RADIO'S LIVEST MAGAZINE

A GERNSBACK PUBLICATION

Radio-Craft

August
25 Cents
Canada 30¢

HUGO GERNSBACK Editor

How to Build the
RADIO-CRAFT
PORTABLE LOOP RECEIVER
See Page 72

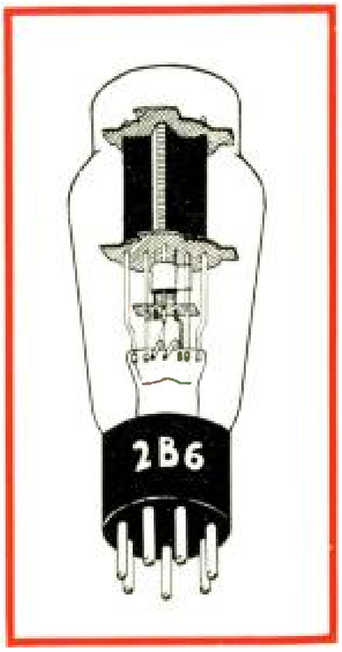
Direct-Coupled Amplifiers—A Modern Tube Tester—Latest Tube Data
The Electric Violin—A Portable Service Kit—A 20-Watt Amplifier

2 B 6

NEW POWER AMPLIFIER TRIODE

WITH WHICH THE LINCOLN DELUXE SW34 IS POWERED

The 2 B 6 is a twin three electrode high vacuum type of power amplifier tube for use in the power output stage of A.C. operated receivers. It possesses wonderful capabilities for delivery, exceptionally large, undistorted power output, with a smaller r. m. s. input than any other tube, and at not only a low tube cost, but low current cost as well. A pair of these tubes in Class A push pull stage operating at 250 volts on the plates will supply 10 watts of undistorted power. The tremendous power-handling capacity of the 2 B 6 is the result of its design features. (A complete story of this will appear in September issue of RADIO-CRAFT.) One of the features of this tube is the direct coupling of the input section cathode to the output section grid, thus furnishing power in the proper proportion at the proper polarity so that the output section operates over the entire portion of its Eg-Ip curve; that making for economical, efficient and low distortion power output.



SINGLE STAGE AMPLIFIER

Class "A"

Filament Voltage (A.C.)	2.5 volts
Plate Voltage	250 volts
Grid Voltage r.m.s. input	24 volts
Plate current total	43 milliampere
Plate resistance output	5,000 ohms
Cathode (resistor)	8,000 ohms
Amplification factor	18
Load Resistance	5,000 ohms
Power Output 4%	4 watts
Self Bias	540 ohms

PUSH PULL AMPLIFIER

Class "A"

Filament voltage (A.C.)	2.5 volts
Plate Voltage	250 volts
Grid voltage r.m.s. input (from grid to grid)	50 volts
Plate current, total per tube	43 milliampere
Load resistance—plate to plate	10,000 ohms
Total harmonic dist.	3%
Power output	10 watts
Self Bias resistor	270 ohms

Following are the tentative rating characteristics.

Filament Voltages (AC or DC) 2.5 volt
Filament Current 2.25 amp.
Maximum overall length—5 3/8 inches
Maximum diameter—2 1/16 inches
Bulb—ST-16
BASE—Medium 7 pin

It can easily be seen from the above just why this great power sensitivity used in dual-channel operation with two speakers gives the new LINCOLN DE LUXE S. W. 34 outstanding superiority in tone and power handling ability, as well as the creation of new musical perspective effects never before dreamed of—see letter on back cover—An appeal to your intelligence. Send for technical data sheet on 2-B-6.

LINCOLN RADIO CORPORATION
Dept. R.C.8, 329 So. Wood St., Chicago
Enclosed six cents for which please send information on your Lincoln DeLuxe SW.34.

Name ....

Street ....

City .... State ....

LINCOLN RADIO CORPORATION
Dept. R. C. 8
329 SO. WOOD ST.
CHICAGO, ILL.

Radio-Craft
FOR THE SERVICE MAN · DEALER · RADIOTRICIAN

HUGO GERNSBACK, Editor-in-Chief
LOUIS MARTIN, Associate Editor
R. D. WASHBURNE, Technical Editor

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VOLUME V NUMBER 2

IN OUR NEXT FEW ISSUES:

MODERNIZING THE RADIO-CRAFT UNIVERSAL ANALYZER. This universal analyzer which received universal acclaim is to be brought up to date. New sockets, no adapters—except for the plug—and accurate A.C. and D.C. scales with a few improvements will make this famous analyzer one of the best that can be made. Almost all of the original parts are used.

CONSTRUCTING A MIDGET 5-TUBE RECEIVER. There is no doubt about the fact that new receivers are flooding the market as rapidly as the Mississippi floods its shores; but when complete constructional details are given, that's another story. This receiver has been under test for the past month, and sure is a "wow."

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3410 Verified Foreign Programs

Received by these 3 Scott Owners

in a Six-month Period

15,847 More Foreign Programs — from 320 Stations in 46 foreign lands — were received by more than 200 other Scott Owners to give this POSITIVE PROOF of SCOTT distance-getting ability

Such performance records speak more eloquently of this receiver's merit than bales of laboratory curves and scientific reports so highly technical as to be understood only by trained radio engineers. Not that we haven't plenty such scientific engineering proof to offer—the curves of SCOTT Receiver performance, *made by recognized independent testing laboratories,* have never been bettered. But unless you're a baker you aren't interested in the kind of plums used in the pudding . . . the proof is in the eating. Likewise, unless you are a radio engineer the technical data regarding a receiver doesn't interest you . . . the proof is in actual performance in the hands of actual owners! That a receiver able to deliver such miraculous distance-getting on the short waves is also a star performer on the broadcast band, with sensitivity, selectivity, and tone quality of richness and fidelity unequalled, is simply an added reason for your wanting a SCOTT ALL-WAVE Deluxe. Soon there will be under way a great International DX Contest sponsored by the world's leading radio publications, that will bring world-fame to its winner. We confidently hope to see this contest, too, won by a SCOTT owner. But why should you wait for that further evidence? Rather, get a SCOTT yourself and go into the contest with the *best* chance of winning!

F. L. STITZINGER

This Erie, Penna., SCOTT owner, between January 1st and July 1st, 1932, logged and received verifications of 1588 programs from 41 stations in 22 foreign countries. Mr. Stitzinger's remarkable DX-ing feat included the reception of 387 programs from Pontoise, Paris, France; 131 programs from Barranquilla, Colombia; 101 from DJA, Berlin, Germany; and others from stations scattered all over the world map, including such remote and seldom heard places as Bandoeng, Java; Leopoldville, Belgian Congo; and a host of other interesting and thrilling air treats unknown to owners of less capable radio receivers.

A. G. LUOMA

From his Chicago, Ill., home this enthusiastic SCOTT dial-twirler reached out to listen to 1261 verified programs from 75 stations in 26 foreign lands. Paris, France, was his favorite station, too, being tuned in 277 times. Followed in frequent reception Saigon, Indo-China; Bogota, Colombia; Chelmsford, England; EQA, Madrid, Spain; and a roll-call of stations all the way from Sydney, Australia and Geneva, Switzerland to Kootwijk, Netherlands and Merida, Yucatan. He began DX-ing because of actual enjoyment of programs received instead of for the thrill of long-distance reception alone.

W. C. GANGLOFF

In six months of distance-grabbing on his SCOTT this resident of Cincinnati, Ohio, succeeded in logging and getting verifications from 42 stations, located in 22 foreign countries, of 592 programs. His favorite station overseas was Barranquilla, Colombia, which came in 112 times. Paris, France, was a close second, with 102 verified programs received. Then, stringing along to build up his impressive total came such little-heard stations as Khabarovsk, U. S. S. R. and many another ear-thriller from thousands of miles away. Mr. Gangloff insists that his performance could easily be duplicated by any Scott owner.

. . . and these men are "Just Average" Radio Fans — Not Professionals!

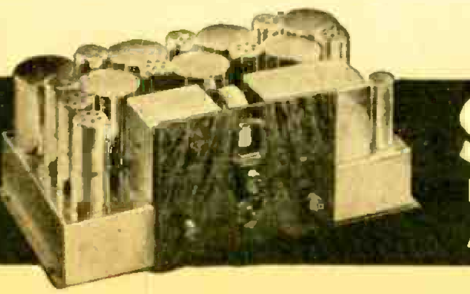
Their mighty feats of DX-ing, and those of the more than 200 other SCOTT owners mentioned, were accomplished under ordinary home reception conditions—probably no better than those you have to contend with. The reason for their remarkable performance was primarily the true ABILITY of their receivers, plus patience and easily acquired skill at tuning that may be learned by anyone. You, and a SCOTT, can do as well, and have as great thrills!

How Will YOU Decide On An All-Wave Receiver?

Every manufacturer of all-wave receivers can claim his product to be the "World's Best"—and most of them do! But are you convinced? Or do you sensibly demand FACTS and PROOFS? Better get the real "low-down!" For instance, find out how long the manufacturer has been continuously in business . . . ask to be referred to owners of several years' standing . . . learn how fully equipped is the laboratory in which his receiver is built . . . insist upon a check-list of features for comparison with other receivers. We are willing to have you submit our every advertised claim to the most searching investigation . . . in fact, we URGE you to do so, and suggest that you get the data on the SCOTT ALL-WAVE Deluxe *first,* for it is truly the standard by which all fine radios must be judged.

SEND THIS COUPON!

It will bring you complete information about the SCOTT ALL-WAVE Deluxe, including technical data, performance PROOFS, particulars as to how the SCOTT is built, and a check list form to use in weighing the merits of *any* all-wave receiver. Mail it TODAY!



SCOTT
15-550 METER
ALL-WAVE *Deluxe*

E. H. SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Ave., Dept. C-83, Chicago, Ill.

Send me at once, entirely without obligation of any kind, complete information about the SCOTT ALL-WAVE Deluxe, and helpful pointers to use in determining the value of *any* all-wave receiver.

Name..

Address..

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

I'll Train You Quickly for RADIO'S

LEARN AT HOME

Get into this Field with a Future

Broadcasting Stations employ trained men for jobs paying up to $5,000 a year.

Television—the coming field of many great opportunities—is covered by my course.

Spare time set servicing pays many N.R.I. men $200 to $1,000 a year. Full time men make as much as $40, $60, and $75 a week.

Talking Movies—an invention made possible by Radio—employs many well trained Radio men for jobs paying as much as $75 to $100 a week.

My book, "Rich Rewards in Radio," gives you full information on the opportunities in Radio and explains how I train beginners at home to become Radio Experts and how I train experienced service men for better Radio jobs—better pay. It's free. Clip and mail the coupon NOW. Radio's amazing growth has made hundreds of fine jobs which pay $40, $60, $75 a week. Many of these jobs lead to higher salaries.

Radio—the Field with a Future

Once or twice in a man's lifetime a new invention starts a new business. You have seen how the men and young men who got into the automobile, motion picture, and other industries when they were started had the first chance at the big jobs—the $5,000 $6,000 and $7,500 a year jobs. Radio offers the same chance that made men rich in those businesses. It has already made many men independent and will make many more wealthy in the future. You will be kicking yourself if you pass up this once-in-a-lifetime opportunity for financial independence.

Many Radio Experts make $40, $60, $75 a week

In the short space of a few years, 300,000 Radio jobs have been created, and thousands more will be made by its future development. Men with the right training—the kind of training I will give you in the N.R.I. Course—have stepped into Radio at 2 and 3 times their former salaries. Experienced service men as well as beginners praise N.R.I. training for what it has done for them.

Many make $5, $10, $15 a week extra in spare time almost at once

My Course is world-famous as the one "that pays for itself." The day you enroll I send you material, which you should master quickly, for doing 28 Radio jobs common in most every neighborhood. Throughout your Course I will show you how to do other repair and service jobs on the side for extra money. I will not only show you how to do the jobs, but how to get them. I'll give you the plans and ideas that have made $200 to $1,000 a year for N.R.I. men in their spare time. G. W. Page, 110 Raleigh Apts., Nashville, Tenn., wrote me: "I made $935 in my spare time while taking your Course." My book, "Rich Rewards in Radio," gives many letters from students who earned four, five, and six times their tuition fee before they graduated.

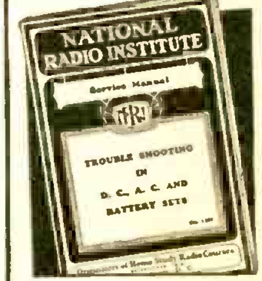
Get ready for jobs like these

Broadcasting stations use engineers, operators, station managers and pay up to $5,000 a year. Radio manufacturers

Police Departments are finding Radio a great aid in their work. Many good jobs have been made in this new field.

FREE LESSON

Act now and receive in addition to my big free book, "Rich Rewards in Radio," this Service Manual on D.C., A.C., and Battery operated sets. Only my students could have this book in the past. Now readers of this magazine who mail the coupon will receive it free. Overcoming hum, noises of all kinds, fading signals, broad tuning, howls and oscillations, poor distance reception, distorted or muffled signals, poor Audio and Radio Frequency amplification and other vital information is contained in it. Get a free copy by mailing the coupon.



Some of the Jobs N. R. I. Trains Men For

- Broadcast Engineer
- Maintenance Man in Broadcasting Station
- Installation Engineer of Broadcast Apparatus
- Operator in Broadcast Station
- Aircraft Radio Operator
- Operator of Airway Beacons
- Service Man on Sound Picture Apparatus
- Operator of Sound Picture Apparatus
- Ship Operator
- Service Man on Public Address systems
- Installation Engineer on Public Address Systems
- Sales Manager for Retail Stores
- Service Manager for Retail Stores
- Auto Radio Installation and Service Man
- Television Broadcast Operator
- Set Servicing Expert

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Radio-Craft
FOR THE SERVICE MAN · DEALER · RADIOTRICIAN
"Takes the Resistance Out of Radio"
Editorial Offices: 96-98 Park Place, New York, N. Y. HUGO GERNSBACK, Editor Vol. V, No. 2, August, 1933

MONEY IN SUMMER SERVICING

An Editorial by HUGO GERNSBACK

EVERY year for the past three or four years Service Men have reported slackening of their activities in the summer months. It is admitted that in radio all activities tend to take a drop at that time. Radio is a seasonal business, and the cyclic phenomenon is pretty well understood today.

