few months of the year, and residential hotels, where permanent guests are apt to own their receivers.

General hospitals, servicing a large number of patients who stay for short periods, are potential profit-making sites for coin sets, for radio has proven the ideal antidote to boredom in bed. Hospital models feature a jack which automatically cuts out the radio speaker when in use, and permits utilization of an under-the-pillow type speaker. Developed for use in Veterans' Hospitals to replace the old style awkward headphones, the pillow-speaker enables the occupant of one bed to listen to his set while his neighbors sleep.

Latest gadget to be incorporated in the coin radio is an electric alarm clock, which can be regulated by guests. This device is designed to attract attention to the presence of the coin radio, which, in turn, provides a constant invitation to drop a quarter in its slot. Several coin radio manufacturers have FM models in the blueprint stage, while one firm has announced plans to produce a coin-operated television set, although its potentialities are at present hampered by the relatively few areas receiving video transmissions and by the limited program schedules available even there.

As the wartime flood of hotel and "motel" patronage has begun to level off, rival managements once again are vying for patronage by adding up-to-date refinements. If a guest is to make a choice between two hostelries which are otherwise equally attractive, he will tend to favor the location providing the additional comfort of a radio in his room. Thus, the pay-before-you-play radio seems destined to become a standard fixture in the traveler's home-away-from-home.

In seeking new markets for its output, the American radio industry is setting its sight on the coin-operated set. Conservative estimates forecast the sale of a million coin models for hotel, tourist camp, hospital, club and restaurant locations, besides creating a brand new radio servicing business potential. In addition, Canada and

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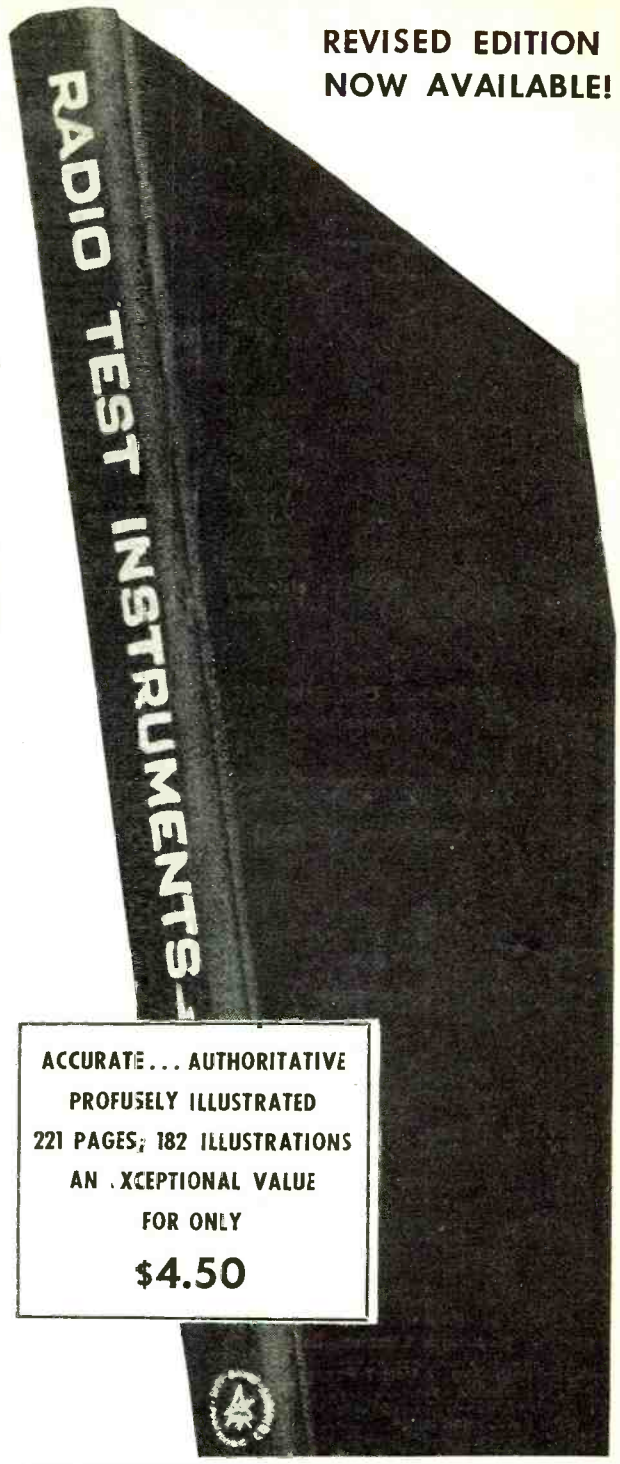

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Alignment of TV Receivers

(*Continued from page* 65)

cuits. Before proceeding, it is important not only to know the end result required, but also something of the behavior of the circuits involved.

One of the most common and effective methods of obtaining broad amplifier selectivity in r.f. and i.f. circuits is to employ the conventional double tuned over-coupled transformer. The coupling coefficient commonly used in video, r.f. and i.f. transformers is adjusted so that the amplitude vs. frequency characteristic just begins to show a double peaked response. Since the television receiver consists of many such transformers, each stage must be adjusted in such a way that the over-all response characteristic, which is a product of all individual stage responses, approximates as closely as possible the ideal curve. Standard practice requires that the video carrier frequency be down 6 db. or 50% of mid-band amplification and that video response to the accompanying sound carrier be in the order of minus 40 db. (voltage) or more. In practice, peaks and troughs in the selectivity curve will result. It is usually considered satisfactory to adjust the over-all response curve so that the troughs, or minimum response points within the bandpass are never less than about 70% of peak values.

Extreme peaks may be caused by regeneration or undesired oscillations in the receiver under test, however, in commercial units or completed designs, they are most likely due to improper alignment. To illustrate how improper tuning may cause an improper selectivity curve, let us observe some fundamental facts about over-coupled, double-tuned coupling. Fig. 4 shows how the conventional double-tuned r.f. transformer is affected by various conditions of coupling and tuning. Curves 1, 2, 3 of Fig. 4 indicate the effect of varying coefficient of coupling between the coils. As the coupling is increased beyond a critical point, the well known double peaked curve appears, and, assuming that L_p, C_p and L_s, C_s are tuned to the same frequency, the peaks will be almost equal in amplitude and quite symmetrical. In the usual designs, television circuit couplings are adjusted so that they exhibit the double peaked characteristic to varying degrees. Unfortunately, in the over-coupled circuit, particularly where heavy damping is used, it is difficult to obtain the correct response characteristic so important in the television receiver, unless tuning is done carefully and with a knowledge of the behavior of the circuits being aligned. Fig. 4B shows effects of improper tuning of the transformer. In this case, where the secondary is heavily loaded, the stronger peaks will follow the tuning of the primary, or in other words, if the resonant frequency of L_pC_p is lower than L_sC_s then the stronger peak will be the lower frequency peak. Conversely, if L_pC_p is tuned higher in frequency than L_sC_s, the stronger peak will be on the high frequency end of the bandpass. The effect of mistuning will be determined by the type of loading, and the usual methods of damping may be either damping both primary and secondary equally or loading down the secondary coil alone. The latter method is most commonly used. Where both primary and secondary are loaded equally, (equal Q's) the effect of asymmetry due to mistuning will not be as pronounced. Note that the effect of mistuning is similar to increasing the coefficient of coupling between the coils.

Improper tuning may result in non-symmetrical peaks of unusually wide separation. If an amplifier, designed for reasonably flat response over a given bandwidth exhibits widely separated peaks with a deep trough in the center, one may suspect that the transformers are badly mistuned. The effect of mistuning is that the *effective coefficient of coupling* is increased in proportion to the degree of mistuning. The family of curves in Fig. 4B shows the effect on the frequency vs. amplitude response curve of a double-tuned transformer as the primary and secondary circuits are tuned correctly (curve 1) then tuning the primary to a higher frequency, (curves 2, 3), etc. In this case, the damping resistor or load is mainly on the secondary coil. Note how the asymmetry and width of the curve increases as the mistuning is increased. The effect shown in Fig. 4B is very useful in providing information as to the degree of mistuning in the particular circuit under test. The experimenter can tell by observing the selectivity curve, just in what direction adjustments shall be made.

Alignment of a Typical Television Receiver

The most important section of the television receiver as far as determination of its selectivity or bandpass characteristic is the i.f. amplifier. The quickest and most accurate way of aligning its many tuned circuits is by visual means. The procedure, although in many ways similar to methods used in aligning a broadcast or communication receiver, requires, if the job is to be done properly, an oscilloscope, a wide-band FM or sweep generator, and a calibrated wavemeter or an ordinary signal generator. The latter equipment is used as a frequency marker, which will be found necessary if quantitative measurements are to be made directly on the cathode-ray tube screen. This so-called marker may be

provided as part of the sweep generator or may have to be supplied as auxiliary equipment. Its function is to superimpose on the visual alignment trace a small "pip" or notch which indicates the frequency at any point on the curve. The visual alignment curve is merely an electronically drawn graph, with a marker to indicate the frequency at any point along its horizontal axis. Amplitude or gain measurements on the graph may be made directly.

The setup for alignment of the television receiver is indicated in Fig. 5. The sweep generator is first connected to the last i.f. grid and its output and frequency adjusted so that the uneven trace appears on the scope. Observation of the first trace will indicate the necessary adjustments to be made. A thorough understanding of the behavior of the circuits involved is useful here but not completely necessary as a few adjustments while observing the visual trace will indicate the effect of tuning. If errors are made in early adjustments, they may be compensated for later by an over-all "touch-up."

The usual procedure in i.f. alignment is to tune and check each stage starting from the output i.f. amplifier and working "backwards" toward the front end of the receiver. The important points to check on the resultant over-all curve are the video carrier, i.f. frequencies, sound i.f. frequency and any irregularities that may appear. The picture i.f. carrier frequency should correspond to the 50% response point on the high frequency side of the bandpass and the sound traps incorporated in the video amplifier should be tuned so that the trace shows a marked dip at the sound i.f. carrier frequency. The relation between the peaks and troughs within the bandpass should be such that the amplification is never less than about 70% of maximum. Excessive peak amplitudes are usually due to improper tuning, however, as mentioned previously, any tendency toward regeneration may cause excessive amplification at one particular frequency and introduce a very strong peak. Sometimes improper connection of the sweep generator output lead may cause regeneration or oscillation that ordinarily is not present and may lead to erroneous results. It is always desirable to connect the "hot" output lead directly to the circuit with as short a lead as possible and to connect the ground side of the output cable to a point close to the ground return of that stage.

After a trial alignment test has been carried out on the i.f. amplifier, it is well to check the over-all response curve as indicated on the scope thoroughly as to amplitude vs. frequency measurements. Always adjust the horizontal sweep width and the sweep generator output so that the visual trace is centered and covers a good portion of the screen. To measure frequencies along the trace, the frequency marker generator is put into use. The

marker generator is tuned to desired points of measurement within the bandpass of the trace and set so that a small "pip" appears. This "pip" will travel along the curve as the marker generator frequency is changed. Sometimes a calibrated absorption type of wave trap coupled to the sweep oscillator of the sweep generator is used as a marker. This type of marker will produce a small notch in the visual curve at whatever frequency it is tuned to, provided that it is within the bandpass of the amplifier under test.

At certain points, particularly at video carrier frequency, sound frequency, etc. on the curve, amplifier gain measurements should be made. To do this the deflection sensitivity of the scope in volts/in. should be known, and a scale used directly on the cathode-ray tube face.

The gain of the amplifier will be proportional to the height of the curve provided, of course, that the amplifiers of the scope and/or receiver are not being overloaded. Amplitude measurements are made from the top of the curve to bottom, however, it will be noticed that the axis or location of the curve in a vertical direction will change as the shape of the curve changes due to tuning adjustment. This is because the axis of the trace is actually an imaginary line extending through what might be considered the average amplitude of the vertical deflection voltage. For example, when a sinusoidal waveform is observed on the oscilloscope, its axis is considered to be a line right at the center of the curve. When the curve is not symmetrical, the curve may move up or down with respect to its axis, depending upon its shape. The effect as far as the visual alignment curve is concerned is that the curve will change its vertical position as its shape is changed but this effect should be considered apart from that due to the actual amplifier characteristic, and amplitude measurements made on the actual height of the curve regardless of position.

In Fig. 5, it is shown that the receiver output is always taken from the 2nd. detector load resistor and then applied to the scope deflection terminals. This is important since the fluctuating voltage which provides vertical deflection of the visual trace is actually a d.c. component varying in proportion to the gain of the amplifier and not the input r.f. voltage that is

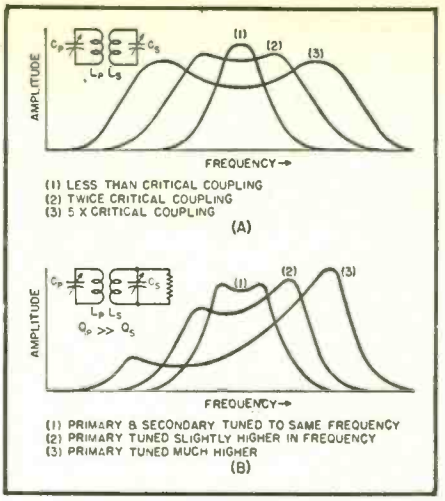


Fig. 4. Wave forms obtained by varying the coefficient of coupling (A) and the effects of mistuning on bandpass circuit (B).

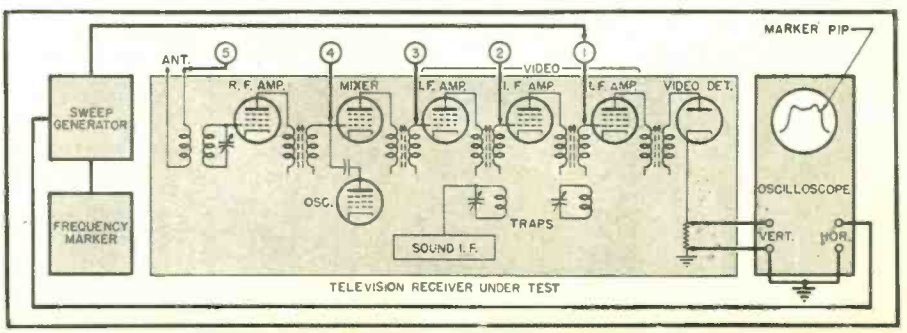
applied to the amplifier. It is interesting to note that if this connection were made directly to deflection plates of the scope without any intervening amplifiers, the d.c. level of the vertical signal voltage would remain constant and the axis of the trace would remain steady regardless of tuning adjustments. This is a desirable property in a visual alignment setup but not entirely necessary.

After the i.f. amplifier has been correctly adjusted, tuning of the circuits ahead of the r.f. and mixer stages is in order. The procedure is quite similar although perhaps not as exacting. Usually the front end circuits are designed to pass a band of about 5 or 6 mc. in width so that the picture and sound carriers are situated within the front end response curve. Front end circuits should be tuned so that they do not materially change the shape of the over-all i.f. curve but merely increase the gain of the receiver as a whole.

Final Adjustment

After alignment has been completed the best check is to tune in on a local broadcaster, preferably when the standard test pattern is being transmitted. Observation of the standard test pattern will usually show up any effects of improper alignment, assuming of course that the other sections of the receiver are performing properly. If the set has been properly

Fig. 5. Visual alignment of a typical television receiver.



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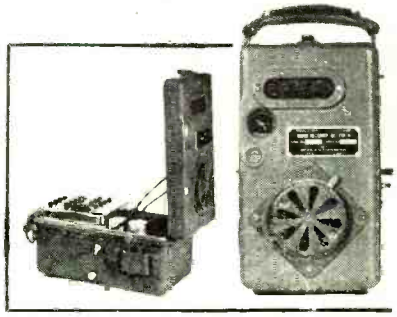

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- Single Band Super-Heterodyne
- Broadcast Band 540 to 1650 K.C.
- Automatic Volume Control
- Super Sensitive Iron Core Transformers
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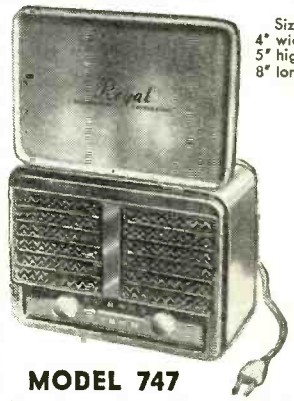

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aligned a clear and stable pattern will result. Picture definition may be determined by observing the vertical "wedge" lines particularly where they converge and meet the "bulls-eye" in the center of the pattern. In high quality receivers it should be possible to resolve the individual lines until they almost meet the pattern center circle. This indicates that the receiver is capable of reproducing a video band of at least 4 mc. in width. The pattern should also be observed for its signal-to-noise ratio, and contrast. Poor contrast or "flat" pictures accompanied by "snow" (noise) may indicate poor sensitivity due to improper r.f. alignment or improper shaping of the i.f. curve. For example, if the receiver amplitude response is much less than 50% at the video carrier frequency, the effect will be the same as if reception is attempted on a very weak station. Receiver noise will become comparable with the signal and a weak video signal will be applied to the picture tube. On the other hand, situating the picture carrier too far "up" the selectivity curve will result in excessive contrast and poor picture definition.

Usually an improvement in picture quality may be made by a final adjustment on the receiver local oscillator. After the set has been aligned and placed into operation, and tuned to a test pattern of a local station, the fine tuning control should be tuned carefully for optimum picture quality. As stated before, this condition will be obtained when the picture carrier is situated around the "50% point" of the receiver response curve. The actual best location for the video carrier may vary somewhat and is therefore best determined by tuning the local oscillator until the pattern appears at its best. After this operation is carried out, it may be found that the accompanying sound is slightly off tune. This is remedied by retuning the discriminator and sound i.f. circuits. It will be found that as experience is gained in i.f. front end alignment and adjustment of the local oscillator made more accurately, final "touch-up" adjustments will rarely be necessary. —30—

HUDSON DIVISION CONVENTION

THE Hudson Division ARRL Convention will be held in Asbury Park, New Jersey on September 26, 27, and 28. This gathering is being sponsored by the Jersey Shore Amateur Radio Association and the Monmouth County Amateur Radio Association.

An elaborate program including technical talks, social activities, and trips has been planned for the hams in attendance while special features have been included on the schedule for the XYL's and YL's at the convention.

Tickets are $3.50 each for the three-day convention and $4.00 for the banquet. Banquet reservations are limited to the first 500 applications for tickets received. Tickets and further information about this convention may be obtained from M. Krause, Jr., W2HKY, 135 Bridge Street, Red Bank, New Jersey.

—30—

Transformer Design

(*Continued from page 60*)

Then $\frac{NI}{l} = \frac{2700 \times .054}{6} = \frac{146}{6} = 24.3$

And from Fig. 9** if $\frac{NI}{l} = 24.3$

then $\frac{LI^2}{V} = 0.5 \times 10^{-2} = .005$

By transposition if $\frac{LI^2}{V} = .005$ then

$L = \frac{.005\,V}{I^2}$ (V = 6 cu. in.), or

$L = \frac{.005 \times 6}{.054^2} = 10.3$ henrys (primary inductance).

Therefore this design is satisfactory.

In Fig. 12** we see that when $NI/l = 24.3$ the paper gap in the core should be about .0015" thick.

Audio Output Transformer

Here let us assume that our audio amplifier employs the same output tubes as used in the modulator described before, which means that the following conditions exist:

Output tubes—P.P. pentodes (10,000 ohm load)

Plate Current—60 ma. for each tube

Output Watts—75

Lowest Frequency—150 cycles (voice frequencies)

Required Primary Inductance—10 hy.

Here we have the same primary circuit requirements which existed when we designed the previous modulation transformer. Therefore, we can use the same core size and primary winding.

Assume that at times this amplifier will feed into a 500 ohm line and that at other times it will drive a loud-

ASBESTOS PAD IN SERVICE KIT

AN asbestos pad of the type shown takes but little space in the tool kit or on the work bench and will be found very useful when soldering.

The iron may be placed directly on the pad or the pad may be used between the iron barrel and the radio cabinet when soldering with the chassis in place, to prevent damage to the cabinet. . . . . H. L.

speaker having an 8 ohm voice coil. Then two secondary windings will be needed; one for a 500 ohm load and one for an 8 ohm load.

$$\text{Turns ratio} = \sqrt{\frac{10{,}000}{500}} = \sqrt{20} =$$

4.47 for 500 ohm winding, and

$$\text{Turns ratio} = \sqrt{\frac{10{,}000}{8}} = \sqrt{1250} =$$

35.3 for 8 ohm winding.

With 2700 turns in the primary we find that the 500 ohm winding must have 2700/4.47 = 604 turns. Similarly, the 8 ohm winding must have 2700/35.3 = 76.5 turns (use 77 turns).

Now, we want to be able to put the full 7.5 watt output either into the 500 ohm load or into the 8 ohm load. Then, the wire used in each of these secondary windings must be heavy enough to carry such current. At 7.5 watts, the current in the 500 ohm winding is:

$W = I^2Z$

Then: $I^2 = \frac{W}{Z}$

And $I = \sqrt{\frac{W}{Z}}$

$$I = \sqrt{\frac{7.5}{500}} = \sqrt{.015} = 0.122 \text{ amp.}$$

or 122 ma. and the current in the 8 ohm winding is:

$$I = \sqrt{\frac{W}{Z}} = \sqrt{\frac{7.5}{8}} = \sqrt{.937} = 0.968$$

amp.

Fig. 5* indicates that the 500 ohm winding must be wound with No. 30 wire to carry 0.122 amp. and the 8 ohm winding must have at least a No. 22 wire to carry 0.968 amp.

The coil size calculation shows a build of 83 per-cent which is satisfactory.

Since the only direct current is in the primary winding where it flows in opposite direction in each half of the coil, the core does not have to have a gap. The laminations can be interleaved as in a power transformer core. Thus our design is a follows:

Core 1" iron 1" stack—laminations interleaved

Primary—2700 turns No. 33 wire, center tapped

500 ohm winding—604 turns No. 30 wire

8 ohm secondary—77 turns No. 22 wire

Only one secondary is to be used at one time.

Practical Hints

When the approximate specifications of a transformer are known, it is a simple matter to determine its construction in more accurate detail.

COMBINATION VOLTMETER AND SAFETY BLEEDER FOR TRANSMITTER POWER SUPPLY

By GUY E. DEXTER

HIGH-VOLTAGE transmitter power supplies should be metered. They *must* have bleeder resistors. The latter is an imperative safety requirement; the first a distinct advantage to efficient operating. The meter keeps the operator constantly aware of the actual value of d. c. voltage delivered to the transmitter and warns quickly of breakdowns, while the bleeder removes dangerous charges from the filter capacitors when the power unit has been switched off.

Both devices can be combined into a single unit, without the usual expense of a kilovoltmeter, as shown in the accompanying schematic. Here, a d. c. milliammeter is converted into a kilovoltmeter simply by connecting it in series with the bleeder resistor which then acts as the meter multiplier. It is necessary only to select the proper combination of resistance and milliammeter range to give the desired kilovolt deflection.

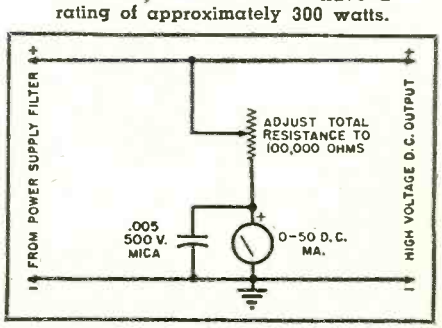
A good universal combination is a 100,000-ohm, 200 to 300-watt wirewound resistor and a 0-50 d. c. milliammeter. If the resistor is selected carefully (or closely adjusted by means of its slider) for an exact resistance of 100,000 ohms, this combination provides an accurate 0-5000 d. c. voltmeter. The meter practically is direct-reading—simply add two ciphers mentally to the meter indications. Most milliammeters have 50 scale divisions, each of these corresponding to 100 volts. The smallest accurately readable deflection (½ scale division) would be 50 volts.

The values shown in the diagram for this voltmeter-bleeder combination are suitable for all power supplies in the 1500 to 5000 volt range. The same meter and bleeder may, of course, be used all the way down to 100 volts, however all voltages lower than 2500 will fall proportionately in the lower half of the meter scale. A more satisfactory combination for voltages of 1500 and less is a 0-20 d. c. milliammeter and 100,000-ohm resistor. This will provide a 0-2000-volt scale.

A higher-resistance bleeder would, unquestionably, permit a lower range milliammeter to be used and would reduce the amount of extra current which must be delivered to the measuring-bleeding circuit. But larger resistances slow down the filter capacitor discharge so markedly as to introduce a hazard to the operator. For this reason, a 1000-ohms-per-volt combination, for example, is out of the question.

—30—

Wiring diagram of combination safety bleeder and high-voltage voltmeter. Bleeder should have a rating of approximately 300 watts.



After this has been done, it is then possible to know how that unit may be used for different applications or how, by slight modification, it can be made to perform an entirely different function.

Suppose that a combination plate and filament power transformer is at hand which has 2.5 volt filament windings. It is a relatively simple job to remove the coil from the core and to remove the 2.5 volt filament windings. In a power transformer of this type, the filament windings are always on the outside of the coil. They are wound after all of the other windings have been completed and they consist of only a few turns. Assume that the 2.5 volt windings consisted of 5 turns of wire and that one wishes to replace them with 6.3 volt windings to operate modern tubes. Then 5 turns/2.5 volts = 2 turns per volt. Then the new 6.3 volt windings would have 2 x 6.3 = 12.6 turns (use 13 turns). In this way, by thus determining the "turns per volt" in a transformer, one can replace any windings with new ones for different voltage output. It is not necessary to wind extra turns here for higher open circuit voltage to compensate for regulation because that was done when the transformer was originally designed for 2.5 volts. Now, if one of the old 2.5 volt windings had been wound with No. 19 wire, one could see in Fig. 5 * that it had been designed to supply 2.5 volts at 2 amperes (No. 19 wire will carry 2 amperes). Then 2.5 volts x 2 amps = 5.0 v.a. This means that the new 6.3 volt winding which is to replace the old winding could also deliver 5.0 v.a. or 6.3 volts at 0.795 amp. (6.3 x 0.795 = 5.0 v.a. For the current of 0.795 ampere No. 23 wire could be used.

Many times it is not desirable to remove any winding in a power transformer to determine the "turns per volt." Frequently, this information can be obtained without even removing the coil from the core. The procedure is as follows:

Wind 10 or 15 turns of light insulated wire around the center leg of the core at one end of the coil. These few turns will fit into the space between the end of the coil and the core. Now, apply the proper a.c. voltage to the primary and measure the open circuit voltage developed across the temporary winding. Then, "turns per volt" is equal to:

$$\frac{\text{Number of turns in temporary winding}}{\text{Voltage across temporary winding}}$$

Assume that a plate transformer is available which can supply plate voltage at 500 v.a. Also assume that one intends to draw only 480 v.a. of plate power from it and that it does not have any filament winding secondaries. It would then not be necessary to use a separate filament transformer to operate some of the tubes in the equipment. One could add a filament winding to this plate transformer because it is able to supply 20 v.a. more power. Thus, a 6.3 volt winding might

LAMINATION SIZE	AUDIO POWER (in watts)
½"	1.0
¾"	3.0
1"	5.0
1⅛"	10.0
1¼"	20.0
1½"	30.0
1¾"	60.0
2"	100.0
2½"	250.0
3"	500.0

Fig. 17. Approximate lamination size for audio transformers to handle various amounts of audio power.

be added to deliver 3.17 amps. (6.3 volts x 3.17 amps. = 20 v.a.).

The wire would not have to be removed from the coil to add the new winding. It is only necessary to find the "turns per volt" by the method shown above. Then, the new filament winding could be wound in the space at the end of the coil. For 3.17 amps. No. 17 wire could be used. Instead of using enameled wire for this winding, use insulated wire of the type used for lead wire (silk or cotton covered). Use enough turns to give 1.08 x 6.3 = 6.8 volts open circuit to provide 6.3 volts under load. A good amount of extra insulation should be employed to insulate this winding from the coil and core. Insulate for twice the highest voltage in the transformer, plus 1000 volts.

The procedure described above to find the "turns per volt" in a power transformer can be applied to find the number of turns in the windings of an audio transformer as well. When checking an audio transformer, it is well to use as many turns as possible in the temporary winding. Apply about 2 volts a.c. to the temporary winding and measure the voltages developed across the various windings in the transformer. Then, since the "turns per volt" in the temporary winding is known, the number of turns in the other windings may be calculated. After the number of turns in each winding is known, one can then find the impedance ratio and primary inductance.

For example, assume that an output transformer of unknown characteristics is to be analyzed. Also, assume that a temporary winding has been inserted which has 20 turns. Suppose that, when 2 volts a.c. was applied to this winding, voltages across the two transformer windings were 6 volts and 200 volts. Because 2 volts was applied across 20 turns in the temporary winding, "turns per volt" = 20/2 = 10. Now, this means that there are ten turns for each volt in the other two windings. Therefore, the first winding has 10 x 6 or 60 turns and the second winding has 10 x 200 = 2000 turns. (The above voltage measurements should be made with a relatively high resistance voltmeter). Since the transformer has a winding of 2000 turns and one of 60 turns, the turns ratio = 2000/60 = 33.3. The impedance matching ratio is equal to the turns ratio squared. Therefore, for this transformer, the impedance ratio is 33.3^2 or 1115, approximately. Because the impedance ratio is 1115, the impedance reflected into the primary will be 1115 times the load connected to the 60 turn secondary. Thus, if 2 ohms is connected across the secondary, the reflected primary impedance will be 1115 x 2 = 2230 ohms.

Suppose a load of 6 ohms were used. Then the primary impedance is 1115 x 6 = 6690 ohms. Here the question arises, "What impedances are correct for this unit?" To solve this problem it is necessary to make some primary inductance calculations. First, we might find out if it could be used to match a tube such as a 2A3 tube to a speaker voice coil. The 2A3 tube draws about 60 ma. plate current and requires a load of about 2500 ohms. This transformer with an impedance ratio of 1115 would reflect 2230 ohms from a 2 ohm speaker and about 2700 ohms from a 2.5 ohm speaker. Either of these values would be satisfactory for a 2A3 tube if the primary inductance is proper for that tube.

Fig. 16 shows that at 50 cycles a triode with 2500 ohms load requires primary inductance of about 10 henrys. Now, with all factors at hand, the primary inductance may be calculated and if it is found to be 10 henrys or more it can be used with a 2A3 tube. Of course, the primary wire size must be able to carry 60 ma.

When the number of turns of wire in each winding has been determined it is then possible to find out what the wire sizes are. There are two ways to do this. One method is to remove the outer wrapper of the coil and measure the diameter of the wire near where it is soldered to the leads. The other method is based on the fact that sometimes the leads coming out of the coil are merely the ends of the wire of the winding. This is only true if the wire size is about No. 27 or larger because smaller wire is not strong enough mechanically to be used for leads. Frequently, an output transformer is constructed with about No. 25 or larger wire for the secondary and the ends serve as leads. In this case, if there are only two windings in the coil, you could measure the secondary wire size and calculate the size of primary wire. Now, if it were found that the coil had 2000 turns in the primary with 60 turns in the secondary and measurement showed the secondary to be No. 24 wire, a wire size could be assumed for the primary and calculate the size of the coil. The calculation showing the largest coil size that would fit into that core would indicate the correct primary wire size. Obviously, it is necessary to know the primary wire size in an output transformer to be certain that it will carry the tube plate current. (Wire sizes are measured with a micrometer caliper.)

When the number of turns in a filter choke have been found by the method described, using a temporary winding, its inductance may be calculated with various assumed values of

direct current. However, one must determine the wire size used in the choke to know what maximum direct current can be allowed to flow in it. To do this, assume a wire size and calculate the coil size for a maximum of 85 per-cent build.

The following notes will help in analyzing an unknown audio transformer:

1. If there is a gap in the core, the unit must have been designed to have d.c. in one or more of the windings. This means that it is to work from a single output tube if the primary is not center tapped, or that it might be an output transformer for push-pull Class "B" tubes, or that it is a modulation transformer.

2. If the core is "interleaved," it was designed to have no d.c. saturation. This means that it might be a line-to-line transformer or a line-to-grid transformer, or a line-to-voice coil transformer, or be for push-pull class "A" or "A_1" tubes.

3. The number of turns in the windings can be taken as a rough indication of the impedance each winding was intended to match.

NO. OF TURNS IN WINDING	IMPEDANCE
10—100	1 to 16 ohms, approx.
200—800	100 to 600 ohms, approx.
1000—4000	1000 to 20,000 ohms, approx.