But, of course, the activities never cease altogether. As a matter of fact, the radio business has to be pretty bad when it registers a drop of as much of 30% from the peak of the winter months. There are exceptions to this rule, too; but, in radio servicing, it is doubtful if the drop reaches a much greater figure than this.

For a number of years, I have maintained that an up to date and industrious Service Man will still find it possible to do a good business even in the "dog days." To be sure, people do not use their radio sets as much in the summer as in the winter, but the difference is not anywhere nearly as great as might be imagined. In the country and suburban sections, the old fable that it is dangerous to operate a radio in the summertime during a thunderstorm is still given a lot of credence. Yet, records for over ten years show that this is a foolish superstition, the same as many other superstitions. A radio aerial is struck not oftener than a dwelling or a building; and, if the radio installation is properly made, the worst that can happen is that a short length of aerial wire and perhaps a few insulators and a lightning arrester will be destroyed.

It is very infrequent that a radio set is affected when a building is struck by lightning. Even when the average private dwelling which has an aerial on it is hit, the chances are 50-50 that the aerial itself will be struck. Remember, the comparatively thin aerial wire does not offer the best possible path for lightning. The usual metal roof or a leader is struck in preference to the aerial. The clever radio Service Man will not overlook these facts. While it is neither ethical nor necessary to scare owners of private residences and apartment house tenants, their attention should be forcibly called to the fact that the law calls for lightning arresters on aerial installations; not only does the law call for it, but should fire break out due to an aerial being struck by lightning where there is no lightning arrester, the owner could not collect insurance. This, of course, is a good point for the Service Man to remember.

We have seen some clever letters by Service Men written to house owners and apartment dwellers calling attention to this fact. One went so far as to use an illustration showing a house in flames; letters two-inches high, on the illustration read: "You Can't Collect on This Loss." This was a good curiosity arouser; and then, of course, the letter went on to explain that a proper aerial installation, with proper lightning safeguards would protect the dwelling, not only from loss of life and property from fire, but would cover the owner so far as his insurance was concerned. This Service Man reported a tremendous response to his letter, sufficient to make it necessary for him to hire several helpers to install new aerial systems and adequate lightning arresters.

But this is only half of the story. It is true that not a great deal of money can be made in such installations, yet, if you get enough of them they will show a handsome profit. Far more important is the fact that such an installation serves as an excellent introduction for the Service Man, which can be followed up later on, because if the owner is satisfied that a good job has been performed, there will be more business to be had later on.

In recent editorials I also stressed the point that there is still an excellent summer business to be had by Service Men installing amplifiers, small "cigarbox" type of radio sets, etc.; in addition to this, there is always a brisk demand in the summer for extra loudspeakers. At the present time this demand is particularly good because of the fact that in many sections of the country there are springing up thousands of beer gardens, open air restaurants, etc., all of which can be "piped" for radio by means of extra loudspeakers, a number of which can be attached directly to the radio set, always providing that it has enough power. Of course, in this connection the amplifier angle also pops up, because, if the open air garden or restaurant is large, a single extra loudspeaker will no longer cover the job, and additional amplifiers must be used. Seldom are two jobs the same.

Then, too, there is the important problem—frequently totally overlooked by Service Men—of renting out radio sets. In the summertime, particularly, such sets can be rented out at a good profit, and frequently the renting price for the season exceeds, by far, the price of the radio set. In the larger cities, second-hand radio sets can be bought for as low as $1.00. All that is required is to put them into shape, equip them with tubes, and after they have been cleaned up and put into presentable condition, they may be rented for about $1.00 a month in many cases. There is a good demand for such a renting service in practically every community. This is particularly the case in summer mountain or seashore resorts, bungalow colonies, camps, etc., where the prospects would rather pay $2.00 or $3.00 for the rental of such a set for the summer vacation period than burden themselves with either bringing their own radio set along or buying a new one for the occasion. It will be found at the end of the season that not only has the capital outlay for these sets been repaid, but usually the sets bring a clear profit and can be rented out again later on for various other occasions.

Then, as I have pointed out before, there is now a lucrative demand for automobile radio sets. Such automobile radio sets can be sold without a great deal of sales talk by actually demonstrating a set in a car.

The same thing is true of motor boat sets, where the surface has not even been scratched. Very few Service Men have thought of going after this business, which is particularly good because very few motor boats are equipped with radio sets, and practically all boats *should* be so equipped. Here the automobile radio sets come in very handy. An extra profit can be realized for the reason that the automobile set has to be water-proofed in some way, which usually may be left to the ingenuity of the Service Man when he makes the installation. Naturally, water, and particularly sea water, is fatal to radio sets. There are, however, means of water-proofing them with rubber insulation, all depending upon where the automobile set is installed in the boat. Frequently, it becomes necessary to build a special waterproof compartment, leaving only the controls protruding. Inasmuch as there are thousands of such boats all over the country, it should not be the most difficult thing in the world to convince every owner that the one thing he should have in his boat is a radio set.

HOW TO BUILD THE RADIO-CRAFT

LOOP-PORTABLE RECEIVER

Here's what every fan has been waiting for—a portable loop-operated receiver, with batteries; and everything contained in a standard typewriter case. The receiver uses three tubes in a novel circuit arrangement.

R. D. WASHBURNE
and N. H. LESSEM

MODERN tubes have made convenient the construction of an entirely self-contained radio receiver for the reception, at "loudspeaker volume," of local stations; the "loop-portable '3'" incorporates in one carrying case a uni-directional loop antenna, three rugged cathode-type tubes—a type 77, a 6F7, and an 89, a magnetic reproducer, a receiver chassis, and the power supply. On the magazine cover the set is depicted in use; it is again illustrated in Figs. A, B, and C. Electrical and mechanical theory, and electrical and mechanical practice determined the design of this instrument; both factors are closely linked. The theoretical description refers to Fig. 1; construction details are illustrated in Figs. 2 and 3.

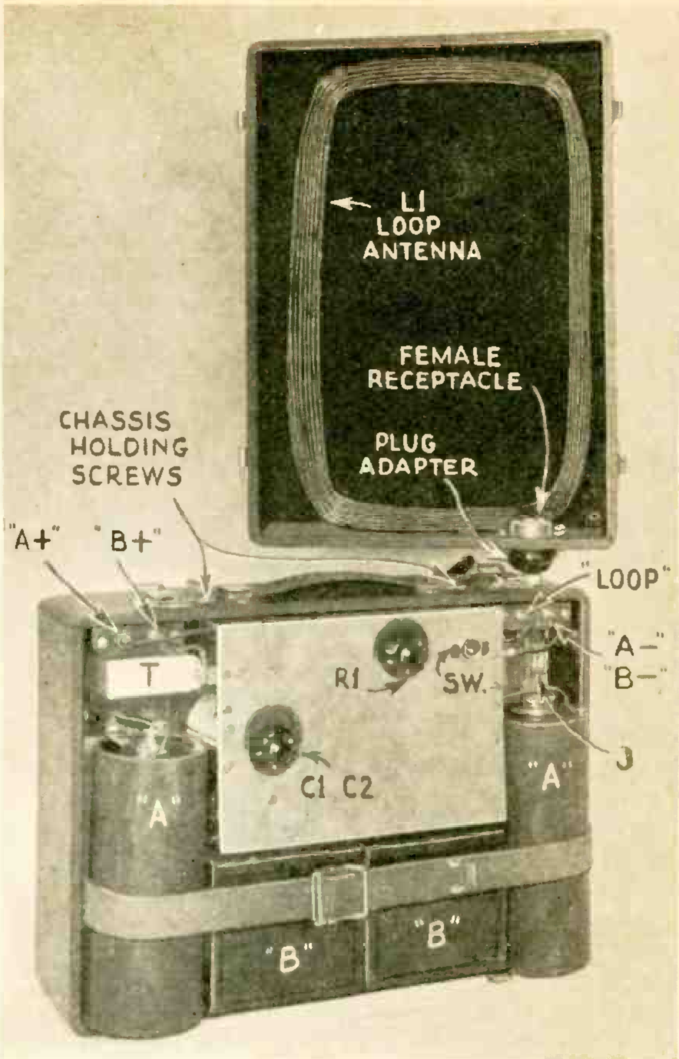


Fig. A
Photograph of the receiver. See other figures for further details.

Design Data

Filament-type tubes are not suitable for any service in which the element of portability, which implies ruggedness, is to form a part; heater-type tubes, on the other hand, are eminently suited to this very purpose, and therefore were the choice for use in our portable.

For reasons which will become apparent as the story progresses, those of the 6.3-V. heater type are most suited to our requirements. Since the tube complement is limited, it is necessary that every possible artifice be used to obtain the utmost from the tubes.

After determining the necessary filament and plate characteristics, rapid progress was made in establishing the dimensions of the carrying case.

The voltage and current requirements of the filament circuit prescribed the use of four No. 6 dry cells for the "A" supply.

The Circuit Design

First on the list of difficulties was the matter of obtaining sufficient gain from the most efficient tube. Since it was desired to obtain the greatest possible amplification in the circuit of the first tube in order to adequately "drive" the remaining tubes, the question arose as to whether a tube having a variable-mu characteristic should be used as the first R.F. amplifier. Since the greatest advantage of the variable-mu tube lies in its ability to amplify R.F. signals without "cross-talk," this point was discounted first, because of the comparatively small amount of pick-up which could be expected from a loop antenna, and second, because of the highly directional characteristics of the "pancake" type of loop-antenna. The tube with the highest amplification factor is the non-variable-mu type 77, with an amplification factor of 1,500. This tube was therefore selected as the first R.F. tube.

The second tube selected for this receiver is the type 6F7 described in the July, 1933, issue of RADIO-CRAFT. It combines in one envelope not only the functions of an R.F. variable-mu pentode, but also makes available a triode which is a very good detector and which may be coupled into the grid circuit of the output tube by means of a transformer, thus obtaining considerable voltage "step-up" due to the turns-ratio of this A.F. transformer; this unit, T, in Fig. 1, has a step-up ratio of 1:5.

The tube having the greatest mu of any in the 6.3 V. line for use as an output device is the type 89; it is this tube which we have chosen as the third in the group.

Unquestionably, the loop circuit must be tuned; otherwise, the cross-talk might be too high. Then, too, if maximum gain from this stage of R.F. amplification is to be realized, it is essential that the plate circuit impedance be maintained sufficiently high by tuning the secondary coupled to the plate circuit primary winding.

The loop inductance is built into the lid of the cabinet and by means of an easily removable, specially constructed simple adapter, plugs into a jack, on which it pivots. The R.F. leakage in this plug-adapter ordinarily is not excessive, but tends to slightly broaden the tuning of this circuit and hence increases the convenience of ganging throughout the tuning range.

Construction Details of Chassis

The first step in constructing the receiver chassis is to drill the three sheets of aluminum, as per Fig. 2. Attention is here called to an important point: the measurements, for the parts specified, are quite exact, since many of the components are a snug fit.

THIS PORTABLE RECEIVER—

(1) May be fully constructed at home at low cost;

(2) Gives good loudspeaker reception on local stations;

(3) Is economical in operation—it uses but three tubes, one of them taking the place of two tubes;

(4) Is completely self-contained in a typewriter case;

(5) Uses automotive tubes, which can stand the strain imposed upon them in portable work.

The use of portable radio receivers has not received the consideration it should receive. Just as automotive radio is being pushed by every large manufacturer, portable radio sets will be pushed, especially during the summer. Everyone sneered at the midgets until they were sold in such quantities as to make the "big fellas" wake up; we predict that they will wake up in exactly the same manner when the portable idea "grabs hold."

This is your chance to "get the worm"; for "the early bird—"

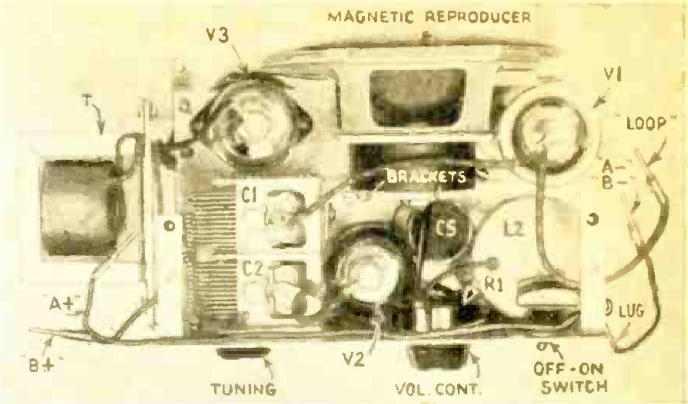


Fig. B
A top view of the loop-portable chassis, with the top aluminum plate removed.

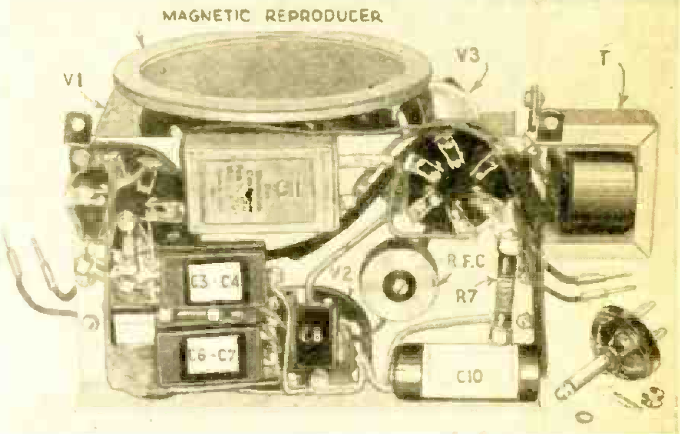


Fig. C
Underside illustration. The compact arrangement of the components necessitates unusual care in arranging the leads to prevent feedback.

Having drilled the aluminum panels, the next step is the assembly. All the bigger units may now be mounted as shown in Fig. B, after having bolted the three aluminum plates together by means of the brackets. The underside of the sub-panel should come ⅞-in. below the edge of the front panel. Use lock-washers wherever possible.

At this stage of affairs note the following details. Fasten the two name plates, "tuning" and "volume," into position by means of tiny brads. Saw off a ⅜-in. strip of the magnetic reproducer chassis at the end opposite that from which the leads are taken. Each socket requires a thin bakelite cover-plate. Before proceeding further, plug the tubes into their respective sockets and check for grounded prongs; a simple continuity meter is used for this test. To provide clearance for the rotor section of V2, it is necessary to counter-sink the holes of the two left-hand brackets for three of the nuts, and to use three short machine screws filed almost flush with the top of the brackets. Condenser C2 is mounted on the front panel by means of two machine screws. Shim the condenser with washers to keep it parallel with the front panel.