4. An "output" tube-to-voice coil transformer" can be easily changed to match a different voice coil impedance. The secondary winding is usually wound over the primary and consists of only a few turns which can be removed and replaced with the desired number of turns.

The design data given throughout this entire discussion is quite conservative and is intentionally so. This was done to provide information for designing and constructing transformers of good quality.

—30—

TESTING VOICE COIL CENTERING

CENTERING of the speaker voice coil may be checked by pressing in on the cone with the finger tips—then releasing the pressure but still keeping the fingers in contact with the cone.

Ordinarily a scraping sound will be heard if the voice coil is striking the pole pieces and in many cases such scraping will be felt by the fingers. H. L.

International Short-Wave

(*Continued from page* 96)

view of the insignificant power of our transmitter, short-wave radiations of Radio Clube de Cabo-Verde are especially to Portuguese listeners in Cape Verde Islands and Portuguese Guinea, so are only in the Portuguese language." With call of CR4AA, 6.024 (49.8 m.), this station is scheduled 1530-1700; QRA, Radio Clube de Cabo-Verde, Praia, Cape Verde Islands. "We shall send verifications of our transmissions to all listeners who will give us their reports—by letter in Portuguese, French, or *English* language."

Celebes—Call of Makassar on 9.357.5 (listed) is YFA4; on 5.060 call is YFA10. (NNRC) Signal of 9.357.5 (actually 9.365) is improving on West Coast. (Dilg) *English* period runs 0800-0900. (Gray) This is probably on Mon., Wed., Fri. *only*.

China—Detailed program schedules of XGOY and XGOA have been received via airmail by Paul Kary. XGOA, Nanking, operates on 15.35 and 9.73 for its "morning service" (beamed to North America), 2000-2300, with news at 2110, 2230, news commentary at 2140. The "evening service" on 11.835 runs 0400-1000, news at 0520, 0900, news commentary at 0600, and talks at 0410, 0840; 9.730 is scheduled to parallel at 0800 and 0915 (probably is used most of the transmitting period.)

XGOY beams to Australia, New Zealand, and East Asia on 11.913, 0355-0530; no *English* listed except has "The Baltimore Gospel Hour" at 0430-0530 on Sundays and "Back to the Bible" at 0500-0530 Saturdays. To East Asia and South Seas, 9.658 and 7.153, news at 0600, 0630; has "Sermons in Song" on Wednesdays at 0635. To North America and Europe on 15.170 (appears as high as 15.175) and 7.153, 0745-1050, news at 0800, 0900 (Foreign Ministry messages on Sundays), 1000; presents religious program, "Bringing Christ to the Nations" at 0830-0900 Sundays.

XGOY's 15.175 channel is heard here in West Virginia *only* on Sundays, around 0745-0900, when is buried by Guatemala; on weekdays, Guatemala's powerful signal on 15.17 precludes hearing XGOY. A good signal is usually heard on the 11.913 frequency around 0500-0530 sign-off; at close, asks for reports and gives Chungking (summertime) as 6:30 p.m.

The *English* newscast carried by Chinese stations at 0800 appears now to originate in Nanking rather than with XGOY as formerly. (Dilg)

XGNC, 6.025 (formerly 6.045), heard mornings on West Coast; apparently is call of former Kalgan station. (Baxter)

XMAG, Nanking, informs Paul Dilg is operating *only* on 4.275. Other frequencies on which it is heard appear to be a harmonic.

XMTA, 12.215, is "The Voice of the Chinese Air Force" in Nanking; is *not* affiliated with the Central Broadcasting Administration; established not long ago. (Kary)

XOPD, after much wandering, has settled down on old frequency of 9.555. (Baxter) Good signals on West Coast; location is Hangchow. (Dilg)

XRRA, Peiping, is back on 10.260, mornings, after a brief stay on 15.130; signs off at 1000. (Baxter) Does *not* carry 0800 Nanking news. (Dilg)

VGOUS, 9.123, Nanking, announced as XOL2; "has several harmonics on various frequencies." (Baxter, Dilg)

Czechoslovakia — Prague's OLR5A, 15.230, is being heard to North America (in *English,* Czech, Slovak), daily 1800-1900; news at 1835. (Sutton)

English periods to Europe are one hour earlier during summer—at 1245 on 9.55; at 1445 on 6.010. Later announcements said news would be given also at 1645. (Pearce)

Denmark—Radio Danmark, 15.320, Copenhagen, is heard in Britain on Sundays from 0700. (Pearce)

Ecuador—On June 26, HCJB, Quito, presented a special program for the International Short Wave Club, London, and other listeners, on 15.115, 12.455, 9.958, 6.240; reports are being verified from Casilla 691, Quito, Ecuador, South America.

Egypt—SUX, 7.860, Cairo, scheduled 1400-1920. (ISWC)

Falkland Islands—Stanley, 3.440, 30 watts, scheduled Sundays at 1500; educational programs, Monday through Friday, 1300-1400; hopes to have new equipment soon.

France—New Paris schedules to North America are 1700-1715 (news and commentary at start) on 17.85, 15.35, 15.24; and 1915-2015 (news at start) on 15.35, 11.845, 9.55. The former 2100-2245 transmission is now *off*; also the 2300-2345 period on 15.24, 11.845. (Balbi)

French Indo-China—Radio Saigon's 11.78 is still heard at 0500 in East with news. (Ferguson) Letterbox is at 0550 on Friday. The 6.190 frequency is heard well in New Zealand. (Gray)

The station on 7.530 has been definitely identified as *Radio Dalat;* schedule varies, usually is around 0715-0845 close down. Hanoi's 9.645, heard to 0700 sign-off with "La Marseillaise." (Baxter) Frequency varies, 9.460-9.468. (Dilg)

Germany—Miers, Berlin, lists present German s.w. stations as Berlin, 6.030; Berlin, 6.070; Baden-Baden, 6.327 (Sudwestfunk); Leipzig, 9.730; and Hamburg, 6.003 (the Hamburg station, however, is reported by other sources as on 6.115).

In verifying, Baden-Baden stated they used 1 kw. power. (Gray)

Leipzig's 9.73 now signs *on* at 2200. (Beck)

AFN, 6.080, Frankfurt, now signs *off* at 1900; announces, "This is AFN, serving the armed forces in the European Theater"; announces long- and medium-wave transmitters in Frankfurt, Bremen, Bremerhaven, Berlin, Munich-Stuttgart; gives a 20-hour schedule of 1100-1900; last feature is musical program called "Midnight in Frankfurt," 1700-1900. (Beach)

Gold Coast—Accra, 7.299, is heard in South Africa at 1230; news at 1245; signs off at 1300; announces 4.915 in parallel, but this one is not heard due to Lourenco Marques on same channel. (Laubscher)

Greece—Paul Kary, Pennsylvania, received this information on the Greek transmitters from Cable and Wireless, Ltd., operators: "Actually, we use the same transmitter or type of transmitter (same as SVM, 9.935) for the SVD-2 broadcasts on 7.295, but whereas SVM has a six-element broadside array antenna, SVD-2 is using a temporary folded dipole, as our third 200-ft. mast has not yet been re-erected. (All three 200-ft. masts were destroyed by the Germans when they left.) The three transmitters are Marconi SWB-10's, using two water-cooled CAT-9 valves in the final stage; the power into the antenna can be 27 kw. on telegraphy, or 7 kw. on telephony. *The 7.295 transmission by the Greek Government has now ceased owing to QRM on that allocation, and they are now awaiting an allocation on the 30-m. band."*

According to NNRC, SVR, 14.420, Athens, is heard on this new frequency calling U.S.; also said they had SVT on 15.010 but could not use that day.

Guatemala—TG2, 6.620, Guatemala City, has been heard in Britain at 1910 with news items interspersed with few bars of "Stars and Stripes Forever"; gave call as "Radio Morse." (Short Wave News)

"La Voz de Quezaltenango" signs off at 2215 on new frequency of 6.900. (NNRC)

Holland — "News of the Netherlands" (in *English*) is scheduled *except Sundays,* 2300 on 11.73, 9.59, 6.02 to North America; at 0430 on 17.17, 15.22, 6.02 to the Pacific Area; at 1300 on 11.73, 9.59, 6.02 to Europe and South Africa; and 1730 on 11.73, 9.59, 6.02 to South America.

India—Delhi's 21.510 has been heard in Ohio signing on at 0900; also heard with weak signal at 2330. (Sutton) Have heard this one in West Virginia carrying the 0730 news.

Ireland—The Irish Radio Service is establishing a new short-wave station; purpose announced to bring to the peoples of the world "an everyday story of the new Ireland speaking with its own voice"; programs to consist of music, talks, and news. (Gillett, Australia) *Watch for this one!*

Radio Eirrean's 9.595 is being heard again around 1610-1630, news at about 1620; announce this as their third transmission and ask for reports from North America to Radio Eirrean, Chrysler Bldg., New York 17; station has fair signal but heavy QRM in Maine; in New York signal is poor; certainly is *not* the 100-kw. job promised! (Beach, Beck)

Japan—WLKS, 2.465, Kure, British Occupation Forces Station, runs to

0900 Saturdays. (URDXC) Normal schedule is 0300-0730; on 6.105, schedule is 1630-1800, 2100-0500. (Harrison)

JO8C, 6.005, Sapporo, runs 1530-2000, 2030-0900. (URDXC)

Java—"Voice of Free Indonesia," 11.001, has been heard in New York with *English* at 1100-1130; call given as YHM (some sources list it as YHN); good signal. (Casey)

Radio Batavia beams a program in *English* to the U. S. *daily* on 11.440, 0930-1000. (Stark) Paralleling in this transmission is 15.140 (possibly as high as 15.145) to Australia and Malaya. (Dilg, Balbi, Baxter) The 15.145 channel has been heard earlier than 0930. (Dilg) The 11.440 one replaced 9.415, used in first tests. (Baxter)

"The Official Radio Station of Batavia" is using about 9.688 from before 0645 to after 1015 fade-out; mostly music; *English* heard some days at 0730-0800. (Stark) Has good signal here in West Virginia some mornings. Balbi lists this station on 9.685, 0400-1030, with news in *English* at 0530, says is Home Service; fair to good level.

Kenya—VQ7LO, 4.885, Nairobi, is scheduled Monday and Friday, 0500-0600, 1000-1400; Tuesday and Thursday, 0500-0600, 0730-0830, 1000-1400; Wednesday, 0500-0600, 1000-1500; Saturday, 0500-0615, 1000-1500; Sunday, 1000-1400. On medium-wave, 810 kcs. is in dual. (*Radio Australia*)

Has *English* at 0500-0540, 1100-1310; on Saturdays carries BBC news at 0600; on Sundays has Forces' Program at 0200-1000; on 6.060 (paralleling medium-wave 714 kcs.) has *daily* Indian and vernacular programs, 1200-1300; a demonstration program is listed for Tuesdays and Thursdays at 0730-0830 on 6.060 and 810 kcs. (Ferguson) (NOTE: *If anyone this side of Atlantic picks up VQ7LO, please notify your ISW editor. Thanks.*)

Lebanon—Short Wave News, London, says that Beirut, 8.028, is heard in Britain closing at 1145 with "This is *Radio Levant,* Joan Edwards saying goodnight to you." Goes off the air with "Pack Up Your Troubles In Your Old Kitbag." Signals were R7-Q4 with some CWQRM. Has ceased to use call letters FXE. Scheduled to carry news at 1100.

Macao—Radio Macao, 9.254, is now on summertime, with program one hour earlier, than during the winter month; heard signing *off* at 0825; news is probably around 0650. (Dilg) Letter verification to Ronald Gray, New Zealand, listed schedule of 1230-1730; stated they are using 200 watts to a center-fed Hertz antenna; use pair of Osram MT9F tubes as Class B linear amplifiers. Call is definitely *Radio Macao,* CR8AA.

Madagascar—Radio Tananarive has been heard signing off later again than when previously reported; this time sign-off was at 1345 on both 9.69 and 6.065; at Easter signals from this station were heard on 10.615 at 1030. (Gillett) FIQA, 9.695, is heard in

Britain at 1155 with recorded dance music, followed by local French news, gives call of "Ici Radio Tananarive." (Short Wave News) Heard signing *off*, at 1345.

Malaya—Tan Bin Hussain, Malayan correspondent to *Short Wave News*, London, reports that *Radio Malaya* is to have three new 5-kw. short-wave transmitters—two in Singapore (for Blue and Red Networks, respectively), one near Kuala Lumpur to provide the link with Singapore, replacing the present rather inefficient telephone line circuit. *Radio Malaya,* however, will concentrate primarily on medium-wave broadcasting, so that radio will be within the reach of the masses, it has been announced by J. S. Dumeresque, the Director of Broadcasting. The medium-wave scheme will center on three 10-kw. transmitters—at Singapore, Kuala Lumpur, Penang; respectively. With all the projects in view, Mr. Hussain writes, it is believed that Malaya "will have one of the finest radio systems in the Empire."

Kuala Lumpur, now on 6.045, opens at 0530; Saturday sign-off is 1130, other days at 1030. (Gillett) Good on West Coast; news at 0900. (Baxter) *Radio Australia* says increased signal level indicates this is a new, higher-powered transmitter, probably 5- or 7-kw.; formerly was 1 kw.

Radio Malaya, 4.820, Singapore, is heard in Mexico around 0715. (Butcher)

Malta—VPT2, 15.015, heard several times afternoons testing with GBC on 13.390. (Harrison)

Mozambique—CR7BJ, 9.650, is heard in Texas at 0000-0100; *no English noted.* (Stark) Is only Mozambique transmission now heard in New York. (Beck)

A. Goncalves, manager, Radio Clube de Mocambique, Lourenco Marques, address of Box 594, sends us this data: "We are broadcasting *two separate* programs—one in Portuguese and the other in *English* and Afrikaan." Schedules are: Portuguese—Weekdays, 0000-0100, 0400-0630, CR7BK, 740 kcs., CR7BJ, 9.645; 1100-1500, CR7BK, 740 kcs., CR7AA, 6.137, CR7BJ, 9.645; Sundays, 0400-0700, CR7BK, 740 kcs., CR7BJ, 9.645, and 1100-1500, CR7BK, 740 kcs., CR7AA, 6.137. *English* and Afrikaan—Weekdays, 1100-1700, CR7BV, 4.900, CR7AB, 3.490; Sundays, 0200-0700, CR7BE, 9.580; 1000-1700, CR7BV, 4.900, CR7AB, 3.490. The *English*-Afrikaan program is entirely musical, therefore has no newscast. Interval signal is four chimes—*doh-mi-doh-sol*—and text, *"Radio Mocambique, Lourenco Marques, for happy listening in the 60- and 85-meter bands."* Verifications are sent to listeners sending in *complete* reports.

New Guinea—Jungle Network, 7.198, Biak, reported 0400-0530; may run later. (URDXC)

Northern Rhodesia—Lusaka's 9.705 (announced) is being heard on West Coast; *English* has been heard some days (Tuesdays); woman announcer

said operating in 31-, 41-, and 76-meter bands. Opens at 1030. (Dilg) Signs on with drums and says, "Good evening." (Baxter) Letter of verification states this new frequency is intended to service Nyasaland, Northern and Southern Rhodesia, a radius of about 500 miles; transmitter is a Marconi SWB8 with power of 2.5 kw. (Laubscher). Has been heard in Australia at 1530-1630 sign-off. Lusaka also uses 7.285 and 3.914. (Radio Australia)

Norway—Oslo's LKQ, 11.735, LKJ, 9.54, are heard signing on at 0300 with what may be Norwegian National Anthem; 26 time pips begin program period. (Gillett) LLS, 7.210, Tromsoe, in verifying by card (airmail), gave power as 10 kw. (Pearce)

Palestine—JCKW, 7.218, Jerusalem, comes on with *English* programs at 1130 after Indian session; leaves the air at 1600 with Ted Lewis' "Goodnight Melody." (Laubscher) Heard in Britain at 0030 with announcement of time as "half-past seven"; good level. (Short Wave News)

Philippines—KZRH, 9.64, Manila, is heard in North Carolina around 0600-0645; musical numbers stronger than voice announcements. (Ferguson)

Siam—Bangkok appears to be experimenting to find a proper frequency; is heard some days on 6.125, others on usual 5.995 (listed 6.040); former best in Australia. First transmission ends at 0630, news at 0615; last transmission (native) concludes at 0915; (Gillett) Heard on West Coast. (Dilg)

Southern Rhodesia—ZEA, 3.658, ZEB, 3.700, Salisbury, are scheduled early afternoons; low-powered. (Harrison)

Spanish Morocco—Radio Tetuan, 6.067, is heard 1330-1500 on weekdays, to 1600 Sundays; 1.5 kw. power, (Swahn) Heard in Britain from 1630 announcing as "Habla Radio Tetuan." (BSWL)

Surinam—PZR, Paramaribo, listed on 11.332, is heard in Charleston, West Virginia, on actual frequency (measured) of 11.323 with S9 level at 1700; sign-off varies, usually is around 2035. Uses some American recording and has had relay of PCJ (Dutch) news at 1900-1915; the 5.843 channel seems to parallel. (Arthur)

Sweden—SDB-2, 10.78, Stockholm, has improved signals in the *daily* 2000-2100 beam; comes on with usual chimes; news shortly after start. Parallel frequency of 9.535 is seldom audible in America. (Officials of the station say would substitute 15.155 for 9.353, but are afraid if leave 9.535 will lose "sole channel" in 31-m. band.)