A bracket 3½ ins. long extends the length of the reproducer metal housing; its foot is ½-in. long and bolts to the sub-panel. A second bracket, ¾x1 in., bolts the left side of the reproducer to the lower-rear mounting hole of the variable condenser. At this point insert V2 into its socket and note whether there is sufficient clearance for the tubular electrolytic condenser C5, which should just fit snugly in the space bounded by V2, the reproducer, and L2. Now mount transformer T on its bracket, which measures 3¾x⅞-in., and mount this bracket on the chassis. One hole in this bracket matches with one of the holes in the chassis bracket; shim the other hole in the transformer bracket with a rectangular washer (made from one of the

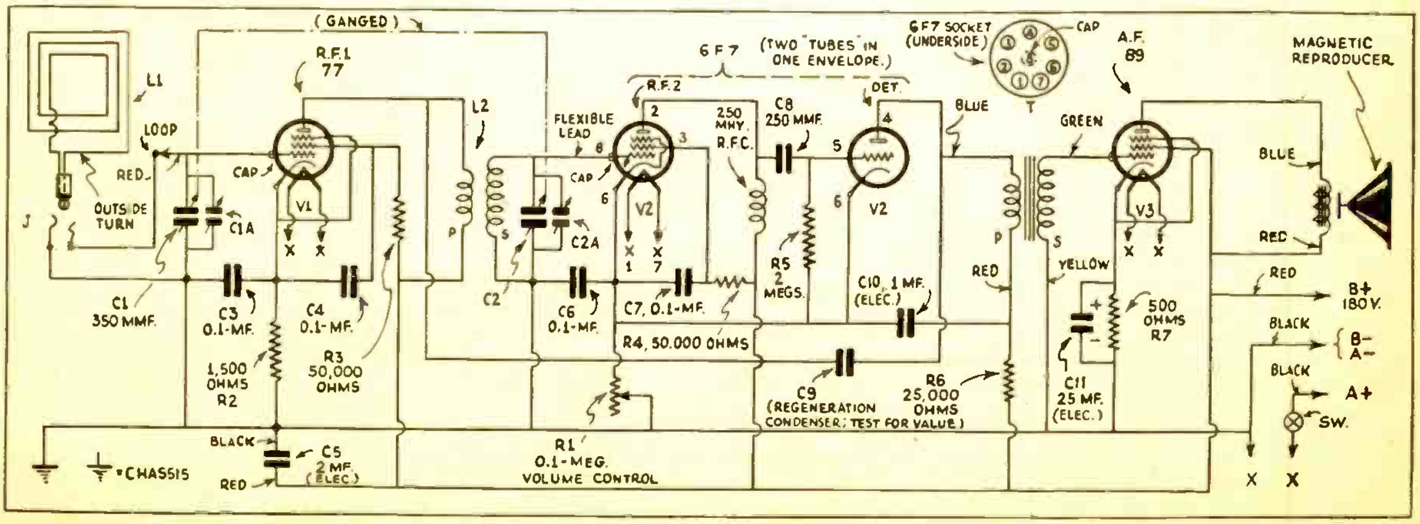


Fig. 1
Schematic circuit of the RADIO-CRAFT Loop-Portable Receiver. After completely assembling and testing the set, it is a good plan to experimentally determine whether any of the component values may be changed to advantage, in accordance with the characteristics of individual tubes, R.F. transformers, etc.

bracket "left-overs") to just fit between this bracket and the condenser gang. After the reproducer has been correctly mounted on its bracket, the front of the reproducer *frame* (not the cardboard gasket) will be 4 7/16 ins. from the front panel and parallel to it; this brings the edge of the reproducer ¼-in. from the "floor," when the set chassis is placed on a level surface, with the rear edge of the sub-panel supported by two double right-angle brackets, as shown in the photographs.

If the drilling layout has been followed, there will now remain in the sub-panel a hole near the front through which a wire is to be run from the left-hand (looking from the rear) soldering lug on the volume control. A copper rivet at the bottom of this control partly assembles the unit; bend over and solder the middle lug to it. The right-hand lug is not used; bend it out of the way.

The tiny knobs used on the controls of this chassis will just clear the cover of the case when it is slid into position and closed. One of these knobs must be *very carefully* drilled out (preferably on a lathe) to fit the ⅜-in. shaft of the variable condenser. Hold the shafts of C1 and R1 in a vise and saw these sufficiently short to permit the knobs to clear the front panel by only 3/32-in. when slipped onto the shafts of their respective controls.

Now turn the chassis upside down and wire all the little components into place.

Wiring the Receiver

First, mount R.F.C. to the sub-panel by means of a brass machine screw; a tapped hole has been indicated in Fig. 2 for it. *Very carefully* scrape the enamel from the hair-fine wire of this choke coil, place spaghetti over the wire, and run the leads directly to their destination, soldering them in position. Choke R.F.C. will mount on the sub-panel in either of two positions; place it so that the choke clearance is the maximum of ¼-in. Connect the outside lead to the plate of the pentode section of V2.

Pull the color-coded leads of the reproducer through the holes provided in the sub-panel, slip spaghetti over the leads to prevent wear at the edge of the aluminum, and solder the leads into the circuit.

Twist three of the color-coded leads (see Fig. 1) of the A.F. transformer and a separate fourth lead which will be "B" plus, into a cable, run them down to the sub-panel, and wire them into position. The remaining color-coded lead from T is to be soldered to a cap for connection to the control-grid of V3.

Grid coupling condenser C8, after being soldered into position close to the socket terminals of V2, must be bent back over the terminals. This prevents A.F. oscillation due to feedback between this condenser and the reproducer leads. To prevent A.F. oscillation due to coupling between the high-impedance R.F. choke and the high-potential lead from the primary of T to the plate of the triode section of V2, run this plate lead along the left and front edges of the sub-panel. Condenser C9 is used to obtain maximum regeneration in the triode section of the 6F7 tube; experimentally determine its value, for a given tube, by substituting a variable condenser, then solder into place a fixed unit of the correct value, being careful to run the leads so that they do not cause circuit oscillation.

Note that the electrolytic condensers are polarized; the correct polarities of the connections are indicated in the schematic circuit. Drop C5 into place and solder its negative lead to the top copper rivet on R1; put spaghetti on the positive (red) lead, run it through the hole in the sub-panel, and wire it into the circuit. The purpose of this condenser is to prevent inter-stage feedback at all times and erratic operation when the "B" batteries become partially discharged. Condenser C11 just fits along the rear edge of the sub-panel. Condenser C10 fits along the inside front edge of the sub-panel; it has a diameter of ⅞-in. and therefore fits flush with the bottom edge of the front panel. If high grade electrolytic condensers are not used, excessive leakage current will cause the "B" batteries to rapidly deteriorate.

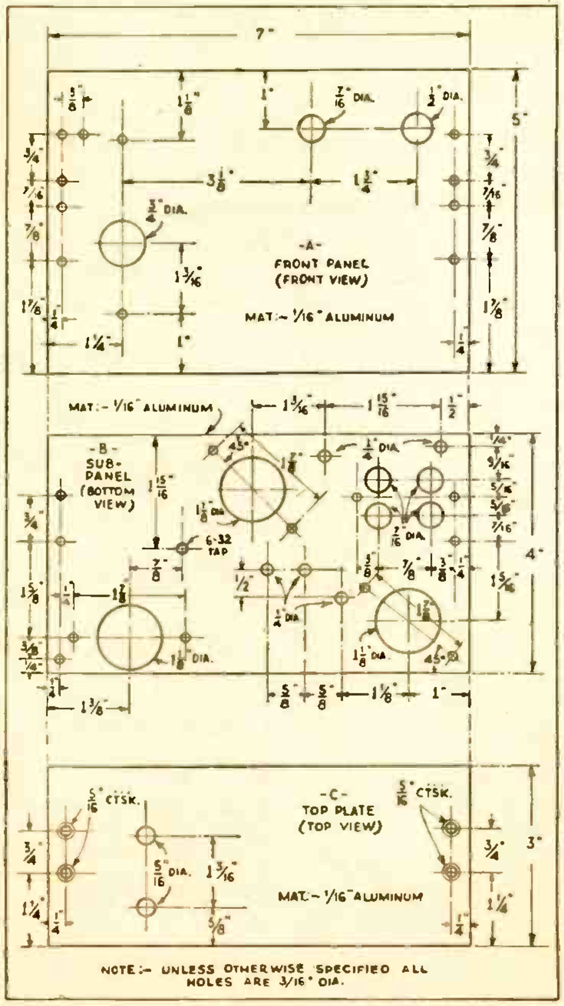


Fig. 2

A layout for drilling the holes in the aluminum panels.

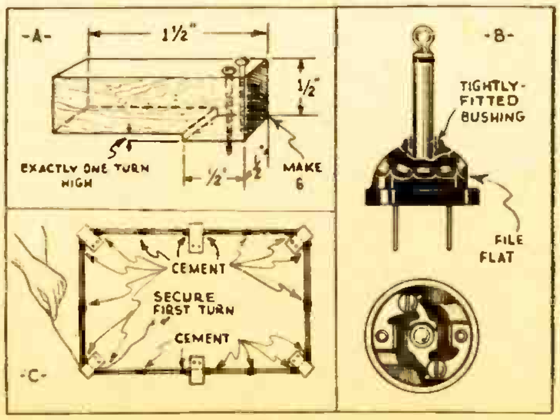


Fig. 3

Details of construction. At B, the assembly of the plug-adapter; A, loop-wire blocks; C, loop winding procedure.

This receiver chassis connects to the power supply and the loop antenna by means of tip-jacks, as shown in Fig. A and in Fig. 1. One tip-jack lead is "A" minus—"B" minus, and the other is the high-potential (outside) lead to the loop antenna, on the right-hand terminal strip inside the cabinet; one tip-jack lead is "A" plus and the other is "B" plus, on the left-hand connection panel; provide tip-jack leads accordingly. The chassis is "A" minus "B" minus, and the other is the lead from the switch extends along the top edge of the front panel to the left-hand side; the top plate, when in position, holds this in place. Be *sure* to letter each tip-jack for future identification.

The R.F. transformer, L2, is of "high-gain type and is provided with four soldering lugs. Use a continuity meter to find the primary and secondary lugs. The control-grid lug (which connects to the flexible lead) is diagonally opposite the plate connection.

The Power Supply

The four dry cells and the four "B" batteries are held tightly in position inside the carrying case by means of a web strap which is bolted to the sides of the case; these bolts (two per strap-end) are separated ½-in., and spaced 1⅜ ins. from the front of the case. The dry cells fit the case so closely that it was necessary to remove their thick cardboard covers and substitute a two-layer wrapping of paper. If the metal edges of the cells are not completely covered, one cell may short to another.

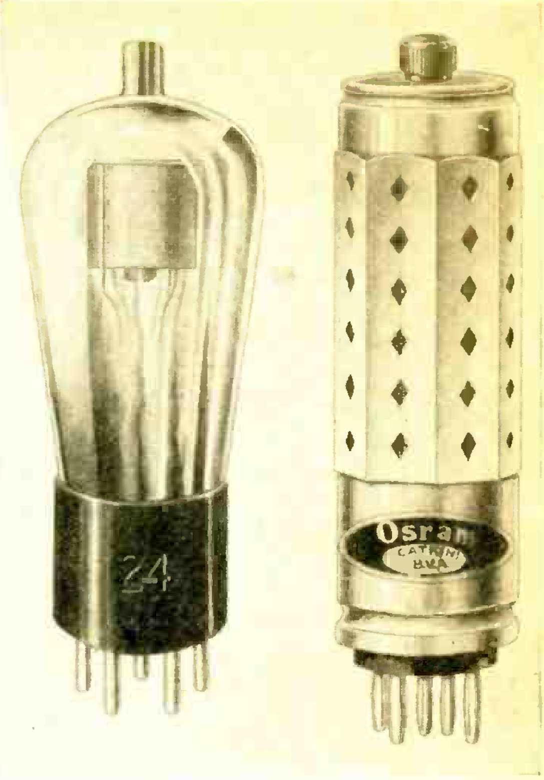
Now comes the most difficult procedure—making the loop.

(Continued on page 119)

A NEW ENGLISH ALL-METAL TUBE

While American tube manufacturers have been content to produce "new" tubes by adding grids and plates to old ones in wild confusion, the British have really done something by eliminating 95% of the glass used in tube construction. The result is stronger and far more uniform tubes than have hitherto been available.

ROBERT HERTZBERG



Here is the new English "Catkin" alongside an American type 24, screen-grid tube.

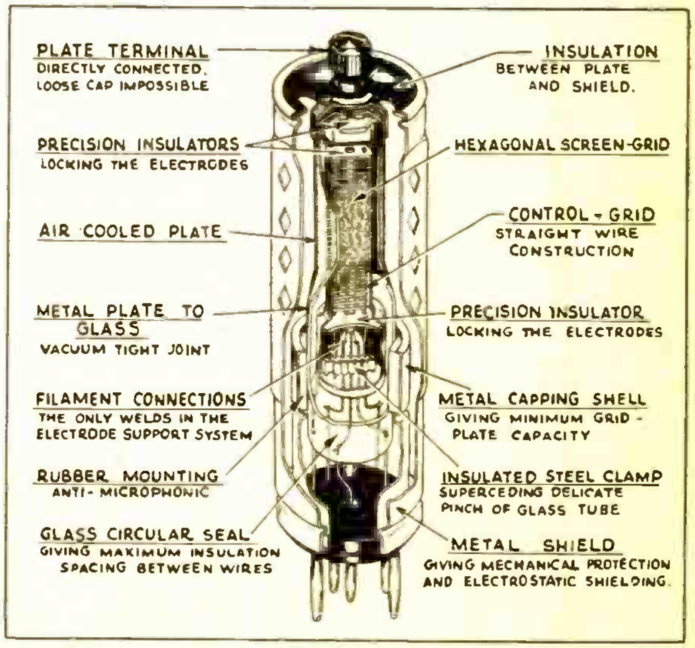
THE current sensation in European radio circles is the new "Catkin" *all-metal* tube, which promises to revolutionize the tube manufacturing industry and to solve a number of vexing problems of set design, construction, and operation. While glass has not been eliminated entirely, the predominance of metal warrants the use of the expression "all-metal."

In brief, the Catkin tube uses a copper cylinder, or container, in place of the customary glass envelope, this container being the plate electrode. The other electrodes, i.e., cathode and grids, are mounted within the cylinder in their usual relationships to form triodes, tetrodes, and pentodes. As shown in the accompanying illustrations, the bottom end of the copper container is sealed vacuum-tight to a short glass member, through which the connection wires emerge and also through which the air is exhausted. The entire lower end of this assembly is supported in the base by a built-in circular rubber mounting.

While this type of construction has been used for many years in high-power transmitting tubes, its application by the British General Electric and Marconiphone companies to the receiving field is worthy of commendation. The name "Catkin" is a coined word based on the laboratory slang word "cat" for "Cooled Anode Transmitters," a "catkin" thus being a diminutive "cat." In transmitting work, where the plate power dissipation is very great, the copper cylinder is cooled by water circulating around it in a jacket. In the new Catkins the mere air circulation is sufficient to bring the overall operating temperature well below that of vacuum type tubes, wherein the very vacuum between the plate and the surface of the glass bulb makes the problem of heat radiation very difficult of solution.

Vastly greater rigidity of internal construction is possible with the Catkins than with glass tubes because the electrode structure can be braced firmly at BOTH ends by means of insulating spacers that actually touch the inner surface of the copper "plate" cylinder. Not only does this arrangement practically eliminate microphonic effects, but it also permits a degree of uniformity in manufacture sadly lacking in conventional tubes; particularly tubes with a number of critically spaced grids. In fact, uniformity of characteristics is the main merit claimed for the Catkins, the tubes, electrically, being the general equivalents of standard British types.

The general-purpose triode and the output pentode of the Catkins series do not require an external cover or shield, and full advantage is taken of the effective cooling action of the exposed "plate." These tubes have a conventional base with apparently nothing but a stubby piece of copper sticking out of the middle. In the R.F. tetrodes an external shield of familiar appearance is employed. This is of the same diameter as the base and is permanently attached to it; no separate tube shields, as we know them in America, are needed.



The entire story of the Catkin is told in the drawing here. A really "new" tube.

An incidental departure in construction is the elimination of the usual pressed glass bead in which the support wires for the electrodes are sealed; instead, the Catkins use mica, the assembly at this point being braced by a steel clamp.

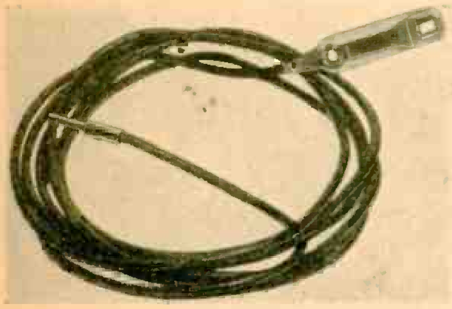
Providing the metal-to-glass vacuum seal proves satisfactory, it is easy to see that the Catkins will enjoy widespread popularity and application. The manufacturers claim they can be dropped six feet on to a concrete floor with but small risk of either mechanical or electrical damage. The admittedly superior internal electrode bracing

(Continued on page 110)

LATEST RADIO EQUIPMENT

OUTPUT ADAPTER

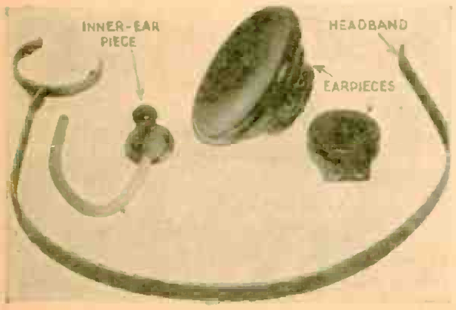
THIS connector will slip over any prong in the base of a tube without interfering with the regular connections. It is very useful for attaching output meters, tone controls, extra speakers, phonograph pick-ups, etc. A long flexible wire is provided.



Output Adapter (No. 114)

HEARING AID

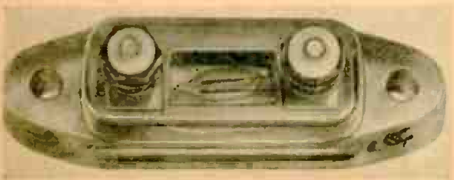
THE hearing-aid earpieces illustrated below are small, light, and inconspicuous, and are capable of delivering large amounts of acoustic energy directly into the ear. They may be used with hearing-aid microphones or with radio receivers, so that a partially deaf person may enjoy radio programs.



Hearing Aid (No. 115)

LIGHTNING ARRESTER

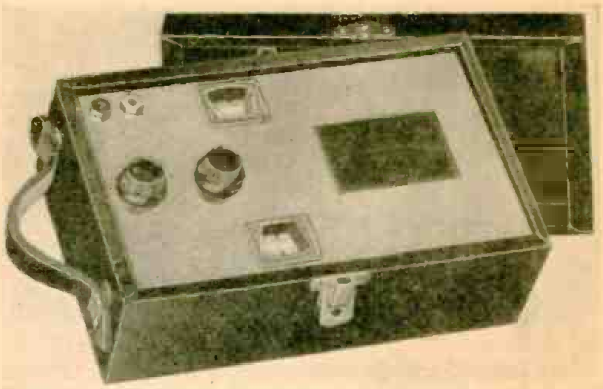
THIS novel all-glass lightning arrester is actually a small neon tube, with the gap electrodes sealed in a small chamber with the neon gas. It fully meets the Underwriter's ruling that arresters must function at 500 volts. The neon merely glows harmlessly when the device is functioning during a storm.



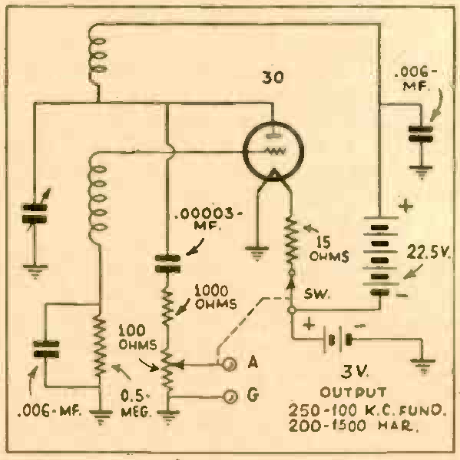
Lightning arrester (No. 116)

SERVICE TEST OSCILLATOR

THE service test oscillator pictured here is virtually a small broadcast transmitter whose output can be adjusted accurately as to frequency and amplitude. Its scale is calibrated directly in kilocycles. There are two windows through which this scale is read; one for the intermediate frequencies, and the other for the broadcast frequencies. The continuous range of frequencies is 100 to 1500 kc., all frequencies higher than 200 kc. being indicated as harmonics. The direct reading scales save time and reduce the possibility of error due to incorrect reading of separate charts.



Service test oscillator (No. 117)



Schematic diagram of the oscillator

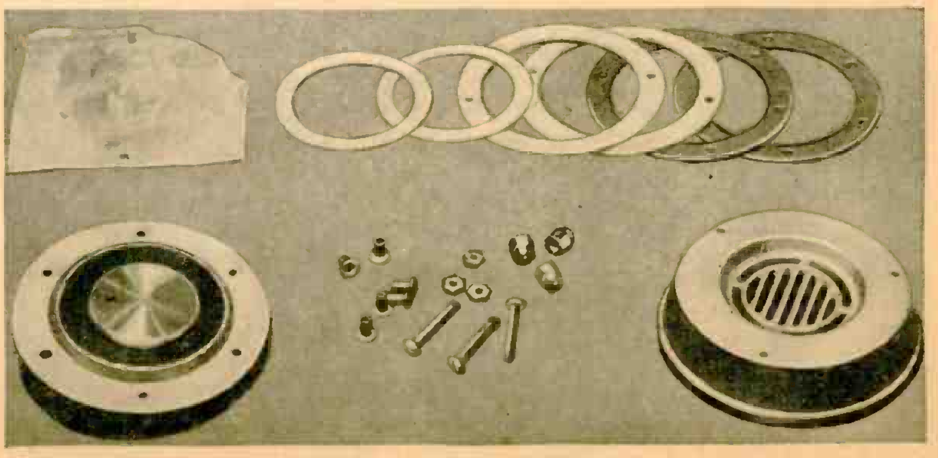
The instrument is entirely self-contained and is fully shielded in a steel copper-clad housing, the outside surface of which is chromium plated. The over-all measurements are 10¼ x 6¼ x 4½ inches. The cover of the carrying case is quickly detachable.

The simplified oscillator circuit using a type 30 tube was chosen because of its stability and its harmonic richness. All controls are grounded, so there are no hand-capacity effects. Two No. 2, 1½-volt dry cells and one small 22½-volt "B" battery are required for power supply.

CONDENSER MICROPHONE KIT

ALL the parts needed for the assembly of a condenser microphone of professional appearance and high quality are included in a kit recently put on the market. The cover and the base plate are die cast and then accurately machined, the shapes of the pieces being such that the thin aluminum diaphragm is stretched perfectly smooth without touching the fixed plate. A number of thin paper washers are furnished, so that the constructor can use a spacing to his own liking. The finished "mike" may be used for P.A. work and broadcasting.

A disassembled view is shown below.



Condenser microphone kit (No. 118)

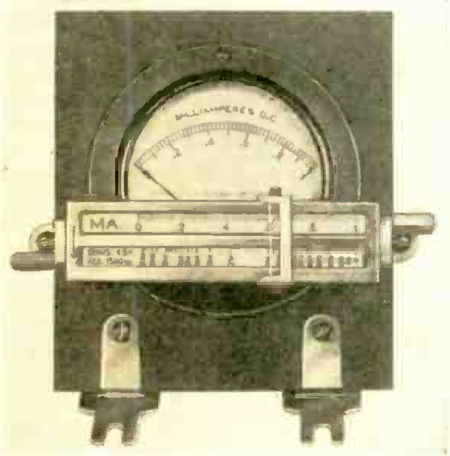
Name of manufacturer of any device will be sent on receipt of a self-addressed, stamped envelope. Kindly give (number) in description under picture.

CALIBRATED DIAL

THROUGH the use of the proper calibration facilities and the special dial adapter illustrated below, an ordinary single range milliammeter may be converted into an instrument having dozens of applications.

The attachment consists of a calibrated roll of linen fastened above the meter in such a way that it does not interfere with the scale. Metal knobs at both ends permit winding and unwinding. A metal slider moves laterally across the face of the roll, above which is a scale corresponding to the meter scale. A turn of the knobs brings the appropriate scale for any particular calibration, *i. e.*, multiplier or shunt, into view. Space for 20 different calibrations is available on the roll.

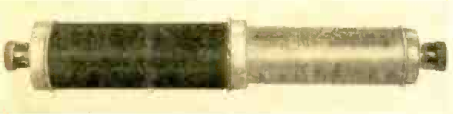
This instrument is fastened to the meter and its scales are calibrated for resistance, any ranges; capacity, several ranges; inductance, if desired; or for multipliers and shunts.

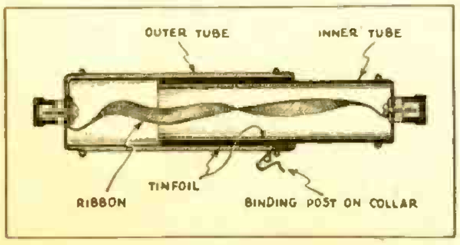


Dial attachment (No. 119)

AERIAL ATTACHMENT

FOR increasing the selectivity of some types of receivers the attachment pictured below is unusually effective. It consists of two tinfoil coated card-board tubes, one sliding within the other to form a variable condenser of low capacity. It is connected in series with either the aerial or the ground wire to the set. An extra binding post on a central collar permits the device to be used as a condenser coupler when the ground is used as the "aerial."





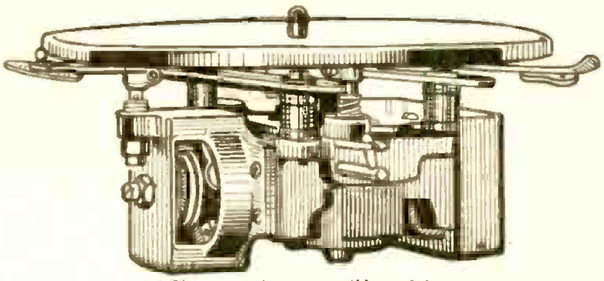
Above: general view of aerial attachment; below: cross-section view (No. 120).

COMBINATION DUAL SPEED PHONOGRAPH MOTOR

THIS motor was designed to meet the demand for a 6-volt storage battery operated turntable for use in sound trucks, automobiles, boats, etc., where 110 volts A.C. or D.C. is not available. It may also be operated from 110 volts A.C. by using an appropriate power pack consisting of a step-down transformer and a copper-oxide rectifier. This feature makes the motor ideal for use in conjunction with universally powered public-address systems, operating from either a six-volt storage battery or 110 volts A.C. A small D.P.D.T. snap switch makes quick changeover possible. The current drain is 2.8 amperes.

A unique constructional feature permits changing the speed from 33⅓ to 78 R.P.M., or vice versa, by the mere shifting of a lever on the side. All gears are spiral cut from laminated bakelite and for silent operation are completely enclosed in oil. Bearings are of the self-lubricating type.

A built-in fan provides constant and automatic ventilation and prevents overheating. Models are also available for 110 volts A.C. or D.C. to play 12- or 16-inch records.



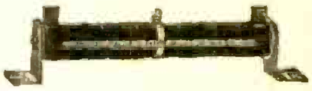
Phonograph motor (No. 121)

RESISTORS AND ELECTROLYTIC CONDENSERS

OF interest to amateurs and Service Men alike is a new adjustable resistor designed for use as a grid leak or voltage divider. The resistance wire is wound on a porcelain tube and is coated with vitreous enamel. A movable slider makes contact with the wire along an exposed strip. Sizes of 5,000, 10,000, 20,000, 25,000, 50,000 and 100,000 ohms are available.

The electrolytic condensers illustrated are representative of a large variety of compact units intended especially for midget receivers. The small condensers, 1-inch in diameter, are high-capacity, low voltage bypass units, while the others are regular filter sizes. Two types of mountings are furnished: strap legs and single hole threaded bushings.

The smaller units shown are but two inches high, while the largest is 5½ inches high. The smallest units are 1-inch in diameter, and the larger ones are 1⅜ inches in diameter. The long, thin fellows are about 5 inches long and 1-inch in diameter. All are of the electrolytic type.