Current frequencies used by Stockholm include 15.155, 11.705, 10.780, 9.535, 6.065. A new Broadcasting House was begun during 1946, is intended that it will be completely up-to-date in every way possible, with 15 major studios including 3 concert halls seating audiences up to 1000; it is expected this new building will be completed in 1949. (BSWL)

Switzerland—*"The United Nations Radio"* in Geneva has been heard testing around 1900-1925 on 9.515, strong signal; verification was by letter, stating that tests were being conducted on 9.515, 9.545, 9.595, 9.655, 11.715, 17.770. QRA is United Nations Radio, Information Centre, Section Radio, Palais des Nations, Geneva, Switzerland. (Shore) Heard signing *off* at 1930 on 9.515. (Beck)

Berne is using 11.865 and 11.815, 0215-0330 on Monday, Tuesday, Thursday, Friday to Australia. (Balbi)

Tangiers—A letter to Bergstrom, Sweden, from *"Radio International"* states that this "is a comparatively new station. We began broadcasting on September 18, 1946. We now broadcast eight hours a day, one to four in the afternoon and seven to midnight in the evening; we use four languages—French, Spanish, *English*, and Arabic." Slogan is "Aqui Tanger, Radio Internacional" (Spanish); "Ici Tanger, Radio Internationale" (French) or "This is Tangier, Radio International" (*English*). Frequency was given as 6.200 (48.39 m.) and QRA is 34 Goya street, Tangiers. Hours of operation would probably be 0700-1000, 1300-1800 EST.

Trinidad—VP4RD, Port-of-Spain, has has testing *daily* at 0600-0620 or later 9.635 (announced); at sign-off says moving to 6.085 where has been inaudible, probably due to proximity of Toronto's powerful CFRX, 6.070. (Ferguson) Fair signal here in West Virginia in earlier period. Fair signals with light QRM in New York. (Beck)

On 9.635, has been heard testing around 1900-2017 sign-off; good carrier but poor readability. (Arthur, McLaughlin) Bad spot due to London on either side (9.625 and 9.64).

I have received a letter from A. Cross, Chief Engineer, Trinidad Broadcasting Co., Ltd., Broadcasting House, Port-of-Spain, Trinidad, B.W.I., thanking me for my report on the 9.635 frequency and asking for further reports. In part, he writes: *"We hope to go on the air with a proper program schedule on or about August 1.* At present we are using a pair of vertically stacked dipoles which are designed to give maximum radiation vertically and so provide a good local service. There is some lateral radiation, otherwise you would not have heard us, but we shall shortly try an experiment of using single dipole radiators, and I shall be glad to know when we do this if you receive us better. I will notify you when the change in antenna is made."

Turkey—During the summer, TAP, 9.465, Ankara, has news daily at 1145 instead of 1245 as in winter. *English* periods to Britain are at 1530 on Monday and Thursday, and the *Postbag* period is Sunday at that hour. (Pearce)

U.S.S.R.—Albert E. Langer, Philadelphia, reports Moscow on 17 megacycles (probably 17.765) 0830-1730; broadcasts alternate in French, *English*, and German, with language change every half hour; notes played on half-hour for about 30 seconds; also says the evening North American (*English*) beam can be heard 1820-1950 on 11.63, 11.89, 15.16, 15.41, 15.44, and 1930-1950 on 11.88 and 15.23.

The morning North American beam (*English*) is scheduled 0745-0815 on 11.75, 15.11, 15.17, 15.23, 17.74, and 21.35.

Uruguay—CXA3, 6.075, Montevideo, is heard with good signal in New Zealand, opening at 0500 with "Good Morning" song. (Gray)

Acknowledgements

Thanks for the splendid reports being received this summer. Reports should be mailed to reach your ISW editor by the 5th of any month. QRA is Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, U.S.A. Good listening!..K.R.B.

Build a TV Receiver

(*Continued from page* 48)

control until a thin horizontal line is visible on the screen. As this control is adjusted, the horizontal line should vary in width.

If a horizontal line fails to appear or if the sweep is erratic, turn off the equipment and recheck all wiring in the vicinity of the *horizontal oscillator* and *horizontal amplifier* stages.

Test the *VERTICAL SIZE* or *HEIGHT* control by first closing the *WIDTH* control and then slowly opening the *HEIGHT* control. Result should be a thin vertical line, varying in height as the *HEIGHT* control is adjusted.

If a vertical line fails to appear or if the sweep is erratic, turn off the equipment and recheck all wiring in the vicinity of the *vertical oscillator* and *vertical amplifier* stages.

Finally: Open the *WIDTH* control to a point where the horizontal line on the screen is of optimum width (just within the confines of the edge of the picture tube), and open the *HEIGHT* control so that the image on the screen is of approximately correct height. Then, if the control circuits

have been wired properly, the result on the screen of the picture tube should be an almost-square *raster*.

Next stage to be wired is the *synchronizing amplifier*, using a type 6N7 tube. Function of this stage is the amplification of sync pulses received from the *second detector* stage of the video circuit.

Mount the *sync amplifier* tube in front of the *vertical oscillator* tube (Fig. 4) so that the output of the *sync amplifier* can be coupled conveniently to both oscillator stages.

Two kinds of pulses are required, horizontal sync pulses at a high frequency and vertical sync pulses at a lower rate of repetition. Both kinds are obtained from the single output of the *sync amplifier* by use of suitable *R-C* network filters to provide separation. Method of separation is evident by referring to the circuit diagram.

Horizontal sync pulses must be of higher frequency than the vertical sync pulses. Thus, an *R-C* network (high-pass filter) is used between the *sync amplifier* and the input to the *horizontal oscillator* stage, and another *R-C* network (low-pass filter) is used between the *sync amplifier* and the input of the *vertical oscillator* stage.

In this way the two oscillator stages are synchronized with their respective high- and low-frequencies pulses, and the resultant beam sweep within the picture tube is synchronized with the sync transmissions of any television station to which the *first detector* of the receiver is tuned.

First Detector

The input of the receiver consists of a *first detector* stage using a type 1852 tube, with a *local oscillator* using a type 955 acorn tube. The r.f. oscillator is tuned *above* the frequency of the incoming television signal, and mixing of the two signals produces a strong intermediate beat frequency.

Particularly critical of construction and adjustment is the *first detector* stage and its associated *local oscillator*.

Each of these stages is tuned by a variable 50 $\mu\mu$fd. condenser. They may be tuned individually, or the two condensers may be ganged together.

To accommodate two *separate* tuning condensers, drill two holes in the side of the chassis so that the condensers can be mounted close to each other *and as close as possible to their respective grids*. If a two-gang condenser is used, drill only one hole in the side of the chassis so that the condensers can be mounted *close to their respective grids*.

The *first detector* tube is placed forward (Fig. 4) above the chassis, but the *local oscillator* tube is mounted underneath the chassis just behind the oscillator tuning condenser, so that all leads of the oscillator circuit are as short as possible.

Drill two holes in the chassis above and just behind the oscillator tuning condenser and mount the acorn socket

on two 6/32 stand-off bolts. Height of the socket may be adjusted by running two nuts *under the socket* up to the desired position.

The 100 $\mu\mu$fd. condenser (C_{31}) used in the oscillator grid circuit should be temperature compensated to minimize any frequency shift due to changes in temperature.

The r.f. coils for the *first detector* and the *local oscillator* stages are made from No. 14 wire. They are air wound with a diameter of about ¾ inch. The exact number of turns cannot be given as the coils will vary in size for each individual case, due to differences in the placement of parts, types of sockets, length of circuit leads, and other common factors. However, *in most cases* between 3 and 4 turns of wire should be about right.

The cathode of the 955 tube is connected to a point on the oscillator coil L_2 about one turn in from the grounded side of the coil.

Solder the completed r.f. coils to their respective tuning condensers.

The *local oscillator* functions at a frequency higher than the television signal frequency by an amount that represents the desired intermediate frequency of the video signal; 12.75 megacycles.

Close proximity of the oscillator coil and the first detector coil is sufficient for adequate mixing, and additional coupling is not required to produce a strong beat frequency.

If desired, additional 10 $\mu\mu$fd. fine-tuning condensers (C_3, C_{30}) can be placed in parallel with the oscillator and first detector main tuning condensers as shown in the circuit diagram. The two fine-tuning condensers should be ganged.

Video Stages

Following the *first detector* stage of the receiver, the video signal is applied to three *video i.f. amplifiers,* each stage using a type 1852.

Since the video signal is composed of a very wide band of frequencies, all components of the *i.f. amplifier* stages must be capable of passing a wide band of frequencies or the definition of the final television picture will be considerably impaired. The chief difficulty in maintaining a broad-band frequency response lies in the construction and adjustment of the i.f. tuning coils.

It may be possible to purchase broad-band i.f. coils at 12.75 megacycles, which would be adequate for use in this receiver.

However, if such coils are not available, they may be constructed without too much trouble.

The best source of parts are old or defective 465 kc. i.f. transformers used in broadcast receivers. These units provide most of the essential units. Unwind the old coils, but keep the coil forms for the new video i.f. coils. Also retain the old assembly bracket, bolts, and shield can.

Intermediate frequency of the video signal is 12.75 mc. To construct a coil for this frequency, wind about 17 turns

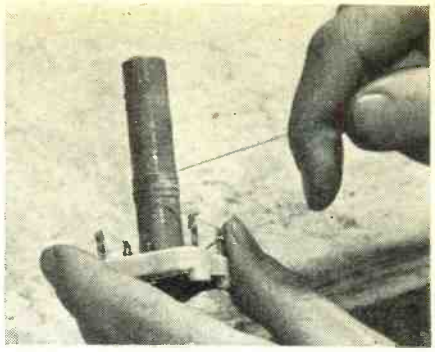


Fig. 6. Photograph shows method of winding i.f.'s on old coil forms. For complete coil specifications see Table 1.

of No. 28 wire on a ¾ inch coil form.

The same trimmer condensers used on the old i.f. transformers can be used across the newly wound coil. Since the *video i.f. amplifiers* pass a wide band of frequencies and are critical, peaked tuning is not necessary.

Mount the rewound coil and trimmer on the assembly bracket. The 1000 ohm filter resistor and the .006 bypass condenser (associated with each *video i.f. amplifier* stage) are also mounted on the assembly bracket inside the shield can, to conserve wiring space underneath the chassis.

Attach proper leads and then place each video i.f. coil assembly can close to its respective stage, as indicated in Fig. 4.

To prevent sound signals from interfering with the video signals, a wave trap—or "sound" trap—is used between the first detector i.f. coil and the grid of the first video i.f. amplifier tube. The "sound" trap consists of a coil L_4 and condenser C_9 in parallel, and tuned to 8.6 megacycles (the sound i.f. signal). Construct the coil of No. 28 wire wound on a ¾ inch form. It is tuned to reject the 8.6 mc. frequency by means of a small trimmer condenser. Connect directly in series with grid of 1st i.f. tube.

All wiring of the first detector and i.f. amplifier stages is now to be completed. But to minimize any tendencies toward oscillation, *make all leads as short as possible.*

The *CONTRAST* control — associated with the second *i.f. amplifier* stage—is mounted on a bracket below the chassis, and an insulated extension shaft protrudes through a mounting hole in the steel front plate of the receiver (Fig. 3).

After suitable amplification, the

Table 1. Coil specifications.

L_1—Pri. 2 t. #28 wire c.t.
Sec. 3 to 4 t. #14 wire, ¾" diam. (See text)
L_2—Osc. coil 3 to 4 t. #14 wire, ¾" diam. (See text)
L_3—I.f. trans. Pri. 17 t. #28 wire on ¾" diam. form. Sec. 2 t. #28 wire link
L_4—Sound trap 25 t. #28 wire on ¾" diam. form
L_5, L_6, L_7—I.f. trans. 17 t. #28 wire on ¾" diam. form
L_8, L_9—Peaking coils 50 t. #32 wire wound on 2 w., 500,000 ohm resistor
L_{10}, L_{11}—Sound i.f. Pri. 2 t. #28 wire link
Sec. 25 t. #28 wire on ¾" diam. form
L_{12}—Discriminator trans. Pri. 25 t. #28 wire on ¾" diam. form; Sec. 25 t. #28 wire c.t.

video i.f. signal is applied to a *second detector and clipper* stage using a type 6H6 double diode. Output of this stage is *R-C* coupled to the final stage: a *video amplifier* using a type 6V6 beam power tube.

Connect the *second detector and clipper* stage and the *video stage* according to the circuit diagram, but do not complete wiring of the plate circuit of the final, output stage.

Peaking coils L_8 and L_9 may be used, as indicated in the diagram, to bring up the higher frequencies for better picture definition. They are simply 2 watt, 500,000 ohm resistors, R_{72} and R_{73}, with 50 turns of No. 32 wire wound on them.

The video circuit of the television receiver is now ready to be aligned and tested.

Video Alignment

Using a signal generator with an output meter or loudspeaker, the *video i.f. amplifiers* are aligned in conventional manner.

The i.f. stages are stagger tuned, that is, the first coil is tuned to 10.8 mc. for maximum output, the second coil is tuned to 11.5 mc., the third coil is tuned to 12.0 mc., and the fourth i.f. coil is tuned to 12.6 mc.

Connect the output or loudspeaker across the output of the final *video amplifier*. Short out the tuning condenser of the *local oscillator*, and turn the *CONTRAST* control up (clockwise).

Then attach the leads from the signal generator between the grid of the *first detector* and ground, and adjust the signal generator for maximum output.

Tune each i.f. coil assembly for maximum output from each stage. Changes in some or all of the i.f. coil windings may be found necessary. Alignment procedure should be repeated several times.

If no signal is indicated in the output of the video circuit, turn off the set and carefully recheck the wiring and construction of all video stages. Start with the final amplifier and work back, step-by-step, to the first detector—until the trouble is found.

After the i.f. coil assemblies of the video circuit have been properly aligned, disconnect the signal generator and output indicator and remove the short across the oscillator tuning condenser. Then connect the output of the *video amplifier* to the grid of the cathode-ray tube, according to the circuit diagram.

The video circuit is now ready to receive a television picture.

First, make certain that a local television transmitter is on the air, preferably a station operating on one of the higher frequency channels. Then tune the receiver to the station. Adjust the trimmer across the tuning condenser of the *first detector* for maximum picture brilliance. Controls on the front panel are used to bring the picture into sharp focus and desired intensity.

If no picture is visible on the cath-

ode-ray tube, insert a pair of phones and a small condenser in series across the output of the *video amplifier*. If a signal is audible, the r.f. coil of the *local oscillator* may have to be pared to bring the receiver into the television band. Absence of any signal indicates either (1) the transmitting station is off the air, or (2) there are undiscovered defects in the wiring, adjustment, or alignment of the video circuit.

Sound Stages

The four-tube sound circuit consists of a *sound i.f. amplifier* stage using a type 1852 tube, followed by an *FM discriminator* stage using a type 6H6 double diode. Audio signals from the *discriminator* pass through a 6J5 *voltage amplifier* and are then applied to an *output amplifier* stage using a type 6F6 tube to feed a 5-inch PM speaker.

The complete sound circuit is constructed on a small, separate chassis (Figs. 1 and 5), which is supplied by the builder. Dimensions are not critical, but the chassis must be small enough to fit snugly in place on top of the main chassis and yet be large enough to accommodate the four sound tubes, two i.f. coil assemblies, and other parts.

As previously mentioned in the discussion of the video stages, the i.f. coil, L_{10} and L_{11}, and the discriminator coil, L_{12}, assemblies can be easily constructed from old or defective 465 kc. i.f. transformers used in broadcast receivers. Note that the top view photograph shows L_{10}, L_{11} as an iron core slug assembly. Should a coil of this type be easily obtainable, it may be used in lieu of a home-constructed coil. It is possible, however, to build your own shielded i.f. coil and use it in place of the iron slug type unit. In doing so, strip all wiring and unwind the old coil. Keep the coil forms, assembly bracket, bolts and shield cans.

The intermediate frequency of the sound signal is 8.6 megacycles.

To construct a coil for this frequency, wind about 25 turns of No. 28 wire on a ¾ inch coil form (Fig. 6).

The *first* i.f. coil assembly also has a 2-turn loop primary winding. This winding is link coupled—via two well insulated leads—to the first i.f. coil of the *video* circuit, and thus supplies an input signal for the sound circuit.

Make a 2-turn loop on the coil form of the first *video* i.f. coil, bring the two leads to the sound chassis, and then connect them to the 2-turn loop on the coil form of the first *sound* i.f. coil assembly. Each 2-turn loop should be in close proximity to the main coil winding, but the degree of coupling is not critical. However, all windings on any single coil form must be in the same direction. Mount coil assembly directly on chassis.

The *second* i.f. coil assembly of the sound circuit (used with the *discriminator* stage) has both a primary winding and a separate secondary winding. The secondary winding is center-tapped, as shown in the circuit dia-

gram. Again, both windings must be in the same direction.

The trimmer condensers retrieved from the old broadcast band i.f. transformers can also be used across the newly wound sound i.f. and discriminator coils, since critical peaking is not necessary. Further, both sound coils are deliberately broadened by placing 200,000 ohm resistors across the windings.

Mount discriminator coil with trimmer and resistor on its assembly bracket, attach leads, and cover the coil assembly with a shield can. Then place coil assembly close to its respective stage (Fig. 1).

Install the 5 inch PM speaker behind the lower opening in the steel front panel.

Mount tube sockets and tubes, and complete all wiring of the four stages of the sound circuit, according to the circuit diagram. Leads associated with the *sound i.f. amplifier* and the *discriminator* stages should be as short and direct as possible.

Power for the sound circuit is obtained from the video power supply.

After assembly, the sound chassis is attached to the main receiver chassis, and the sound circuit is aligned in the conventional manner.

Operation may often be improved, however, by further *realigning* of the sound circuit when the television receiver is actually tuned to a transmitting station.

Sight and sound must be synchronized. When they are not, it's a good indication that the video or sound i.f. amplifier stages are improperly aligned.

When the television receiver is functioning normally, the set is ready for installation and connection to an antenna.

Installation

Twin-parallel 300-ohm feeder line is used to connect the receiver to its antenna, and this transmission line may be of any reasonable length. At the receiver, this line terminates in a 2-turn loop inductively coupled to the *first detector* r.f. coil assembly. The 2-turn loop must be center-tapped to ground, and must be wound in the same direction as the r.f. coil. The two windings may be loosely coupled.

It's important that the antenna of any television set be given considerable consideration with regard to type of design, construction, and installation, because the effectiveness of the antenna greatly influences the operation of the receiver.

The designer of this set, Leon S. Wecker, recommends use of a folded dipole, constructed from a section of 300-ohm twin-parallel feeder line.

Cut off a 7-foot section of the transmission line. Close and solder the pair of wires at each end. At the exact center of the 7-foot section, nip one of the pair of wires and pull out the ends from the plastic dielectric. At this point connect the feeder line (which leads to the input of the receiver). Since the plastic shield material melts easily when heated, use a red-hot nail or piece of metal to join the two pieces of plastic in a strong physical bond.

With the wires extended taut and supported by insulators or other *non*-metallic means, mount the folded-dipole antenna in a horizontal position and as high as possible. Position of the antenna *in azimuth* is adjusted for reception of the clearest and brightest picture images from a desired television transmitter, indicating maximum signal reception. Usually this position will be broadside to the transmitter. But in cities and towns, signals *reflected* by tall buildings may be used to better advantage.

However, if multiple images appear on the picture tube, they may be due to either poor antenna design, poor antenna location, or both.

At times better reception is possible when using a directional antenna. The folded dipole may be converted into a directional antenna simply by placing an 8-foot length of taut, heavy wire 3½ feet behind and parallel to the folded dipole. Both antenna and reflector can be mounted on a wooden framework so they can be rotated together until the point of best and clearest reception is reached.

Further improvements in the physical appearance of the completed television receiver may be made. At a nominal cost, the set can be enclosed in a plywood cabinet or other covering. Such finishing touches can be accomplished at the convenience of the builder. —30—

18-db. Preselector

(*Continued from page* 61)

of the equipment. High-gain, all-band r.f. amplifier stages add materially to the cost of the equipment.

The actual advantages of additional r.f. stages increases with frequency. One r.f. amplifier stage can be adequate at 14 megacycles yet be totally insufficient at 28 megacycles.

Commercially built preselectors normally cover all bands, and adequate shielding is required to prevent oscillation. The equipment is normally housed in an attractive cabinet with an elaborate dial.

The preselector described was designed around the following specifications; low cost, minimum size, and the elimination of all shielding, the frequency requirement being 28 megacycles. The unit was to consist of two amplifier stages and three tuned circuits. Experience proved the use of three tuned circuits would require shielding. Rather than complicate the mechanical design by the addition of shielding, one tuned circuit was removed.

6AK5 type tubes were selected because of high gain and minimum space requirements.

The circuit of the 18-db. preselector is unique in its simplicity. The r.f. is fed into the antenna pickup coil. The input and output tank condensers are ganged together, each section being shunted by a 30 $\mu\mu$fd. trimmer. The plate circuit of the first stage and the grid circuit of the second stage are resistance coupled. The plate circuit of the second stage is tracked with the input grid circuit. The output of the preselector consists of a pickup coil which feeds the antenna circuit of the receiver.

Power for the preselector is supplied by the receiver. The power required for the filaments of the 6AK5's should not seriously overload the power transformer in the receiver, since the current drain is low. The plate voltage supplied to the preselector should be approximately 90 volts. If such a voltage is not available from the screen circuit in the receiver, a suitable dropping resistor should be employed to reduce the voltage to approximately 90 volts. This voltage is in no way critical. The use of higher plate voltage will not materially affect the gain, but may cause regeneration or actual oscillation.

Mechanical Design

A piece of #14 bus bar is formed around and connected to the rotor on both ends of the variable condenser. The shield plates between the sections of the variable are connected to the bus bar with both ends soldered.

The tube sockets are soldered to the bus bar. The tube sockets are placed to require minimum grid and plate leads. The cathode bypass condensers connect directly to the cathodes and bus bar ground. These leads are kept at an absolute minimum. Individual screen bypass condensers connect directly from the screen to the metal shield plates on the variable. The "B+" end of the plate coil connects directly to the screen connection of the tube socket.

Although the two screens are connected directly, individual bypass condensers are used to reduce the r.f. path to ground to a minimum. The coupling condenser between the plate of the first stage and the grid of the second stage is a 50 $\mu\mu$fd. ceramic. The two trimmer condensers are soldered directly to the condenser stators and the condenser shield plates. 30 $\mu\mu$fd. ceramic trimmers were used. The use of a ceramic trimmer is desirable due to the limited amount of space required and the excellent "*Q*" factor.

The input coil consists of seven turns of #16 tinned wire with the inside diameter of ¾" and spacing between turns 1/16". The coil is secured by connecting one end to the variable condenser stator and soldering the sixth turn to the bus bar which supports the tube sockets. Antenna connections are made from this supporting bus bar and the end of the coil.

The output tank circuit consists of six turns of #16 tinned wire with an inside diameter of ¾", spacing 1/16". One end of the coil is connected to the variable condenser stator, and the other is connected to the screen prong of the tube socket. The output coil consists of two turns of #16 tinned wire, inside diameter ¾", spacing 1/16". One end of this output coil is soldered directly to the bus bar which supports the tube sockets and is secured so the output coil is properly coupled to the plate tank coil.

The filaments of the two 6AK5's are parallel, with one side going to ground. Three leads are required to connect the preselector to the receiver: ground, filament, and "B+". An additional cable will be required to connect the output coil to the antenna circuit of the receiver. If transmission line is used for this purpose and the antenna circuit of the receiver is grounded, make sure that the output connection is such that the ground of the receiver and the ground of the preselector are connected properly. In such a case, the "B—" lead between the preselector and the receiver may be eliminated. Connect an antenna and ground to the input coil of the preselector. If a transmission line is used for this connection, the connections are the same.

Both input and output pickup coils need not be connected to ground. The addition of a terminal block will supply an insulated mounting. If a balanced transmission line is used to feed the preselector, ungrounding one side of the pickup coil may be desirable.

Tuning Procedure

Tune the receiver to the low-frequency end of the 10-meter band. Rotate the variable of the preselector to maximum capacity (20 $\mu\mu$fd.). Ad-

just the two ceramic trimmer condensers located on the side of the variable for maximum signal output.

The actual location of the variable will be determined by the adjustment of the trimmers.

The spacing of the coils should be varied so that the same amount of trimmer capacity is required for both input and output coils. If this is accomplished, the preselector will track over its entire range. This condition can be indicated by observing the position of the ceramic trimmer rotors. When the two rotors are in the same position, the capacity will be approximately the same.

Actual gain measurements indicated a consistent gain of 18 db.

A calibrated dial for a one-band preselector is not absolutely necessary, since the condenser is tuned for maximum output. The operation of this condenser is the same as the antenna trimmer control which is used on most communications type receivers.

The preselector can be designed to cover both 10 and 20 meters with the same coils if the coils are properly designed. For such operation the coil inductance should be increased so the 20-meter band is covered when the variable condenser is nearly closed. The 10-meter band will tune with the variable condenser near the minimum capacity position.

Such operation will result in extremely sharp tuning. The addition of a vernier to the tuning control will improve this condition.

If more bandspread is desired, plates may be removed from the main tuning condenser and additional capacity will be required in the trimmer adjustment.

The preselector may be mounted in any convenient location. Some receivers may have sufficient space for actual mounting in the cabinet. If the preselector is to be mounted in the same cabinet as the receiver, a certain amount of caution should be observed in establishing the actual location. If placed too near the r.f. stage of the receiver, regeneration or oscillation might result.

This preselector may be constructed for all-band coverage by adding the necessary switch and coils. A shield between the two stages may be required.

Although only two sections of the 3-gang variable condenser are used, the space created by the use of the 3-gang condenser is desirable. The use of a 2-gang condenser will change the mechanical layout slightly. If the mechanical layout is changed, the position of the coils should be such that inductive coupling between the coils is reduced to a minimum.

NOTE: This preselector, after being observed by a 10-meter Los Angeles organization known as "The Rabbit Twisters," was labeled the "Stinkommeter." "The Rabbit Twisters'" network consists of W6FHN, W6MYS, W6MYN, W6WTS, W6NXW, W6WHH, W6EAT and yours truly, W6LVT.

-30-

Sound Recording

(*Continued from page* 59)

first consider the magnetizing action of a typical wire record-reproduce head as illustrated in Fig. 11A. The demagnetized wire entering the head from the left will be shielded from the magnetic field until it enters the recording gap between the two pole pieces.

During the time in which it travels from the first pole to the shielding of the second pole, the element of wire will be subjected to the varying magnetic fields existing in the gap. In this time interval the audio signal intensity will have changed only a small increment. However, the supersonic bias will have gone through 1½ or 2 cycles. The residual flux density that is left in an element of wire will depend upon the field intensity existing in the gap at the instant that the element left the gap and entered the second pole. Referring again to Fig. 10, this means that if one element of wire had a residual flux density corresponding to a field of point *E*, the residual flux of the following segment would correspond to point *F*.

But what effect does this have upon reproduction? We find that the gap is long enough to contain several negative and positive peaks of the supersonic bias. The total flux in the gap will then depend upon the sum of the gap fluxes. In Fig. 10 the projection of the positive peaks on the residual flux curve at each instant of the audio signal produces curve *A*. The projection of the negative peaks forms curve *B*. The addition of *A* and *B* results in a curve that represents the effective flux that the wire will reproduce in the gap. Although some distortion is present in the resultant curve, it is a great improvement over reproduction without bias. As in d.c. biasing, the linearity of the response using supersonic

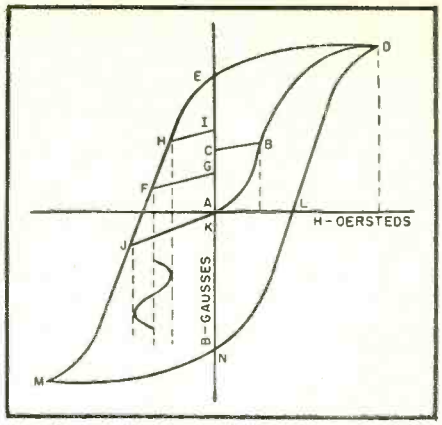


Fig. 8. Typical magnetic material magnetization characteristics.

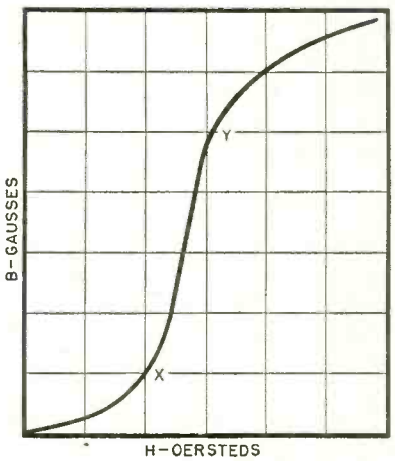


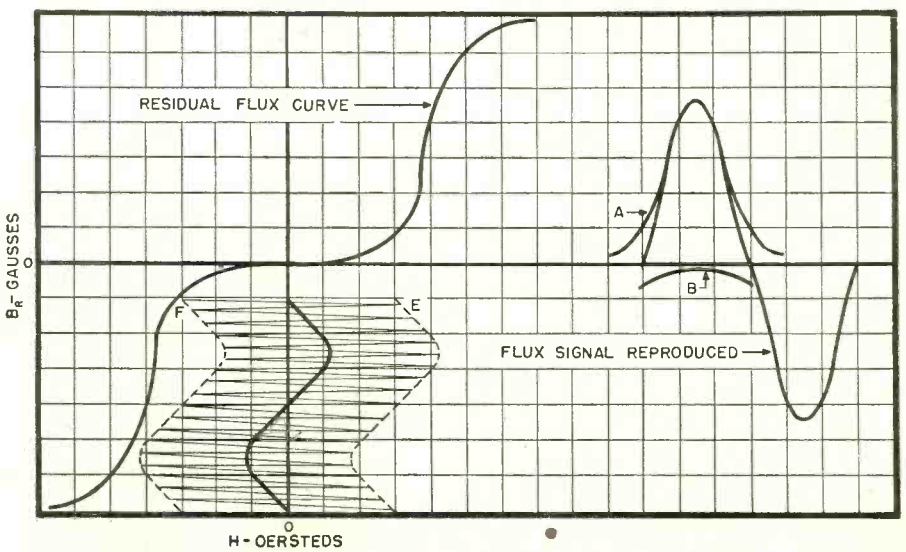
Fig. 9. Residual flux density curve.

biasing is dependent upon the amount of bias used. The response shown in Fig. 10 probably could be improved upon with a more careful choice of bias.

Distortion

Regular intermodulation measurements can be made to check distortion

Fig. 10. Supersonic biasing effect. Combined audio and supersonic magnetizing field is applied to residual flux density curve to plot the flux signal that the wire will produce in the gap.



and, accordingly, to check the bias for best results. A low frequency sine wave of fairly large amplitude is simultaneously recorded on the magnetic material with a high frequency sine wave of low amplitude. If the system were perfectly linear, the output of the reproducing head would show no modulation of the high frequency signal by the lower. As the system is not perfectly linear, some modulation will occur. The bias can be adjusted to make this a minimum.

Two advantages can be attributed to supersonic biasing as compared to d.c. biasing. These are, less noise and a greater linear amplitude range allowing higher level recording. Experimenters have been led to the conclusion that noise in magnetic recording is largely caused by the passage between pole pieces of many randomly distributed magnetic irregularities which are less than .0015 inch in diameter. Magnetically saturated material was found to be ten to twenty decibels noisier than demagnetized material. This means that d.c. biasing, with its saturation erase and fixed magnetic bias, will be noisier than supersonic biasing which uses a demagnetizing erase.