Above: electrolytic condensers. Below: adjustable resistor (No. 122)

A.C.-D.C. PUBLIC ADDRESS AMPLIFIER

THIS compact portable public address amplifier measures only 3 x 8½ x 10 inches, weighs only 7 lbs. complete with loudspeaker, and works on 110 to 140 volts A.C. or D.C., 25 to 60 cycles. It enables the Service Man to get started in the public-address business, as the first several rentals will pay for the entire equipment. A technical operator is not needed; simply plug in the power cord and the outfit is all ready.

Three tubes are used, a 39, a 43, and a 25Z5. The dynamic speaker is built into the amplifier cabinet, with a volume control and on-off switch on the front of the latter. Extra magnetic speakers can be hooked in if desired. A lapel type microphone is supplied. This outfit is available in factory built form.

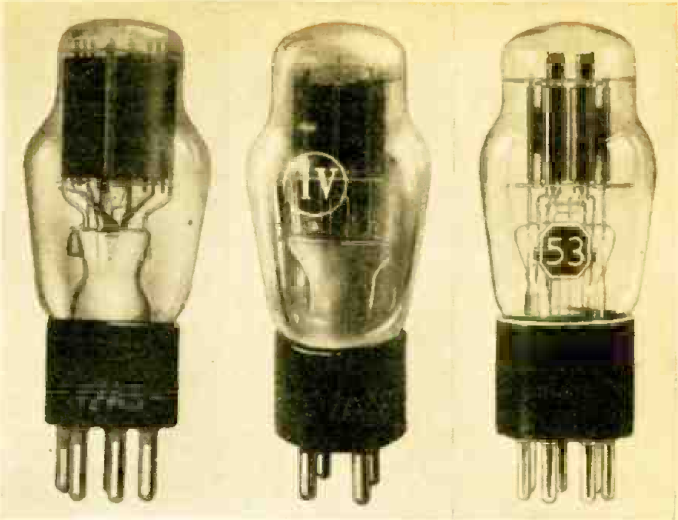
There is a possibility that the manufacturers of this unit may offer it in kit form so that constructors may build the amplifier themselves. It is very simple to operate.

Portable P. A. amplifier (No. 123)

NEW TUBE DATA

The new tubes this month include a new 12-volt output tube, a new high vacuum rectifier, a complete class B amplifier, and a 2-volt duo-diode triode.

LOUIS MARTIN



(Data courtesy RCA, Sylvania, and Sparton)

IN spite of the announcement of numerous new tubes that have made their appearance lately, there are still several more which are being used in many receivers with which the Service Man should familiarize himself. It might be well to mention, at this time, that a tube chart covering the characteristics of all the tubes now available would be quite useless, as in all probability it would be obsolete before it came off the press. We can promise, though, that just as soon as the tube industry becomes a little more stabilized, a comprehensive tube chart will be published.

The 12A5—Pentode Power Amplifier

The 12A5, a power output pentode, is designed for two classes of service: (1) for operation in "universal" receivers operating from either 110 volts A.C. or D.C., and from storage batteries. In the case of 110-volt operation, the two sections of the heater are operated in series, and when used on a 6-volt storage battery, the two sections of the heater are operated in parallel. It is clear, therefore, that this tube has *three* filament connections—one at each end of the filament and one at the center; (2) the second use is for automobile or home operation where about 200 volts are available for the total "B" supply.

In the case of the automobile receivers where efficiency is of prime importance, a self-biasing resistor of about 850 ohms and a load resistance of about 6,000 ohms are recommended. In the case of A.C. operation, where ample D.C. power is available, a cathode resistor of 600 ohms and a load resistance of 4,500 ohms are recommended.

The output characteristics, with fixed bias, are shown in Fig. 1 for both 180- and 100-volt operation. The characteristics for a 200-volt "B" supply, using a cathode resistor for bias, are shown in Fig. 2. In this latter curve the efficiency curves shown include the loss in the screen and cathode resistors and, hence, is the over-all efficiency of the tube.

The socket connections are shown in Fig. 3A. The ratings and characteristics of this tube are as follows:

	Series	Parallel	
Heater Rating			
Voltage	12.6	6.3	Volts
Current	0.3	0.6	Amps.
Class A Pentode Amplifier			
Plate Voltage	100	180	Volts
No. 2 Grid (Screen Grid)	100	180	Volts
No. 1 Grid (Control Grid)	-15	-27	Volts
Load Resistance	5,000	4,500	Ohms
Plate Current	18	40	ma.
Screen Current	4	9	ma.
Power Output	.70	2.8	Watts
Class A Pentode Amplifier Self Bias			
Plate and Screen Supply	200	200	Volts
Load Resistance	4,500	6,000	Ohms
Cathode Resistance	600	850	Ohms
Power Output	2.7	2.2	Watts
Cathode Current	44.0	36.0	ma.

The 1-V—A High Vacuum Half-Wave Rectifier

The use of a 6.3-volt heater in the type 1-V tube makes it adaptable to small receivers designed either for A.C.-D.C. service or for storage-battery operation (automotive service). This feature has been successfully employed, and satisfactory operation is made possible through proper circuit design which permits changing from one type of service to the other by means of a convenient switching device. In A.C.-D.C. sets the heaters are in series, while for automobile service the connections must be for parallel operation of the heater elements.

The only other half-wave rectifier having a 6.3 volt heater is the type 1, formerly designated as KR-1. This latter tube is a mercury-vapor rectifier with characteristics quite similar to the 1-V. In fact, the 1-V tube is directly interchangeable with the mercury-vapor type in equipment where the A.C. plate voltage does not exceed 250 volts R.M.S.

When the tube is employed in A.C.-D.C. receivers, the heater is operated in series with the heaters of the other tubes in the set. Its use in this manner is similar to that for a 12Z3 or for the 25Z5 as a half-wave rectifier. Output characteristics for an A.C. input of 115 volts R.M.S. may be found in Fig. 4.

The type 1-V may be employed in

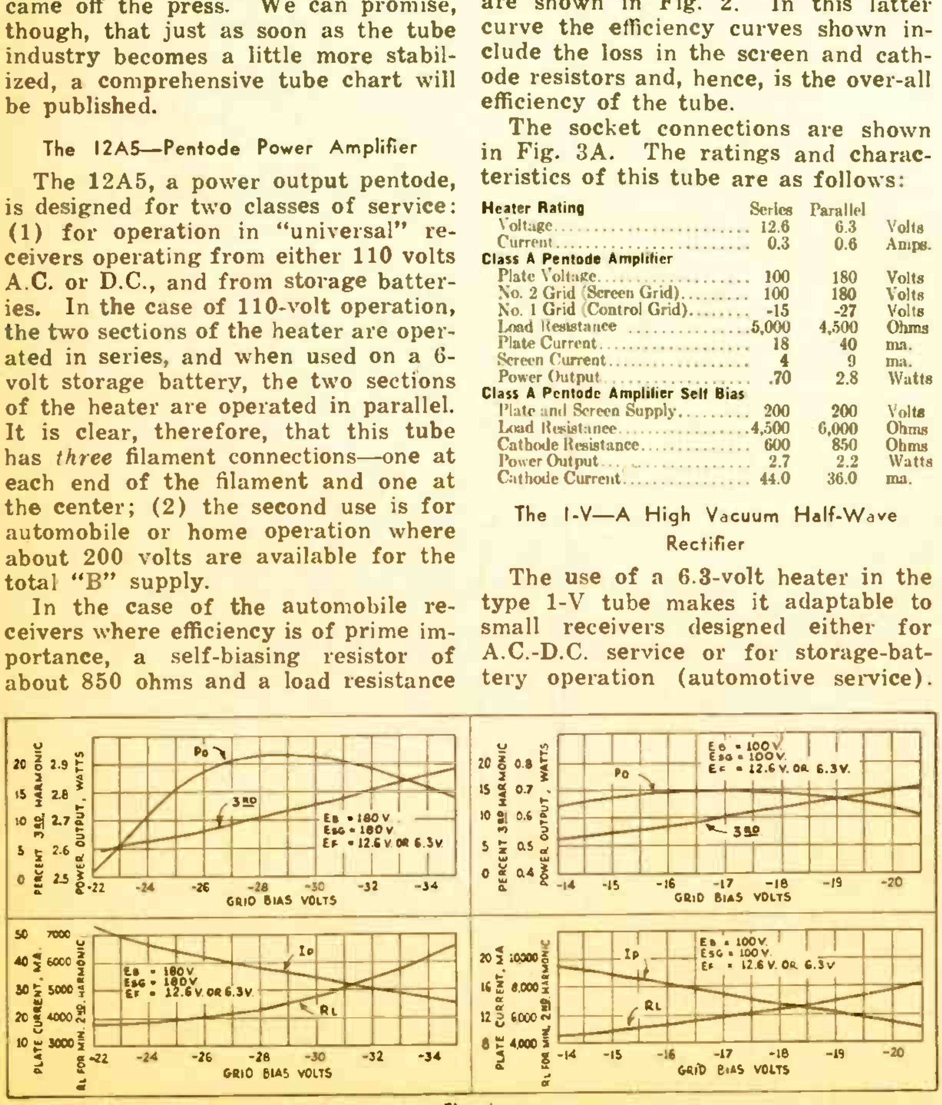


Fig. 1
Output characteristics of the 12A5 with fixed bias for both 180 and 100-volt operation.

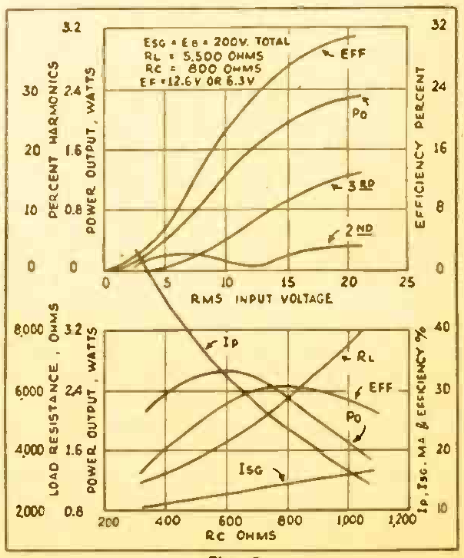


Fig. 2
Characteristics of the 12A5 for a 200-volt "B" supply.

THE TUBES AT A GLANCE

The 12A5—Output Pentode

Filament voltage, 6.3 or 12.6; plate voltage, 100 to 200, depending upon connection; plate current, 18 to 40 ma., depending upon connection; power output, .7- to 2.8 watts, depending upon connection.

The 53—Class B Tube

Complete Class B tube in one envelope. May be used either as a class A driver or as class B output tube. Filament voltage, 2.5; plate voltage, 250; power output, class B, 8 to 10 watts

The 1-V—Half-wave Rectifier

A 6.3-volt rectifier suitable for A.C.-D.C. or automotive use. In use where the A.C. voltage does not exceed 250, this tube is directly replaceable with the KR-1.

The 25-S—Detector-Amplifier

A special 2-volt duo-diode triode designed for battery-operated receivers. Similar in construction to the 55. Has a .06-ampere filament; plate voltage, 135 volts.

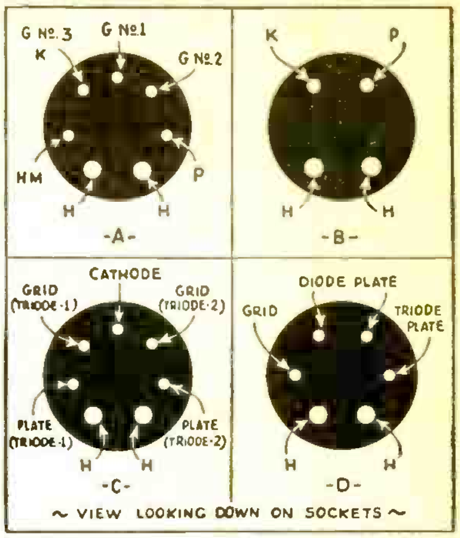


Fig. 3

At A, socket connections of the 12A5; at B, connections for the 1-V rectifier; at C, connections for the 53, class B tube; and at D, connections for the 25-S.

automobile receivers wherein the power supply unit incorporates a half-wave circuit for rectification. This application is possible provided the output voltage characteristics and permissible D.C. current drains of the 1-V are satisfactory for the requirements of such sets.

The filament and cathode are electrically insulated from each other so as to permit operation with a difference of potential between these elements. The maximum permissible voltage between heater and cathode is 300 volts D.C. In general, this condition is assured, provided the tube is operated within its specified maximum plate voltage. Output characteristics for an A.C. input of 230 volts R.M.S., using different values of condenser C, are shown in Fig. 5.

The socket connections of this tube are standard and are shown in Fig. 3B. The characteristics of this tube are as follows:

Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
AC Plate Voltage RMS	250 Volts (Max.)
DC Load Current	50 Milliamperes
Peak Current	200 Milliamperes (Max.)
Voltage Between Heater and Cathode	300 Peak Volts (Max.)

The 53—Twin Class B Amplifier

The 53 is a heater-cathode type of tube combining in one bulb two high-mu triodes designed for class B operation. It is intended primarily for use in the output stage of A.C. operated radio receivers. The triode units have separate external terminals for all electrodes except the cathodes and heaters, so that circuit design is similar to that of class B amplifiers utilizing individual tubes in the output stage. The 53 may be used as a class A amplifier (with triode units connected in parallel) to drive a 53 as a class B amplifier in the output stage.

The base pins of the 53 fit the standard seven-contact socket which may be installed to operate the tube in any position. For socket connections, see Fig. 3C.

The heater is designed for A.C. operation at 2.5 volts. The cathode should preferably be connected directly to a mid-tap on the heater winding. If this practice is not followed, the heater may be biased negative with respect to the cathode by not more than 45 volts.

As a class B power amplifier, the 53 is used in circuits similar in design to those utilizing individual tubes in the output stage. It requires no grid bias, since the high-mu feature of the triode units reduces the steady plate current at zero bias to a relatively low value.

The D.C. plate current required in class B circuits fluctuates under normal operating conditions. The power supply, therefore, should have good regulation to maintain proper operating voltages regardless of the current drain. For this purpose, a suitably designed power unit should be employed. The rectifier tube should have reasonably good regulation over the operating range. In some circuit designs, a vacuum-type of rectifier tube can be used; while in others, a mercury-vapor type may be needed to provide the required regulation. As a factor in obtaining good regulation, the filter chokes and the transformer windings should have low resistance. In the design of a power supply for a class B amplifier, consideration should be given to economical distribution of losses. Also, the power supply should be designed to take care of the average power requirements with sufficient regulation to meet the peak power demands.