Magnetic Head Design

Fig. 12 illustrates in simplified form, various types of recording-producing heads now being commonly used. Practical experience has shown the desirability of combining the recording and reproducing functions into a single head. At the same time, while the overall response characteristics are influenced to some extent by the recording head design, they are much more dependent upon the design of the playback head. Therefore, the playback requirements usually govern the design of the head.

The open type head, commonly employed where a magnetic material is in the form of wire, is shown in Fig. 11B. Note that the wire hole of Fig. 11A has been replaced by a tapered slot. This is done for ease in placing the wire in the head while the taper will allow a splice or knot to be made in the wire and yet permit the wire to ride up out of the slot and prevent a jam. Fig. 12C shows a closed type head which is similar to the open type except that the coil surrounds both the wire and the pole pieces. The closed type reduces the effect of stray fields and produces a response curve that is a little more regular than that of the open type.

The heads illustrated in Figs. 12C and 11B may be made of several laminations if a high impedance head is desired, or of a single lamination if a low impedance head is preferred. In either case, the lamination should be kept as thin as practical to reduce eddy current losses and to improve the high frequency response.

Heads for record-playback should be made of a material that offers high permeability at low flux density. Mu metal or molybdenum *Permalloy* are commonly used. Magnetic coupling

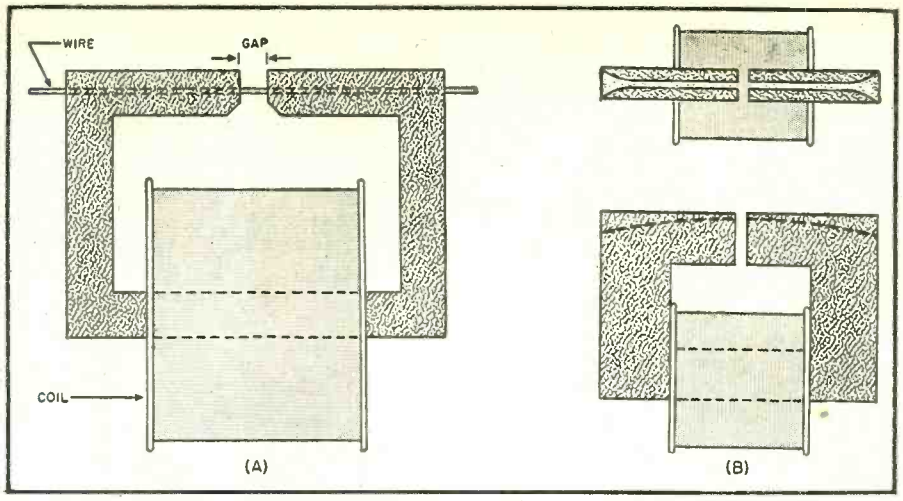


Fig. 11. (A) Typical wire record-reproduce head. (B) Open type wire record-reproduce head.

between the magnetic recording material and the head should be excellent. The gap between pole pieces is normally filled with a nonmagnetic material such as solder or soft copper but these materials wear excessively. Better results can be achieved and a more permanent head secured by employing beryllium copper.

The gap in commercial heads is usually somewhere between .001 inch and .002 inch depending upon the wire speed and the desired frequency response. Inasmuch as frequency range is largely dependent upon the length of gap, the matter of spacing becomes extremely important, as will be discussed later. The major difference between a recording-reproducing head and the erasing head is in the length of the gap. Usually an erasing head gap will be about .010 inch.

Considerations for Magnetic Tape Recording

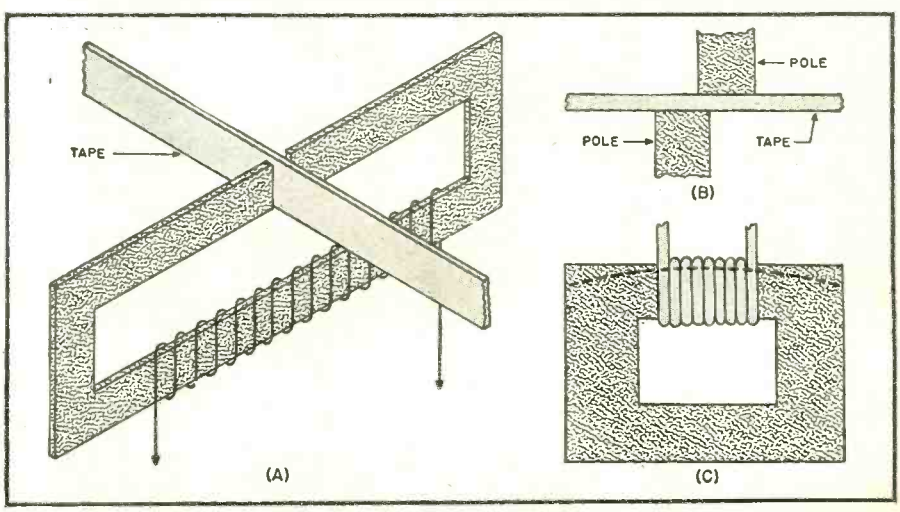
Considerable advancement has been made in magnetic recorders which employ a magnetized material in the form of a tape. As tape will run flat and will not twist when unwinding, it can be magnetized either longitudinally or transversely. A simplified diagram of a head for transverse recording on magnetic tape is illustrated in Fig. 12A. It will be noted that pole pieces are thin, single laminations. Increasing the thickness of the laminations will have the same limiting effect on frequency as increasing the gap on the head of Fig. 11A. Improved and increased response, combined with a sturdier construction is obtained by using thicker offset pole pieces (Fig. 12B). This head derives increased gain from the decrease in reluctance that wider pole pieces effect in the region of low permeability that exists at the end of each pole.

Frequency Response

As mentioned previously, the length of the air gap becomes a most important factor in setting the general frequency response of the system. The over-all frequency response of a magnetic recorder is also dependent upon such factors as head design, wire or tape speed, magnetic recording material, and amplifier compensation. Some of the frequency limiting factors in the recording-reproducing head have already been discussed.

If a wire containing two alternating magnetic fields, both of the same mag-

Fig. 12. (A) Record-reproduce head for transverse recording on tape. (B) Offset thick pole pieces used to improve characteristics of head shown in (A). (C) The closed type record-reproduce head used in some types of magnetic recorders.



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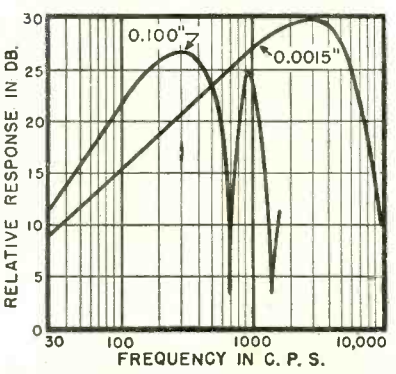
nitude, but one twice the frequency of the other, is passed through a reproducing head, the higher frequency will induce an e.m.f. that is twice that induced by the lower frequency. This is, of course, caused by the fact that induced voltage is directly proportional to both the flux density and frequency. As might be expected, a constant rise in output is had with frequency but this is true only at the lower frequencies. At higher frequencies the response begins to drop off when the wavelength of the signal, as recorded on the medium, approaches the length of the gap. Fig. 13 illustrates the effect of gap length on frequency response while Fig. 14 gives the effect of wire speed.

The speed of the magnetic material has little effect upon the low frequencies but it does have a considerable effect upon the high frequency response. Commercial recorders operate at speeds ranging from 7.8 inches per second up to 6 feet per second with 2 feet per second giving excellent results on some of the latest models, such as the machine used to dictate this article. The current through the recording head coil determines the residual flux density which will be left in the magnetic material. A recording head is largely inductive and its impedance increases with frequency. It is necessary to use an amplifier with a rising characteristic to make the recording head current independent of the frequency of the input signal or to insert a large resistance in series with the coil. Constant recording current was used for the curves of Figs. 13 and 14. Referring to Fig. 13, it may be seen at a glance that some sort of equalization is required in order to achieve an over-all flat frequency response within the desired range.

Pre-equalization, post-equalization, or a combination of both are commonly used in magnetic recording. As the linear section of the magnetic materials magnetization curve does not extend indefinitely, only a limited amount of pre-equalization can be used before overloading. This is particularly true when using pre-equalization to extend the high frequency range. On the other hand, post-equalization is not desirable for the higher frequencies, as most of the noise lies in this region. Higher frequency response can be obtained by using pre-equalization but overloading necessitates reducing the recording level and lowering the signal-to-noise ratio as the range is extended. Inasmuch as the low frequency response is normally lower than that of the middle frequencies, some sort of equalization is required. Overloading precludes the supplying of all of the required equalization with pre-equalization alone. Therefore, a combination of pre-equalization and post-equalization will be found to be most satisfactory.

Fig. 13. Frequency vs. response curves show result when gap length is changed.



Materials for Magnetic Recording

Many varieties and shapes of magnetic materials are now being employed for magnetic recording. Noise level, frequency response, and signal amplitude will be affected by the type of magnetic material used. At the lower frequencies, with a fixed speed, the retentivity (measure of residual flux density) will determine the magnitude of output voltage from the reproducing head. However, we find that the shorter magnetic poles of the higher frequencies in the thin cross section of the magnetic material produce a strong self-demagnetizing effect which tends to reduce the induced higher frequency output voltage.

The effectiveness of this demagnetization depends upon the coercive force of the material. Coercive force is defined as the magnetizing force required to reduce the residual flux density to zero after saturation. If the residual flux were *N*, Fig. 8, the coercive force would be *AL*. Materials having a high coercive force will experience less self-demagnetization. Since high coercive force materials have a low retentivity, it means that some low frequency output voltage must be sacrificed in order to extend the upper frequency range.

High coercive force and low retentivity offer the additional advantage of reducing noise from crosstalk induced into the material by an adjacent turn of material when wound upon the spool.

Improved magnetic tape, having only part of its density occupied by the magnetic coating, does offer a certain amount of insulation and crosstalk is not encountered when turns are wound over one another on the spools.

There are two commonly used types of wire for magnetic recording. If we are satisfied to reproduce only the human voice, say to 3000 c.p.s., hard drawn carbon wire, or a chrome steel with a coercive force of about 50 oersteds is very satisfactory. Stainless steel wire possessing a coercive force of 175 oersteds will give recordings that are superior to the common shellac records found in our stores, but not quite equal to the latest vertically cut vinylite records.

When Vicalloy tape (developed by *Bell Telephone Laboratories)* with a coercive force of 250 oersteds is used, the quality of vertically cut vinylite can be readily equalled. An equalized response from 100 to 8000 cycles, with

a useful volume range of more than 50 decibels, has been obtained from Vicalloy tape using the recording-reproducing head illustrated in Fig. 12B. The tape speed in this case was only 16 inches per second. Considerable research on magnetic tape recording has also been done by the *Indiana Steel Products Company*. (Metallic wire and tape are the most common magnetic material shapes used in magnetic recording.) A German machine, on the other hand, was found that records upon magnetically coated plastic tape, producing forty-five minutes of recording from one-half mile of tape. It possesses the additional feature of a special pitch restoring head that permits restoration of the original pitch when the tape is played back at other than the recording speed.

Magnetically Coated Tape and Paper Discs

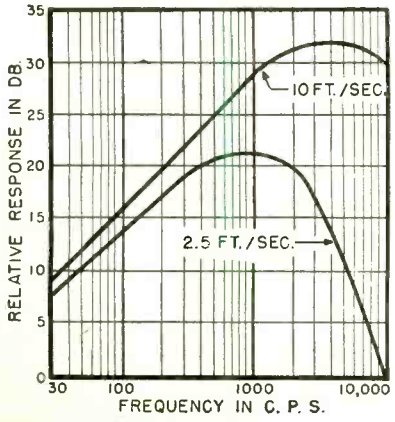
Considerable research has been done in the United States by the *Brush Development Company* on magnetic recording materials. Both a magnetically coated paper tape and a magnetically coated paper disc have been used successfully. Here the recording medium is a suspension of finely divided magnetic particles in a coating applied to paper. Paper tape is very easy to handle and cheaper than most other magnetic materials. It lends itself readily to editing for a section of the paper tape may be cut out with a scissors and the ends joined with glue or adhesive.

Plated brass wire has also been found to be well suited to magnetic recording. A frequency response of 80 to 8000 c.p.s. (down 6 db. at 10,000) with a signal-to-noise ratio of 35 db., can be obtained. The wire is .0046 inch in diameter and is plated with a magnetic material. Wire speed is 24 inches per second and the minimum recording time is four hours for a unit which has been developed.

Another unit uses a ¼ inch wide magnetic coated paper tape. The frequency response is 100 to 5000 c.p.s. with a signal-to-noise ratio of at least 40 db. The tape speed is very low, being only 7.8 inches per second.

New uses are being found for magnetic recording almost daily. Expand-

Fig. 14. Illustrating the influence of wire speed on frequency response.



ing at a terrific rate and becoming more and more popular with the passing of time, magnetic recording bids fair to become universally used not only in certain dictating machines but also as a conventional entertainment media.

(To be continued)

Capacitance Test Bridge

(Continued from page 43)

critical nor will it affect the bridge circuit, but it should have as high an inductance as is possible. Its object is to prevent the bridge supply voltage from being shorted by the polarizing voltage power supply. The 3 μfd., 1000 v. condenser in series with it is to prevent any polarizing voltage supply ripple from reaching the input of the bridge.

The null indicator is a vacuum tube voltmeter circuit. The series grid resistance is to limit grid current flow, since the voltage applied to the input circuit of the 6SJ7 is rather high for conditions of unbalance. The 1 megohm grid resistance is to make the input resistance of the null indicator equal the bridge output impedance. The unbalanced bridge condition slightly lowers this input resistance (due to grid current) but as the balanced condition is approached, the input resistance becomes approximately that of the grid resistance. The tube is designed for maximum voltage gain and is followed by a 6H6 diode rectifier. The first portion of the 6H6 (on the drawing) serves to rapidly discharge the coupling condenser from the 6SJ7, and the second portion rectifies the output and applies it as bias through an *RC* filter to the grid of the 6SF5 . The plate resistance of the 6SF5 is so chosen with the voltage used, and the grid grounded, that the current in the plate circuit is limited to approximately 1 milliampere. Contact voltage of the 6H6 will cause this value to be lower since it is actually applied as bias, but this initial adjustment will protect the meter should the 6H6 burn out, etc. It will also be noticed that should the coupling condenser become shorted, the positive voltage will not be applied to the grid of the 6SF5, but rather be harmlessly bypassed through the first portion of the 6H6. The power supply transformer has a 650 volt, center-tapped winding.

The whole amplifier and power supply is above chassis ground to prevent shorting out one arm of the bridge circuit. The power transformer core and shell should also be insulated from the chassis since capacity indications of the bridge will be lower than the true value. It is much easier to do this than to compensate for its effects in the bridge circuit.

The principle of this arrangement is that when the bridge is unbalanced the condition is reflected into the grid circuit of the 6SJ7, its amplified output rectified by the 6H6 and applied as bias to the grid of the 6SF5, caus-

ing the tube to go into plate current cut-off. The 6SF5 high mu tube was chosen so that cut-off could be reached without too high a grid voltage. When the bridge is balanced, there is no input to the 6SJ7, hence no output to be rectified and applied as bias to the 6SF5, with the result that the meter indication increases to maximum. Consequently this circuit reads as a normal meter does, and at the same time provides protection to the meter as well as a higher input resistance as compared to the conventional a.c. meter.

The polarizing voltage transformer, T_2, is a 650 volt transformer. It is connected as a half wave rectifier. The 3000 ohms in series with the cathode is to reduce the voltage to about 700 volts. The main object of this is to limit the inverse voltage across the 1V tube to as low a value as possible. The total current for this circuit is 5 ma. The entire bleeder circuit is composed of 2 watt resistors. No trouble has been encountered with this circuit; the 1V seems to be rugged enough to withstand the 1400 volts inverse voltage without any undesirable effects.

This circuit arrangement was selected for two reasons; accuracy of measurements, and simplicity and ease of operation. Leakage measurements were not incorporated within the instrument because it was felt that it would be a duplication of qualitative measurements. A leaky condenser will show up in power factor determination just as easily as a condenser with a high series resistance, although it is possible to measure leakage current with an external milliammeter. A meter is simply connected in series with the capacitor under test and the combination connected to the terminal posts. However, before connecting the meter and condenser across the terminal posts it should be borne in mind that unless there is a polarizing voltage applied to the terminal posts damage might be the result from the raw a.c. being applied to the d.c. milliammeter.

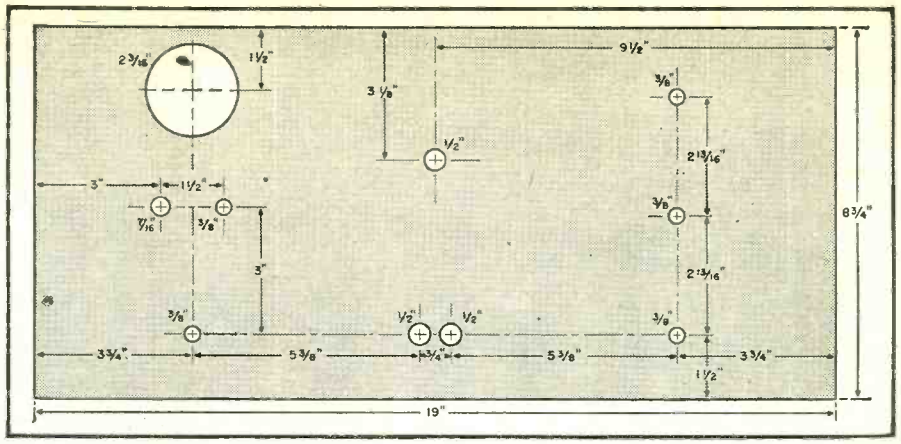
Construction

The whole instrument is built on an 8"x17" chassis with an 8¾" relay rack panel for rack mounting. The first components mounted on the chassis are the power transformer for the null amplifier and the bridge supply transformers. These must be properly oriented in relation to each other to prevent any undesirable effects from them. One of the two can be mounted on the chassis, but the other's position and orientation must be determined by trial and error. The full line voltage is applied to the primary of the mounted transformer, and with either phones or an a.f. amplifier connected to the primary of the other it is rotated until the hum reaches its lowest volume. This will then be the position in which to mount it. The power transformer for the polarizing voltage is then mounted on the other side of the chassis. The position of the tubes is not critical, although they should be arranged for the shortest possible leads. All wiring, except that of the bridge proper, is cabled and should be so arranged and positioned that the cables do not cross each other unnecessarily. All long bridge circuit leads should be as far removed from the chassis and adjacent wiring as possible. This is best done by rigidly supporting them on insulators. These wires should definitely be as short and as direct as is consistent with good design and construction. All resistors are rigidly supported on mounting strips. On the drawing there are only two active grounds shown, but in the unit itself there is a bus wire connecting all portions of the circuit requiring a ground, with the chassis itself being grounded at as many points as is possible. Unless this is done, erratic behavior of the instrument may be experienced.

The large *"Capacitance"* dial, 5¼" diameter, was made on a lathe and is mounted on a *General Radio* 3" skirt knob, type #637-S. The engraving was done after calibration of the potentiometer with a Wheatstone bridge. The calibration points on the dial can be determined by the equation:

$$R_r/R_r = C_s/C_x$$

where: R_r equals the range resistance; R_r equals the potentiometer (10,000



Panel layout shows actual location of component parts.

ohms); C_s equals the value of the standard condenser, and C_x equals the value of the unknown condenser.

The value of the unknown in the equation should be made equal to the highest value for the particular range under consideration, though it is recommended that the range be unity (1). By determining the highest point, it is only a matter of dividing the required resistance in the variable element by ten to determine the main dial divisions. The main divisions are then all subdivided into equal parts, this being a matter of preference with the constructor. For accuracy a reliable bridge should be used. An ohmmeter does not have the required degree of accuracy for this particular job. By using a bridge for both the dial calibration and in determining the resistance of the range resistors, the degree of accuracy can be maintained at an extremely high value. Once the dial is calibrated it will read and be applicable for all the ranges in conjunction with the multipliers for the instrument.

Before calibrating the final instrument it should be mounted in a metal cabinet. This is necessary if the calibration is to be reliable at all times since surrounding objects tend to affect the unshielded bridge.

The instrument must be calibrated with a known capacitance standard. It is recommended that this calibration standard equal, or approximate, that of the internal standard. With the calibration condenser connected directly to the terminal posts, the bridge is balanced and the dial adjusted until its reading corresponds to that of the calibration standard. This is all that is necessary for calibration of the final instrument. The power factor control is also a linear function of the resistance, and hence the required potentiometer can be divided into ten equal parts of resistance, with these further subdivided if desired.

Results obtained with the completed instrument were very satisfactory. To check operation ceramic condensers rated at 12 $\mu\mu$fd. plus or minus 10%, or plus or minus 1.2 $\mu\mu$fd. which were available were used. Connecting them individually to the terminal posts showed them to be well within their rating, and by paralleling the combination the indication corresponded exactly to their arithmetical sum. Placing them in a series combination also indicated the correct result well within 2%. It is suggested that each range be checked in this manner to ascertain the reliability of each individual range and the over-all performance of the complete instrument.

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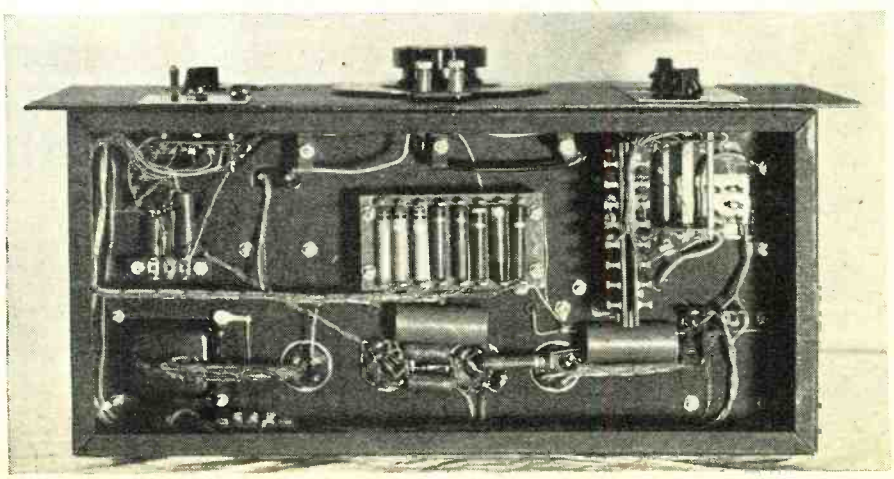
Underchassis view of the home-built capacitance test bridge.



Every Home a Bonanza!

(*Continued from page* 49)

who buy. Your calls should be made at the time of the day most suitable for interviewing housewives, usually in the morning between 9 and 11:30.

The canvassing must be done thoughtfully. Each call should be so handled as to yield the most information possible and create a friendly respect for your business. You must find out what radios and appliances are now owned, their age and condition. Without appearing inquisitive try to secure pertinent data about the family. Family statistics, such as age and sex of the children, birthdays, anniversaries, etc. are all valuable to the dealer, but in attempting to obtain this information remember that you are not a census taker and can't quiz the housewife. If during the course of your visit this data is volunteered, by all means jot it down for future reference.

After each call record the information you have secured on a generous sized card or several cards, separating like information from unlike to make for better reference. File these cards properly in a working file. Check these cards each day for the action necessary to direct attention to your product and to build good will.

Every time a sale is made the transaction should be used to yield pertinent information for your file and to create good will. Suppose you sell a washing machine, refrigerator or a sunlamp.

This sale provides an opportunity to get into the home in a way nothing else does. You make the delivery, you check on the installation, you visit several times to give service and, if you have done your job in a friendly and helpful way, the family talks to you confidentially and you can ask questions. You can discover what electrical equipment they haven't got but should have and can afford for each important room. You can begin to educate them. Carefully and subtly you can point out what equipment should be in the home. A complete package, such as a modern kitchen, might be worked out and offered, or related items played up, one at a time. You sell a washing machine and can then offer dryers, ironers, water heaters, and perhaps a fan. All these things make washday easier, quicker, and more comfortable.

During your visits to the home in connection with the sale, servicing, and installation of electrical equipment, you can often glean additional information about how the family lives. As an example, everyone likes to be remembered on his birthday. If such information is obtainable, you should have in your file the birthdates of your customers and prospects. Send them individual, personal birthday cards with an inconspicuous signature of your store and your signature as owner. A week or two before the birthday or wedding anniversary of the homemaker remind her husband that you have a particular appliance his wife would like to have, or one that would be appropriate for the occasion. Thus, you can solve his problem of selecting a gift, he can give something practical, and you have made a sale.

Perhaps you have discovered that an advertising specialty would be appreciated as a gift. Hundreds of such inexpensive items are available; appointment pads, ash trays, blotters, bottle openers, pencils, lighters, lucky coin pieces, desk rulers, envelope openers, fans, key tags and rings, license holders, needle books, thermometers, paper weights, school bags, serving trays and so on. If one of these advertising specialties is to be used, never send it out at a time when seasonal gifts are exchanged by members of the family. Advertising specialties are inexpensive and unfavorable comparisons with family gifts might be made. Send them out sufficiently long before or after Christmas (say) to be appreciated for what they are, a good will offering on your part.

You might also give away related samples with a purchase; floor wax or oil, moth crystals, insect sprays, soap powder or whatever else may go with one of the devices that has been purchased. Recipe books should be pre-

ENTERTAINMENT—FURNITURE GROUP
Radio—home, auto and "ham" types
Television
Subgroup—Hearing aids and other electronic devices
LAUNDRY GROUP
Washing machines
Irons
Dryers
Ironers
Sewing machines
KITCHEN UTILITY AND FURNISHING GROUP
Refrigerators
Electric ranges
Dishwashers
Kitchen cabinets
Frozen-food storage group
Subgroup—grills, mixers, toasters, waffle irons, juicers, coffee-makers, roasters
GENERAL UTILITY GROUP
Water heaters
Fans and ventilators
Vacuum cleaners
Waxers and polishers
Space heaters
Room coolers and humidifiers
Water supply systems
Electric clocks
Lamps and lighting fixtures
Flashlights
Fluorescent lights
Portable air conditioning units
FARM APPLIANCES
Water systems
Portable motors
Electric fences
Quick freezers
Milking machines and coolers
Poultry brooders
Ventilating fans
Health lamps
COSMETIC AND HEALTH GROUP
Razors
Tooth brushes and massagers
Curling irons and hair dryers
Vaporizers
Vibrators and massage devices
Electric pads and blankets
Sun lamps
Bottle warmers

Table 1. Major and traffic appliances which go to make up an "E" home.

sented to purchasers of refrigerators and ranges telling them "just how to mix, prepare, and cook the many palate-pleasing dishes which now become possible."

Briefly, your success as a dealer will depend, to a great degree, on your remembering the following points:

1. The market for radios and appliances is different from prewar.
2. Many more devices are being offered and others will come along after full reconversions are effected.
3. Competition is going to be keener because there will be more dealers and many of these dealers will be more aggressive than ever before.
4. More people to whom you can sell will be available.
5. They will have to be sold.
6. They are, however, more ready to be persuaded than ever before.
7. The first sale should be the prelude to many others.
8. You, Mr. Dealer, will have to sell them and make friends of them.
9. You, Mr. Dealer, will have to go out and canvass them.
10. You, Mr. Dealer, must have the

finest of mailing lists to work on prospects through direct advertising.

11. You, Mr. Dealer, must show them how the related items work together to give them more leisure, greater comfort, and healthier homes by means of personal sales talks and through direct mail advertising.

12. Do you wonder, Mr. Dealer, when we say an "E" family might well be persuaded by you to put 20 to 25 per-cent of their home investment into radios and appliances?

Thus we say to you, Mr. Dealer, with all the emphasis at our command, you can do it with regular, consistent, thoughtful effort and by insistence on your part that both the wholesaler and manufacturer give you all the aid they are able and equipped to give, and that, finally, you ask the cooperation of the utility company's local office. They are as anxious as you are to see every home fully equipped with electrical devices of every kind, and if their help will do it, they will gladly give you the assistance you require.

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Within the Industry

(*Continued from page* 30)

vision succeeding E. H. McCarthy who has retired from active business because of ill health.

Mr. Hendrickson, who joined the *Farnsworth Television & Radio Corporation* in 1939 as Sales Manager of the *Farnsworth Division,* served as Manager of the company's Field Expediting Division from 1942 to 1945. He served as Manager of the Chicago Distributing Branch from 1945 until his appointment to this new post.

* * *

ELLERY W. STONE, who has recently returned to this country following a distinguished war career, was elected a Vice-President of the *International Telephone and Telegraph Corporation* recently.

Holding the rank of Rear Admiral, Mr. Stone served as Chief Commissioner of the Allied Commission for Italy until recently. He has been associated with the *I. T. & T. System* or predecessor companies for more than twenty years. He was recalled to active Navy duty in 1943.

* * *

L. M. HEINEMAN, president of *Permoflux Corporation,* recently announced his company's entry into the jobber field with a line of speakers, transformers, pickups, and microphones.

The new jobber line will be handled by the company's two plants. The Eastern territory will be served by the plant at 4900 West Grand Avenue in Chicago while Western jobbers will be supplied from the plant at 236 South Verdugo Road, Glendale, California.

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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.

ENGINEERING HANDBOOK

Cornell-Dubilier Electric Corporation is now distributing a new technical handbook entitled "Power Factor in Your Plant" written by W. C. King, a sales engineer.

This 208-page book has been prepared to answer many questions directed to Mr. King by maintenance engineers. In a thoroughly readable fashion, the author has provided the answers to many of the problems that confront the industrial plant operator.

The book may be ordered from *Cornell-Dubilier Electric Corporation,* South Plainfield, New Jersey. The price is $3.00.

EQUIPMENT CATALOGUE

Concord Radio Corporation has announced the availability of the new Supplement No. 477 covering radios, electronic equipment and parts.

This 72-page catalogue lists hundreds of items of interest to the serviceman, amateur, hobbyist and electronic engineer including tubes, amplifiers, microphones, p.a. systems, test instruments, meters, batteries, condensers, resistors, etc.

A copy of this catalogue may be secured by writing *Concord Radio Corporation,* 901 W. Jackson Boulevard, Chicago, Illinois or from the company's Atlanta, Georgia office at 265 Peachtree Street.

RADIO CATALOGUE

Lafayette Radio of New York has announced the publication of a new summer flyer, No. C-39, which is now available for distribution.

The company has set special prices on many popular items such as tubes, transformers, inductors, condensers and resistors as well as ham gear, test equipment, radio sets, phono players, and stock equipment used by servicemen.

Several new lines including FM-AM radios, magnetic wire recorders, TV receivers and kits, etc. are also listed in this new flyer.

Copies of catalogue C-39 may be obtained by writing *Radio Wire Television Inc.,* 100 Sixth Avnue, New York, New York.

NEW OLSON CATALOGUE

The recently issued *Olson* catalogue has been designed to be carried in the serviceman's pocket or hung over his service bench.

In addition to hundreds of items including components, tubes, test equipment, antennas, amplifiers, intercoms, microphones and receivers, the new catalogue also lists five pages of free gifts which are being offered by the company to servicemen who make purchases of radio materials from the company.

A copy of this new catalogue will be sent to readers who request it from *Olson Radio Warehouse, Inc.,* Dept. 89, 73 East Mill Street, Akron 8, Ohio.

NAMEPLATES

Premier Metal Etching Company have just issued a 2-page bulletin covering their partial line of etched and lithographed metal name and trademark plates.

Manufacturers of radio and electronic products are especially invited to avail themselves of the opportunity of looking over the company's line. The company maintains branch offices in leading cities, but requests for this bulletin should be made to *Premier Metal Etching Company,* 21-09 44th Avenue, Long Island City 1, New York.

REPLACEMENT TRANSFORMERS

A catalogue covering their line of replacement transformers has just been issued by *Crest Transformer Corporation* of Chicago.

The company's line which includes transformers for the radio industry, neon lighting, and power transformers for electric fence control, is illustrated and described in this 8-page catalogue.

Readers may secure copies of this publication by writing *Crest Transformer Corporation,* 1834-36 West North Avenue, Chicago 22, Illinois.

SHURE CATALOGUE

Two new 1947-48 catalogues which have just been issued by *Shure Brothers* feature new and simplified listings of the company's complete line of microphones and pickups.

Catalogue 157 covers the company's line of microphones and features the new Multi-Impedance "Unidyne" and "Sonodyne" dynamic microphones, the "Econodyne" dynamic and two new crystal microphones, the "Monoplex" and the "Versatex."