(Continued on page 111)

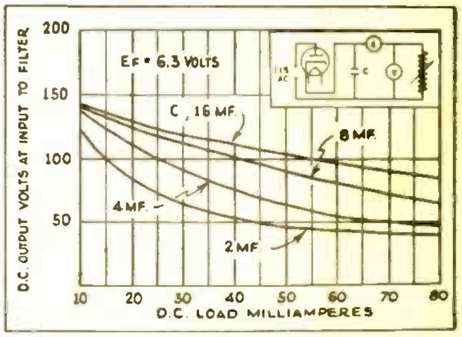


Fig. 4

Output characteristics of the 1-V rectifier for an A.C. input of 115 volts. When used in this connection, the tube is designed for use in "universal," A.C.-D.C. sets.

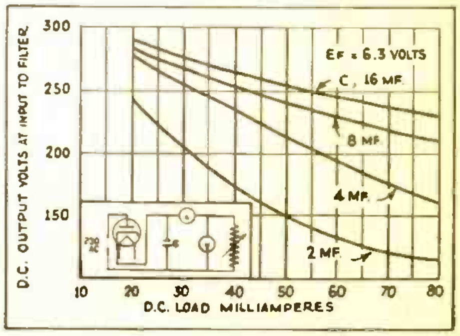


Fig. 5

Output characteristics of the tube when the input is 230 volts, A.C. When used in this manner, it is especially suitable for automotive use.

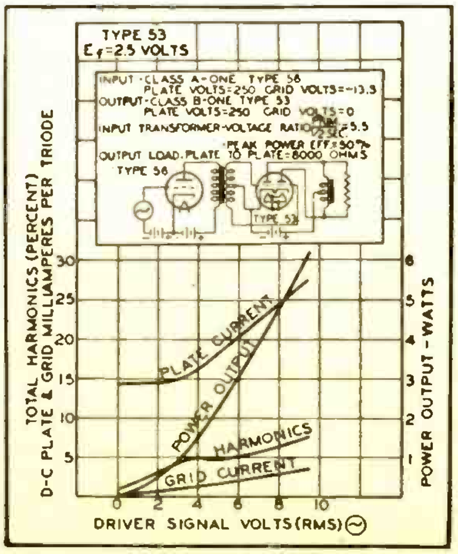


Fig. 7

An interesting set of curves of the 53 showing the variation of plate current, power output, and distortion, with signal voltage.

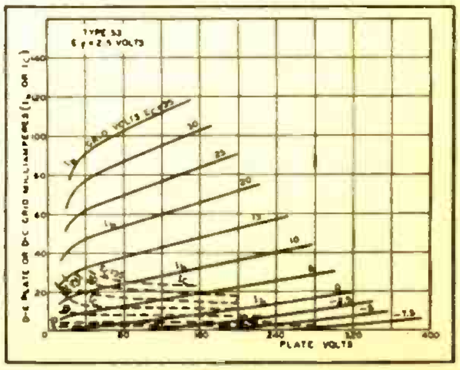
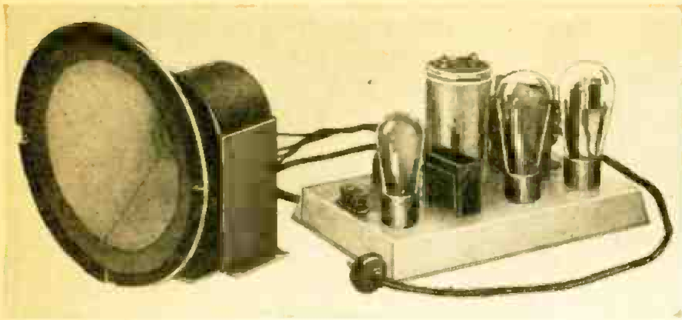


Fig. 6

A family of plate-grid current curves of the 53 tube. The solid lines correspond to the plate currents and the dotted lines to the grid currents.



Photograph of an A.F. direct-coupled amplifier built by the author which uses the circuit of Fig. 1.

DESIGNING AND CONSTRUCTING DIRECT-COUPLED A. F. AMPLIFIERS

The first of a series of two articles designed to give the reader a number of practical direct-coupled circuits with sufficient design data to explain "what's what."

L. B. BARCUS

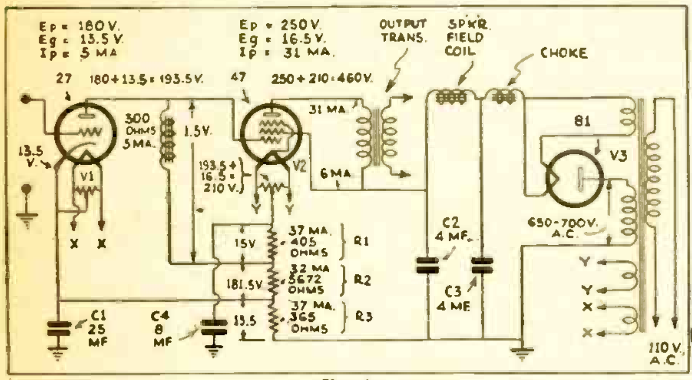


Fig. 1
Circuit of a direct-coupled amplifier using a 27 (or 56) feeding a 47.

OF LATE the attention of the radio fraternity has been turned more and more to the audio characteristics of radio apparatus. Urged on by the better class of radio receivers, the public has become critical of tone quality wherever audio amplification is employed. In an attempt to stimulate the sale of radio sets, engineers have made tremendous strides in the perfection and development of existing circuits. The past year has seen a number of elaborations in audio circuits, giving, in the aggregate, more power, better control and greater fidelity.

Unfortunately, however, practically every application of audio amplification in use today makes use of circuits almost impossible of complete perfection. Even the best amplifiers, in use today, show considerable distortion, regardless of the care and expense involved in their construction. For this reason, the amplifiers to be discussed in these articles were developed to give every constructor the opportunity to build an amplifier which will fulfill his every expectation and to give results noticeably superior to the most expensive conventional circuits.

The direct-coupled amplifiers, to be described, are all alike in that they are uniformly free of drummy, muffled, or blaring output. Their frequency response is uniform from the lowest bass to the highest note broadcasted. The limitations of these circuits are not in themselves, but in the speakers and the input systems in use today.

Each of these amplifiers is constructed upon one basic system, and a clear understanding of the principles will enable anyone to devise an instrument to exactly fit his own needs. A close study of Fig. 1 will reveal the underlying facts encountered in the system. Since the plate of one tube is directly connected to the grid of the next, the first problem, naturally, is that of arranging the voltages to give each of the tubes its normal operating potentials.

Theory of Direct-Coupled Circuits

If V1 and V2 have the same plate-current drain, and the plate of V1 is connected to the filament circuit of V2 by the choke, it follows that the two tubes will form an electrical circuit similar to two resistors in series, and any plate voltage applied to V2 will be divided between the two tubes. Thus, by giving the plate of V2 a potential equal to the sum needed by both tubes, we have a method of giving both stages the proper differences of voltages while gaining, at the same time, the highly desirable direct-coupling. Let us consider the facts in greater detail.

It is seldom that the first stage, V1, draws as much current as the succeeding tube. Therefore, we must rely on resistors R1, R2, and R3 (Fig. 1) to apportion the currents properly. The determination of the values of these resistors is the chief calculation encountered in designing an amplifier.

If any value of "B" voltage is available, the voltage requirements of each tube are noted. Then, beginning with the grid of V1 which is effectively at ground potential, the required tube voltages are jotted down on the diagram and added, progressively, throughout the circuit as shown. In Fig. 1 there are four voltage levels in the circuit, the cathode of V1 being the first. With the operating potentials given, the voltage applied to the plate of V2 amounts to 460 volts. This high voltage can be best obtained by using a type 81 rectifier tube, as shown. The usual power transformer with a 650- or 700-volt center-tapped secondary winding may be used. When used with a choke input to the filter, the well regulated output of the filter is approximately the correct voltage needed. In case only a *limited* "B" voltage is obtainable, it must be apportioned to the tubes in a manner best calculated for their satisfactory operation.

The first step is to determine the voltage drop across the coupling choke by the formula, E equals IR, where I is the plate current of V1 and R is the resistance of this choke. This voltage drop is seldom enough to furnish the bias for V2, it being only 1.5 volts with the choke shown in Fig. 1, so that the balance of the bias must be obtained otherwise. It is feasible to place a resistor in series with the choke, but the author prefers to use R1 to maintain a more stable bias. The entire plate current of V2 flows through R1. Thus, the rest of the needed bias is calculated in the usual manner. Tube V2 normally has a bias of 16.5 volts, 1.5 volts of which results from the voltage drop across the choke, leaving 15 volts as the potential across R1. Therefore, by Ohm's law, R1 equals E/I or 15 divided by .037 ampere, which gives R1 as 405 ohms. It should be observed that the screen of the 47 tube draws 6 ma. which must be added to the plate current in the calculations.

The bias of V1 is derived from R3, which is seldom over 500 ohms due to the large current flowing through it. While the plate of V1 draws 5 ma. from the resistance strip, this entire amount is returned to it through the cathode of the tube resulting in the same current flowing through R3 as through R1. The 13.5 volt bias divided by 37 ma. thus gives us a value of 365 ohms for R3.

It falls upon R2 to bear the greatest load in maintaining the filament of V2 at the proper potential. The voltage drop across R2 is always equal to the desired plate voltage of V1 plus the voltage drop across the choke, or 181.5 volts in Fig. 1. Since the 5 ma. consumed by V1 does not flow through R2, that amount is subtracted from the total current flow through R1 in calculating the correct value of R2. In Fig. 1, therefore, R2 equals 181.5 volts divided by .032 amp which results in 5,672 ohms.

Regardless of the complexity of the circuit to be used, it is necessary to rely on no more than arithmetic in calculating the values of the components. No difficulty will be encountered if, first of all, the required voltages at all points are noted and the various divisions of currents traced, as was done above. In each of the diagrams illustrating this article, each step is shown. A study of them should give enough pointers to enable the average technician to design any type of amplifier, desirable, from two stages to a multi-stage P.A. system with 500 watts output.

Volume Controls

In order not to disturb the voltages and currents flowing in an amplifier, a different type of volume control is necessary. A potentiometer shunted across the choke would remove the grid bias of the following tube in some cases and alter it in others when the arm of the potentiometer, to which the grid of the tube is connected, is turned to the low potential side. In Fig. 3, where the voltage drop of the choke is only 1.5 volts and the total bias 50 volts, the use of the potentiometer shunt could scarcely be called objectionable since the bias would not be thrown off over 3%. In Fig. 2, however, the bias would be altered over 10%. It is wise, therefore, to insert a large bypass condenser on the lower side of the potentiometer or to run the lead to a tap on R2 at the same voltage level as that of the plate of V1.

Considering that these systems were designed solely for their superior tonal characteristics, care should be taken in choosing the components with which an amplifier of this type is to be built. For example, C1 and C4 shown in Fig. 1 should have a high capacity, with C1 one of the low-voltage, high capacity bias type. The audio chokes are most important, too; although the action of this type of amplifier tends somewhat, it seems, to improve the frequency characteristics of audio chokes so that one having only a fairly straight line choking effect will be found to give good account of itself when used in this connection. Naturally, however, a choke of the very best sort should be selected.

Uses of the Amplifiers

When using a tuning system of extremely high gain, we may fall back on a recently popular layout; that is, the use of a power detector with one audio stage. V1 of Fig. 1 would thus be converted into the detector with V2 as the power output tube. The tone quality would be good, to be sure, and much better than if any other type of interstage coupling were used. If at all possible, a type 45 tube should be substituted for the 47 because of the inherent weaknesses of the pentode tubes in operation and performance. Likewise, a screen-grid tube is not at all satisfactory in place of V1. The high resistance necessary in its plate circuit precludes the use of this system without the use of automatic bias and other desirable factors which are to be found in the well-known Loftin-White circuits. Screen-grid tubes are subject to many of the weak points of the pentode in tone, and are never recommended by the author in audio amplifiers.

Another possible use of two stages is with diode detectors, as shown in Fig. 2. If the R.F. end of the receiver gives sufficient gain, there is a good possibility of excellent performance insofar as the 47 pentode may be dispensed with and a triode power tube used in its place. Since the amplifying half of the 55 is diode-biased, there is no need for an audio bypass condenser which means better tone. It should be noted here, that in many cases the voltage drop across R4, due to the rectified signal, may be insufficient to properly bias the triode half of the 55, except on strong local stations. For this reason the plate voltage on the 55 should be as low as possible without too much sacrifice.

In the quest for greater gain, the most logical development of the two stage layout is, naturally, the use of three or more stages using practically the same system as the two-stage amplifier. Figure 3 shows a three stage amplifier designed along these lines. It is actually very simple to construct and requires only one tapped resistor, a point which promises long, trouble-free life. Every technician knows how often the numerous resistor units fail, especially in resistance coupled systems, and the promise of substantial wire wound components and unchanging voltages should be appealing.

We may extend the idea to four or even five stages should it be necessary. There is no technical difficulty other than the necessity for a high potential. Regardless of the number of stages, only one tapped resistance is used, and the tone quality is superior to resistance-capacity coupling. It should be noted that a separate filament winding is used for each stage to avoid high poten-

(Continued on page 111)

DIRECT-COUPLED AMPLIFIERS

Most men are afraid to build direct-coupled amplifiers because they don't know what makes the wheels go 'round. The author, in this series of articles, gives a number of modern arrangements using the direct-coupling principle; and, at the same time, explains each and every step. Nothing is left to the vivid imagination of the builder.

Direct-coupled amplifiers have long been known for their simplicity, low cost, and, most important of all, for their excellent fidelity characteristics.

Here is your chance to understand and build direct-coupled amplifiers.

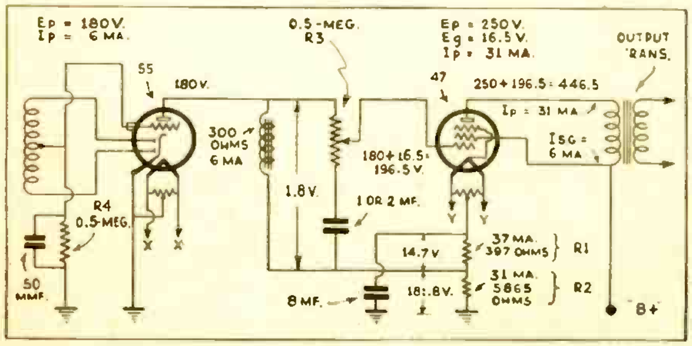


Fig. 2
Another direct-coupled amplifier featuring the 55, duo-diode triode.