Catalogue 158 lists various pickups including the new "Muted Stylus" unit, cartridge, and needles, cartridge replacement packs, and the company's lever-type cartridges.

Copies of either or both of these catalogues are available from *Shure Brothers,* 225 West Huron Street, Chicago, Illinois.

SIGNAL BOOSTER

L. S. Brach Mfg. Co. has a new brochure describing the "Puratone Signal Booster" which is currently being distributed to those requesting it.

The unit described carries AM, FM and television antennas on the same

mast and is especially designed to provide noise-free demonstration of radio equipment. A shielded coaxial cable runs directly from the mast to the concealed amplifier on the display floor. From the amplifier a radiating wire may be placed around the display space in the store without direct wire connection to the radio set. One system serves any number of floor models. Dual wave traps in the video type AM-FM amplifier bring in all stations at an average tone-level.

A copy of the new brochure will be forwarded upon application to *L. S. Brach Mfg. Co.*, 200 Central Avenue, Newark 4, New Jersey. —30—

Appliance Financing

(*Continued from page* 50)

ures on this potential durable goods market. Conservatively, it is estimated that approximately two billion dollars will be spent toward the purchase of major household appliances and home furnishings.

As to how these purchases will be made—with cash or by monthly installments out of current income—is a question that can only be conjectured. It is reasonable to assume, however, that a fairly large portion of these purchases will be made on the installment basis. The American public, as has been evidenced in the past, is installment-minded and many authorities believe that a program urging the continuation of savings and the retention of war bonds as nest-egg savings will be a hedge against inflation. If, during the postwar period, purchases of consumer durable goods are made substantially from income one of the inflationary factors will have been averted.

When a commercial bank decides on the basis on which to do this business it will select a dealer by conducting an investigation and making an analysis of his credit responsibilities and also by evaluating certain factors, some of which are as follows:

1. The dealer must be a good moral risk. The investigation should cover his entire history and background in order to establish, within reason, evidence that the risk is unquestionable. This is extremely important because of the large amount of credit extended to and through the dealer in relation to his net worth. Any financial institution that handles wholesale paper or retail paper (or both) for a dealer who is a poor moral risk or tricky in his business dealings is assuming a hazardous risk that may eventually result in a substantial loss.

2. There must be reasonable evidence that the dealer has the ability to manage his business on a sound basis.

3. He must have sufficient capital, exclusive of the financing of the floor plan and retail sales, so that his business can operate safely and profitably.

Of fundamental importance to banks when setting up their dealers on a time sales plan and when handling their ap-

pliance paper, is the manner in which the selling is done. Whether or not he employs canvassers, how he displays his inventory, and whether he uses price appeals are factors which will be considered in dealer relations.

Retail paper should be purchased on its merits and not on the basis of the dealer's endorsement. This policy is being largely followed even when a dealer is doing business on a full recourse basis. When selling an individual contract to a financial institution, with credit investigated before approval, the dealer has the right to feel that the financial institution will protect his interests by approving credits on such a basis that the experience on the paper will be satisfactory. Occasionally, sales managers may urge the bank to approve bad credits pointing out that the paper is endorsed. It has been found through experience that to purchase paper on bad credits under such circumstances obviously would be unfair to the dealer. Moreover, experience indicates that while a dealer may urge the purchase of paper on bad credits, often when he is called upon to honor his endorsement he will criticize the bank and possibly seek another financing connection.

Installment paper on appliances is as good as the dealer who creates it. A dealer with a satisfactory financial background may operate on a high-pressure sales basis, and the experience and the paper he creates may not be satisfactory even though reasonable care is used in passing upon the credits. On the other hand, if the dealer sells on a sound basis and the consumer is completely satisfied with the transaction it is often possible to approve credits of a lower grade and still have a satisfactory experience on the paper.

While it is true that a dealer has the right to sell his paper at the best price he can get (and he has a theoretical right to make his finance charges what he wishes if they are agreeable to the purchaser), paper should not be bought if misrepresentation or excessive charges enter into the contract since the bank is going to collect his payments. Arrangements should be made between the bank and the dealer and a definite understanding of the bank plan is important. The bank will tell the dealer what the basis may be for his price since the bank proposes to buy the paper arising from the sale and the quality of the paper will be affected by the justice of the price. A dissatisfied customer means collection problems, with the bank's prestige becoming involved if paper is accepted where charges are abnormally high.

It has been generally agreed that in order to obtain satisfactory volume and profit from retail time sales appliance financing it is necessary for a bank to meet the dealer's reasonable requirements for handling his merchandise purchases. This, of necessity, becomes a part of a bank's install-

ment sales program. Experience has also been that in dealing with dealers of established responsibility this business can be conducted on a safe and sound basis.

During the past few years, while merchandise has not been available for purchase, banks have streamlined their operations and formulated sound plans in order to give the dealer prompt and efficient service. It has been found that by having dealers and banks cooperate in a community program credits have been approved within a matter of hours. This often permits the dealer to consummate the sale and to make delivery of the merchandise within twenty-four hours.

Banks are willing and able to take care of their time sales dealers and dealers who cooperate fully will find the banks equally cooperative so that maximum mutual benefits will result. Some bad practices have been indulged in by shortsighted, unscrupulous dealers, but fortunately these are in the minority and their practices are short-lived. A bank will not condone an unsound operation, a fact which will be quickly recognized in the procedure that a bank will adopt. Banks realize the value of their appliance dealer customers and will do everything possible to cultivate this relationship.

Regardless of the kind of development that takes place in the consumer credit field independent banks with satisfactory dealer plans will continue to get their share of the business. When a manufacturer wants a nation-wide credit mechanism to take care of distributors and dealers, nothing can quite compare with the banking system and its 15,000 outlets. Banks have all the necessary machinery and many thousands of them have already had satisfactory experience in installment sales financing. These facts, together with the knowledge and technique acquired by banks that are becoming interested in all phases of consumer credit, give strong indication that the banking system will be able to render to appliance dealers efficient, prompt, and considerate treatment of both their wholesale and their retail financing.

American banking is eagerly looking forward to a sound, healthy economy in the period ahead. Banks all over the country realize that such an economy cannot flourish and grow without the lifeblood of adequate constructive credit.

Whether or not we can maintain high levels of production, consumption and employment in the years ahead or whether we return to the normal of the thirties after our immediate wants are supplied will depend entirely on the joint effort of distribution and finance. We will face a stupendous task of selling and financing an increase of thirty billion dollars annually over our best peacetime year, which was 1940. If we cannot sell America's increased production, our factories will not produce. Therefore, bankers and distributors must work out new sales methods and sound consumer finance to sell more goods to more people than we have ever shown any ability to do if we are to prevent another depression. In the full realization that only through the wide use of consumer installment credit can present goals of production and sales be maintained, it is highly advisable for the nation's bankers to plan now in cooperation with the nation's industry in each community for the tremendous sales job which lies ahead.

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ERRATUM

The circuit diagram appearing in the article "A Beginner's Transmitter" (June, 1947 issue, page 63) should show the negative "B" supply grounded. We regret this omission.

* * *

Photo Credits

Pages	Credit
39, 41, 104	Buhrle & Company
51, 53	Radio Wire Television, Inc.
44 (top left), 64	Radio Corporation of America
44 (top right)	National Slug Rejectors, Inc.
44 (bottom)	Tradio, Inc.
45, 47, 48, 136	Walter Steinhard, Staff Photographer
49	Julian Krupa, Staff Artist
50	Joe Tillotson, Staff Artist
57	Peirce Wire Recorder Corp.
68	Radio Luxembourg
78, 80	Arthur Haug, Staff Photographer

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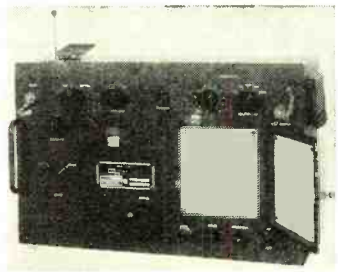

A combination signal generator and heterodyne wavemeter. It consists of a 5 megacycle crystal-controlled oscillator used as frequency standard calibrator, a variable two-range oscillator, an untuned detector with two stages of audio amplification, a sliding-rod stub antenna, a rough pi-type RF attenuator, a frequency calibration chart and a power supply. Coverage of the test oscillator on the low range setting is from 8 to 15 megacycles; the high frequency range coil covers from 45 to 76 megacycles and since the third harmonic is utilized, this gives a coverage of from 135 to 230 megacycles.

The signal generator cabinet measures 19¼" wide, 12" high, 7¼" deep; weight 50 lbs. Tubes in BC-1298 Power Supply — 16 — 6SN7GT; 1 — 5Y3GT/G; 2—6H6; 1—6SA7; 2—6V6GT; 1—6SJ7. Tubes in 1—222-A; 1—6J5; 2—9006; 2—6SJ7; 1—5Y3GT/G. **An additional extra power supply and tubes, with many other small items including cables packed in wooden chest is included in this price. Gross wt. of entire equipment 490 lbs.**

GENERAL ELECTRIC 0-30 DC Milliammeter—3" bakelite case..... **$3.50**

CRYSTAL DIODES 1N21B (1N34) See Radio News May issue page 50. Each 50c or 3 for $1.25.

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No. RA91A—Selenium plate, full wave 115 or 230v AC; 50-60 cycle, single phase input; output is 6 to 48v DC at 2 to 15 amp; manually controlled, complete with overload input and output switches. 0-15 amp DC meter. Excellent for laboratories, servicemen, service-stations. Shipping weight 150 lbs. Price..... **$39.50**

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3" Full Vision type Scale, with basic 100 Microampere D'Arsonval type movement.

A completely self contained pocket type multimeter, with functions for the measurement of DC voltage from 0.1 to 600 volts in 4 ranges. Measurement of resistances from 1 ohm to 1,000,000 ohms (1 megohm) can be made in 4 ranges. Height 5¾", width 3⅝", depth 2⅛". Shipping weight 3 lbs. Complete with operating instructions and circuit diagram.

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Brand New

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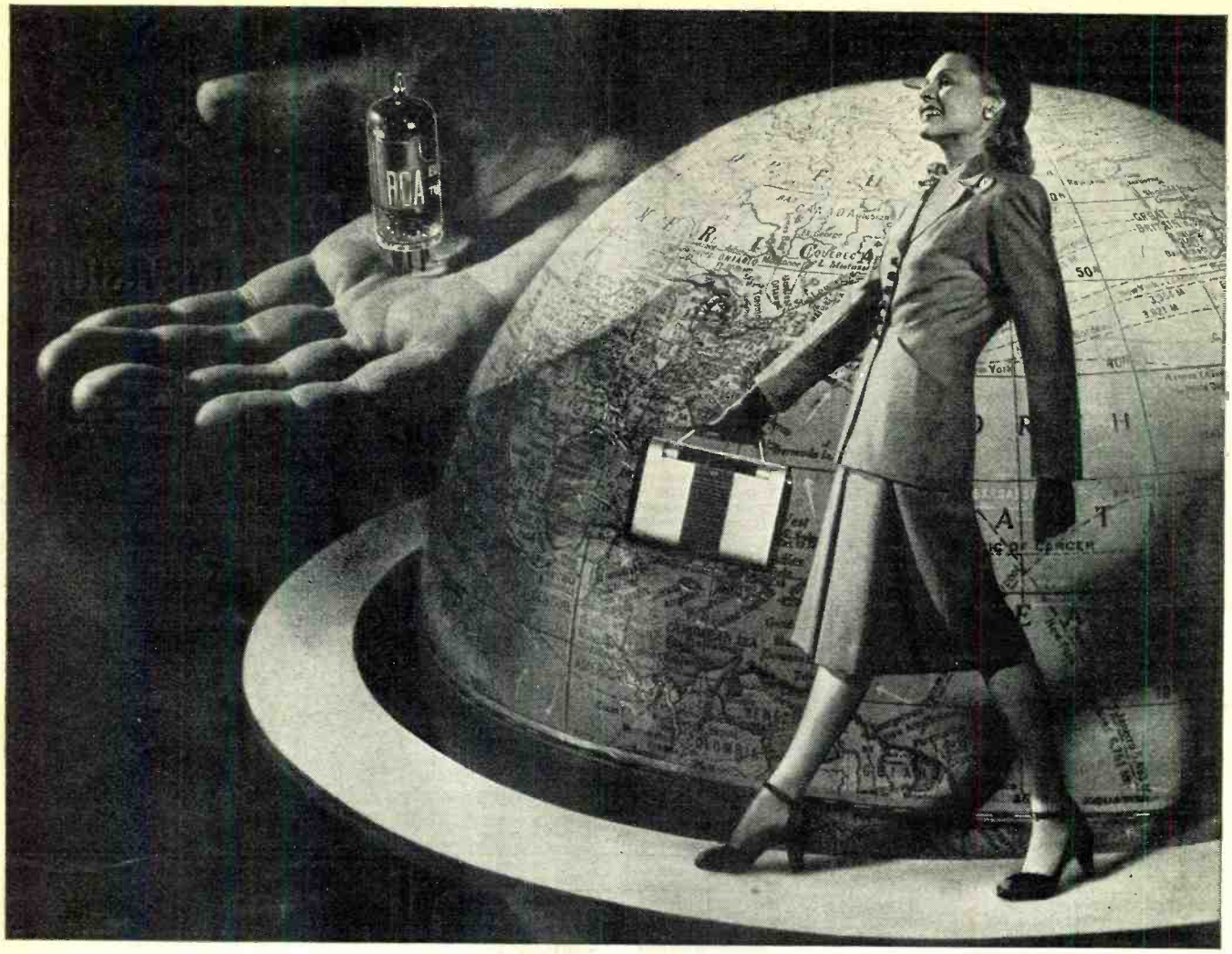
INDEX OF ADVERTISERS August, 1947



RCA Miniature Tubes enhance the tonal brilliance of RCA Victor Globe Trotter portable radios.

She shall have music wherever she goes!

Wherever you go with an RCA Victor Globe Trotter portable radio you'll enjoy richness and clarity of tone—volume enough for outdoor dancing—made possible through tiny tubes.

Miniature tubes save valuable space in small radios—space that can be used for larger and better loudspeakers and for longer lasting, radio-engineered RCA batteries.

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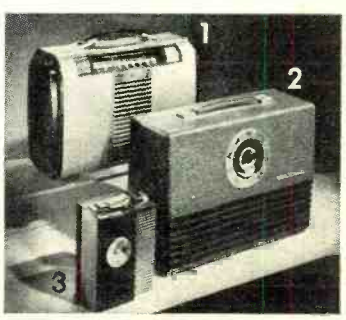

Ideal traveling companions. (1) RCA Victor "Globe Trotter" portable radio—operates on AC, DC, or batteries. (2) RCA Victor "Escort"—has a battery *you* can recharge from any ordinary AC electric outlet. (3) RCA Victor "Solitaire"—less than 6¼ inches tall!

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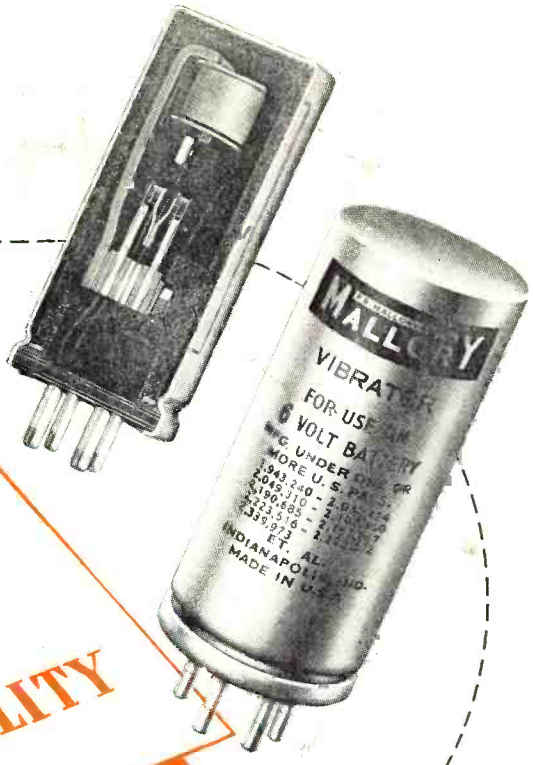

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See Your Mallory Distributor for a free copy of the 1947 Replacement Vibrator Guide

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Why
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IN TELEVISION!

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...the radio tube whose electrical and mechanical superiority makes it the ideal choice for marine radar, equipment in the air, on the road, FM and television.

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