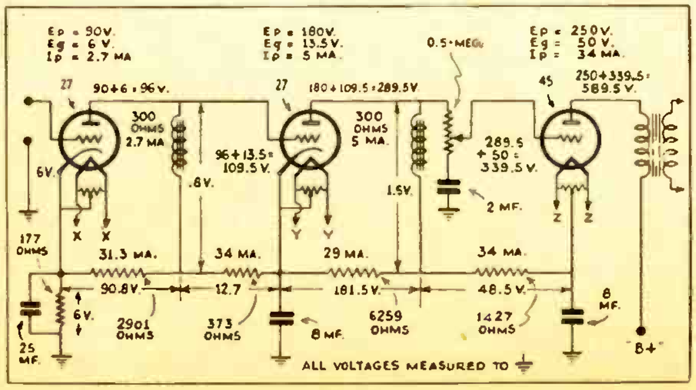


Fig. 3
Complete information on a three-stage direct-coupled amplifier.

HOW TO BUILD A PORTABLE SERVICE KIT

LOWRY E. EASLEY

A description of a portable service kit incorporating a tube tester, a resistance-capacity bridge, and a combination voltmeter-milliammeter.

Fig. A
View of the tester featuring the special scale.

WITH the arrival of new circuits, amplified automatic volume and tone control, silent tuning, and what-not, the Service Man must depend more and more on a thorough knowledge of Ohm's law and must know and be able to identify a great variety of currents, voltages, resistances, and capacitances in the routine of his daily work. It was because of this condition that the writer undertook to combine a number of useful test instruments into a single unit which would allow him to perform a greater variety of circuit tests with a minimum of equipment and expense.

The instrument, to be described, consists of a tube tester, a resistance-capacity bridge (covering resistance values from .1-ohm to about 5 megs. and capacities from .001-to 10 mf.) and a combination meter arrangement giving voltage readings of 0-10, 0-100, 0-500 volts D.C. and current readings of 0-10, and 0-100 milliamperes. A tap switch is provided to allow the selection of the various elements of a radio circuit through a plug-in arrangement which permits the operator to obtain voltage, current, and resistance readings.

The writer recently constructed a battery model of "The Meterless Tube Tester," as described in the January, 1933 issue of RADIO-CRAFT. This unit proved dependable for a great variety of tubes, and it was decided to incorporate an A.C. model of this same tester in the combination unit. The constructional and operating data on this part of the instrument parallels that given in the January and February issues, so little will be said about it in this article. However, it should be noted that the indicating device of this new tester bears little resemblance to the R3 unit shown in Mr. Prensky's articles. This new indicator constitutes a story in itself and will be described fully, later in this article.

Referring to Figs. A and 1, the tube-testing, resistance-capacity bridge side of the instrument, R2, R3, and R4 is manipulated to obtain tube tests. The phones are plugged in at Ph1 and the tube, under test, is inserted in its proper socket. The 4-, 5-, and 6-prong sockets are visible on the top of the instrument together with the four switches which are necessary for the

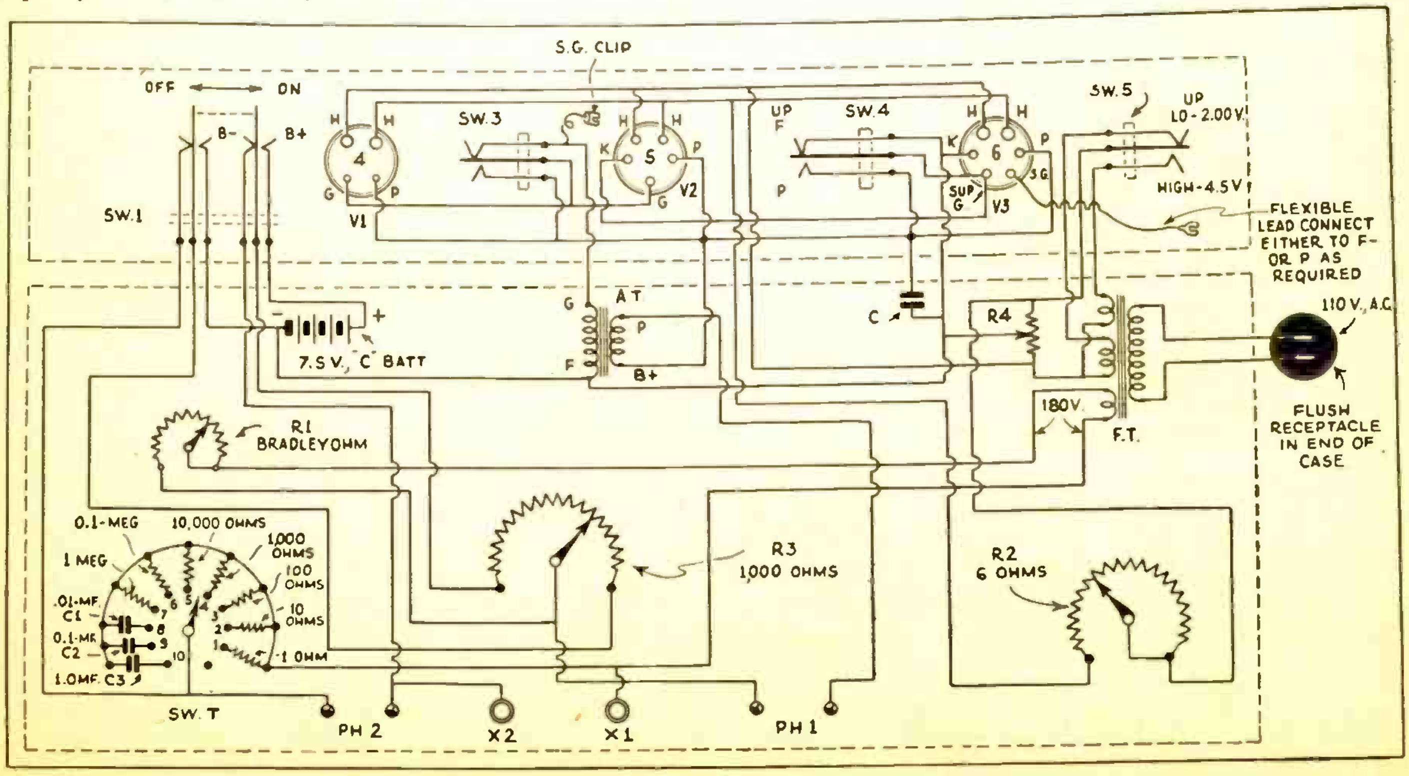


Fig. 1
Schematic circuit of the tester. See Fig. 4 for details of the volt-milliammeter.

WHAT THIS TESTER DOES

(1) Measures resistors from .1-ohm to 5 megs;

(2) Measures condensers from .001- to 10 mf.;

(3) Measures D.C. voltages from 0 to 500 volts in the following ranges: 0-10, 0-100, and 0-500 volts.

(4) Measures currents to 100 ma. in the following ranges: 0-10 and 0-100 ma.;

(5) Uses a resistance-capacity bridge for the measurement of resistors and condensers;

(6) May be fully constructed at home from standard parts.

Fig. B
View of the side of the tester opposite from that shown in Fig. A.

proper operation of the tester.

Resistors R1, R3 and switch Sw.T are manipulated when the bridge circuit is used. The phones are plugged in at Ph.2 and the resistor or condenser under test is placed across terminals X1—X2. It is believed that this bridge circuit is both novel and dependable enough to warrant a thorough description, so that we will begin with the simple slide-wire bridge (Fig. 2A) from which it was developed.

The Bridge Circuit

Instead of using a straight slide wire as at R3 in Fig. 2A the 1,000-ohm potentiometer, R3, for tube testing, was used. Now it will be seen that if a resistor Rx be placed across terminals X1—X2 (Fig. 2A) equal in value to Rs and if the slider on R3 is placed midway on R3 the bridge will be balanced and there will be no current through the phones; *i.e.*, the 60-cycle hum will disappear. If a resistor Rx, more or less in value than Rs, is placed across X1—X2, the slider must be moved along R3 to some other balancing point.

Experiment proves that, for a reasonable distance either way from the mid-point of the resistor R3, this bridge circuit is highly accurate provided R3 is so constructed that its resistance varies uniformly from one end to the other. Indeed, it will be found sufficiently accurate for all practical purposes up to the point where the A/B ratio is not greater than 1 to 10 or 10 to 1.

In view of this fact, the writer reasoned that if the resistor R3 were calibrated in 100 parts and the ratios of A/B were worked out and set down on a suitable scale, it would be possible to obtain, practically, direct resistance readings, provided, of course, that Rs be known and be available in simple numbers. It was decided to use Rs in units of 1, 10, 100, 1000, and so on up to 1 megohm, and provided with a suitable tap switch so that any one of these values could be used for Rs, thus making it possible to obtain a balance on the bridge circuit (somewhere near the midpoint) and then multiply the ratio indicated at the pointer by 1, 10, 100, 1000, etc., depending upon the setting of Rs, to obtain the correct resistance value of Rx. A small 60-cycle current was tried first, but it was found that much more sharply defined balances could be obtained (especially with extreme low and extreme high resistances) by using a potential of about 180 volts controlled by a suitable resistor R1 so that practically any voltage from a low value to 180 volts could be used. See Fig. 1.

Since A. C. was used, it was thought wise to incorporate a few capacity values in the bridge circuit, and, accordingly, the last three taps of the switch Sw-T were used to provide condensers of .01, .1, and 1 mf. It will be noted that no circuit changes are necessary to install this additional valuable service test. It permits the testing of condenser values from .001- to 10 mf. with good accuracy.

Tube Tester and Indicating Dial

Perhaps the most novel feature of the entire instrument is the combination tube testing and resistance- capacity indicating dial designated as R3. The dial itself (see Fig. 3) consists of a 5-inch disc of heavy white paper (use a good grade of paper, which will take India ink without smearing). It is very essential, however, that the start and finish of the scale coincide exactly with the start and finish of the resistance unit R3. This dial may be calibrated by placing the resistor, R3, in its position on the panel, then placing the blank disc of paper on the opposite side of the panel, finally, putting the knob and pointer (see Fig. 2B) in place. Now, starting with the pointer at the extreme left end of the resistor winding, carefully mark this point on the blank disc, in pencil. Next, obtain an accurate Wheatstone bridge, or ohmmeter, and connect it between the left-hand connection and the slider terminal of R3. Move the arm of R3 until the ohmmeter reads 100 ohms. Mark this point on the dial; then move the arm of R3 until the ohmmeter reads 200 ohms and mark the point again. Continue this process 100 ohms at a time being careful to obtain accurate readings. If the resistor, R3, happens to be exactly 1,000 ohms total, you are lucky, and your worst job is over when you have finally located the 10 major divisions. However, if the unit is slightly more or less than 1,000 ohms, you must repeat your bridge readings beginning with the *right-hand* connection and slider terminal of R3, and advance counter-clockwise, 100 ohms at

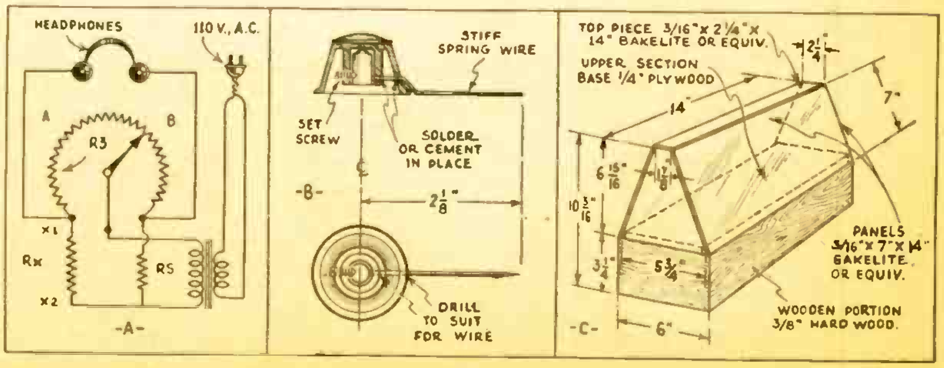


Fig. 2
Detailed sketches of various parts of the tester.

a time, until you have 10 new points on the dial. (Note: it is not a bad idea to make this back check even if the R3 unit does show exactly 1,000 ohms total). Now locate the mid-point between each of these pairs of markings on the dial and you will have ten major points accurately determined.

Intermediate points between the main divisions are computed. Each main division is divided into ten parts; therefore, each small division is 1/100 of the total. Since these markings are to be ratios of A/B, the first marking will be .01/.99 or 1/99; the second small division, 2/98; the third, 3/97, etc., and their decimal equivalents are readily computed with a slide rule. The first few ratios of A/B are marked in Fig. 3.

Observe that all connections to the meterless tube checker (Fig. 1) correspond to those given by Mr. Prensky in his original description of this unit, with the exception that switch Sw.1 in his article calls for a D.P.S.T. switch connecting the "C" battery to R3, and the power transformer to the line; whereas in this instrument a D.P.D.T. switch is used for connecting R3 either as the tube-testing potentiometer or as the variable slide wire of the bridge circuit. Also, no pre-heating socket was provided, as it was found that a tube could be so rotated in either the 5- or 6-prong socket that the heater prongs alone would make contact. A combination 4-, 5- and 6-prong socket as well as a 7-prong socket should be used but these were not available at the time this instrument was laid out.

A color combination on the dial is used for indicating the condition of tubes. The green, yellow, and red combination (see Fig. 3) for indicating the condition of a tube is self-explanatory. The green stands for good; yellow, for weak; and red, for poor. The inner concentric ring has its green band ending at the third major division point of R3, corresponding to point 7 on Mr. Prensky's instrument. The successive rings are each stepped back half a major division until the outer ring is reached at the 6th major division, corresponding to No. 4 in the original description of the tester. The separate rings or bands on this indicator are used to identify the different tubes. The inverted V-shaped area on the chart, directly below the control knob of R3, serves as an ideal space to list the various tube numbers. Thus, as rapidly as the operator finds the limits of good, weak, and poor tubes of a certain type, he can print its number in the proper band in this space.

Needless to say, it takes a lot of tubes, much time and plenty of patience to sit down and run a complete test of all of the various tubes possible to test on this instrument. The article in February RADIO-CRAFT gives a chart which lists a great variety of tubes, and this chart may be followed roughly in checking tubes with the tester shown in this article.

The reverse, or meter side, of the instrument (see Figs. 4 and B) presents very little out of the ordinary to most constructors. It is wired as a separate unit from the rest of the instrument and provides, at the left side, voltage ranges of 0-10, 0-100 and 0-500

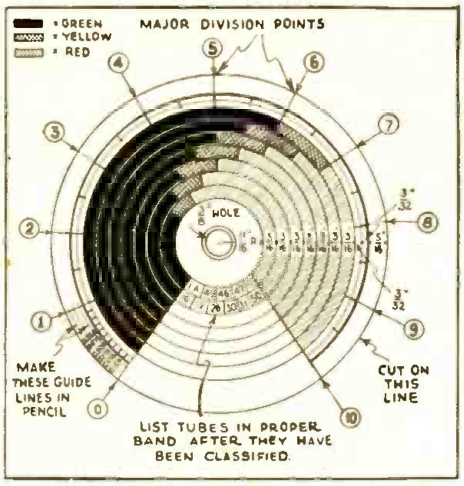


Fig. 3
Detail sketch of the special scale used.

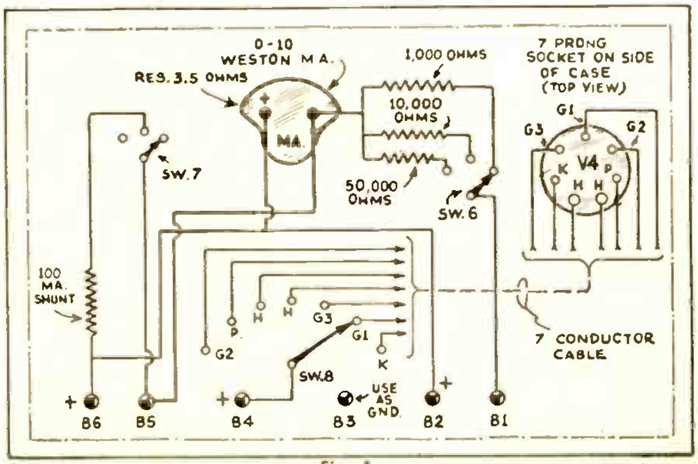


Fig. 4
Schematic of the voltmeter-milliammeter section.

volts D. C. The meter is connected for voltage tests by means of the binding posts B1, B2 and the ranges are obtained through the tap switch Sw.6 above these binding posts. Current ranges of 0-10 and 0-100 ma. are obtained through the shunt switch, Sw.7, located above binding posts B5 and B6, which are the current binding posts.

The 7-point tap switch Sw.8 connects to the 7-prong socket located in the left of the instrument and serves, through binding posts B3 and B4, to make available, at the instrument, the different circuits in a radio set through the medium of the tube sockets. This arrangement is the same as that given by Mr. Al Beers in the February, 1933, issue of RADIO-CRAFT. His explanations and diagrams are sufficiently complete to discount further mention in this article, except to note that all connections are lettered to correspond with the original data given by Mr. Beers.

The meter used here is an 0-10 milliammeter and was used because it was the best meter the writer had available. Much greater flexibility and a wider range of readings may be obtained with an 0-1 milliammeter of the A.C.-D.C. type; but after all, pocketbooks must be considered in these days. The writer knows that anyone reading this article and possessing such an instrument will immediately see how it may be utilized.

Operation

The operation of this unit is very simple. The unknown resistor or condenser is placed across terminals X1-X2, Sw.1 is left in the off position, the phones are plugged in at tip jacks Ph.2, 110 volts A.C. is connected to the flush receptacle in the end of the carrying case through the extension cord provided, R1 is set in position with most of its resistance cut in, Sw.T is placed at tap 5 (for resistors), and, finally, R3 is moved to the point where it *first* makes contact, at which point a hum should be heard in the phones. Rotate R3 until a point is reached where the hum disappears. This is the balance point and may be sharpened by adjusting R1. If the point obtained is near either of the ends of R3, Sw.T should be moved one way or another until the balance is obtained near the center of the dial. Set the pointer of R3 as near as possible to the center of the dead spot, as indicated by the phones, and read the marking on the scale. Multiply this reading by 1, 10, 100, 1000—by the value of the resistor cut in at Sw.T, and you have your correct unknown resistance value. If accurate resistors are used in Sw.T, it soon becomes very easy to read directly the value of the unknown resistor. The same procedure of operation is followed in checking condensers, except that taps 8, 9 and 10 of Sw.T are used and the reading of R3 is divided into that of Sw.T.

If you have ever wondered, after reading the average ohmmeter, whether or not the resistor you have checked is 500,000 ohms or 1½ megohms, you will appreciate this bridge circuit. It does not cost much to set it up, and the effort will more than be repaid in accuracy. Needless to say, this instrument also makes an ideal continuity tester.

Operation—Tube Tester

In operating the tube tester, the identical procedure set down in Mr. Prensky's articles is followed with the exception that the heater settings as indicated by R2 are different. Since line voltages fluctuate widely and transformer secondary voltages vary, it is thought best for each constructor to determine the settings of R2 for his own particular needs. After you have

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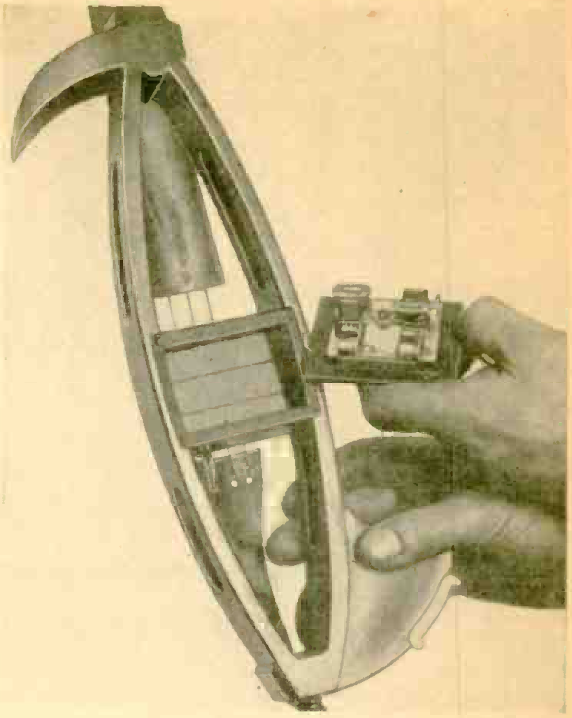
AND NOW--THE ELECTRIC VIOLIN

A description of a very novel electrical violin which has no sounding board, but which transmits its vibrations to a regular audio amplifier and reproduced from the regular radio speaker.



(Halbran)

The works: vibrations from a special bridge induce an E.M.F. in the coils of the winding which, in turn, are amplified.

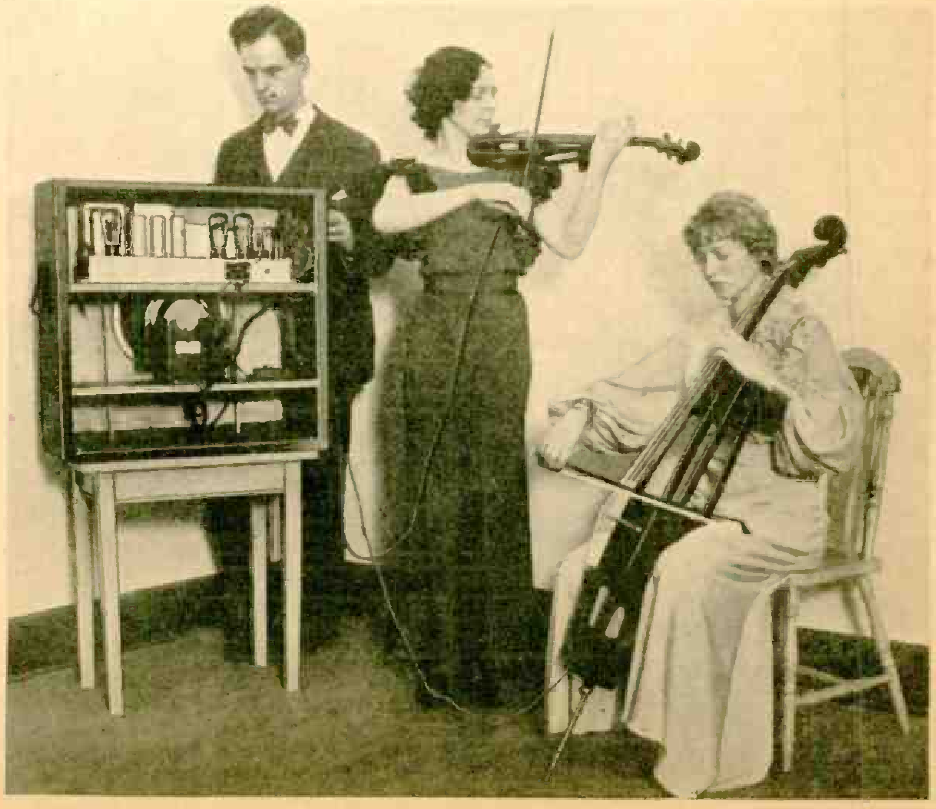
EVER since the advent of the thermionic vacuum tube, engineers, and others interested in musical instruments, have endeavored to create a single instrument that would simulate all known instruments both as regards tone quality and frequency range, or pitch. And the efforts of these pioneers have not been in vain. Today, there are available a host of musical instruments designed to produce the lowest notes of the bass viol and drum to the highest notes of the piccolo with the intensity of an electric organ.

Notwithstanding these remarkable achievements, there exists a field which has not as yet been developed to the proportions it deserves. This field covers the design of, what might be called, single electronic instruments. By this phrase we mean the design of electrical instruments which reproduce the tones of only a single instrument—even better than the original. An example of one of these devices is illustrated on this page.

As may be seen by reference to any of the photographs, the device is a skeleton violin, arranged to change the vibrations of the strings into electrical impulses, which may, in turn, be amplified by a conventional amplifier, such as used, for example, in any radio receiver.

This new violin, which has no sounding board, is the invention of Mr. Victor Pfeil, well-known violin maker. Instead of the usual tone chamber, or sounding board, this violin has only a light skeleton frame. Concealed directly under the bridge, as shown in one photograph, is a small electromagnetic pickup. The magnets of this pickup are directly under a small strip of iron, or similar magnetic substance, which is set in motion when the bridge is vibrated by the strings. Thus, the magnetic flux between the pole pieces of the magnet is varied which, in turn, generates a voltage across the terminals of the coil wound around the pole pieces. Furthermore, the variation in this voltage is exactly in accordance with the variation of the bridge which, in turn, depends upon the mode of vibration of the strings. The magnet coils may be connected to the amplifier exactly as a phonograph pickup or microphone is connected, and the resultant reproduction heard from the loudspeaker.

(Continued on page 114)



Above, an illustration of the size of the violin compared to that of an average hand. Right, a recital with one of the new violins and cellos. Note the wires from the instruments running to the radio amplifier. (Halbran)

CONSTRUCTING THE DEPENDABLE MODEL 303 TUBE TESTER

Complete construction details of an advanced model of the tube tester described in the April, 1933 issue of this magazine.

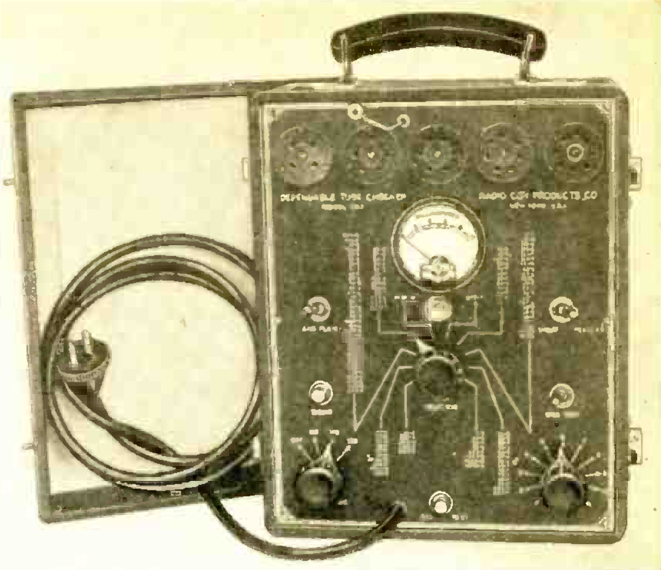


Fig. A
Panel view of the Model 303 tester described here.

MILTON REINER*

IN THE April, 1933 issue of this magazine a tube checker known as the Dependable Model 301 was described. At the time the instrument was designed, it represented the latest equipment available, as it would test the seven-prong tubes that were then on the market. On the whole, it was a very economical and efficient tube checker compared with other commercial instruments in the same price class.

Many letters of commendation have been received as testimonials to the utility, economy, and simplicity of operation. In appearance and portability it was equivalent to that of many testers in a considerably higher price class. However, it is only fair to mention that there were also some complaints and suggestions.

The outgrowth of all this, together with the condition of the tube industry, has resulted in the design of the new tube checker Model 303. The writer realized that, at the rate new types of tubes were appearing on the market, the old Model 301 would soon be obsolete. This new tester, therefore, will test all the new tubes brought out to date, besides allowing spare switching arrangements for 20 per cent additional capacity for the future.

One design was considered that would eliminate obsolescence as long as tubes were manufactured according to conventional standards. This design was discarded, however, as it was necessary to set at least six individual selector switches to test any one tube, and even then there was no assurance that future trends in tube design might not make this obsolete also.

The present Model 303 tester, therefore, represents a practical compromise. It tests more than 120 different types of tubes, *all of which are listed directly on the panel.* In addition, it provides for the future in that there is 20 per cent reserve capacity in the tube selector switch to allow for altogether new types of tubes that might be developed. Moreover, some of the new tubes that will appear will be similar in many respects to some of the types recently announced, and they, therefore, will not require any additional capacity on the tube selector switch.

It is safe to assume, therefore, that in addition to the 120 tubes that can be tested on this new model tester without any adapters, there will be reserve capacity for about fifty new tubes that might be brought out. All this is accomplished so that only two simple selector switches are operated for testing any type of tube. The switch setting is plainly marked on the panel, *thus eliminating any reference to charts.*

This method overcomes the main objection in regard to obsolescence. The other objection, which, incidentally, aroused the most complaints, was in reference to the type of meter used. In order to keep down the cost, a cheap iron-vane, or magnetic vane, type of meter was used on the old

*Chief Engineer, Radio City Products Co.

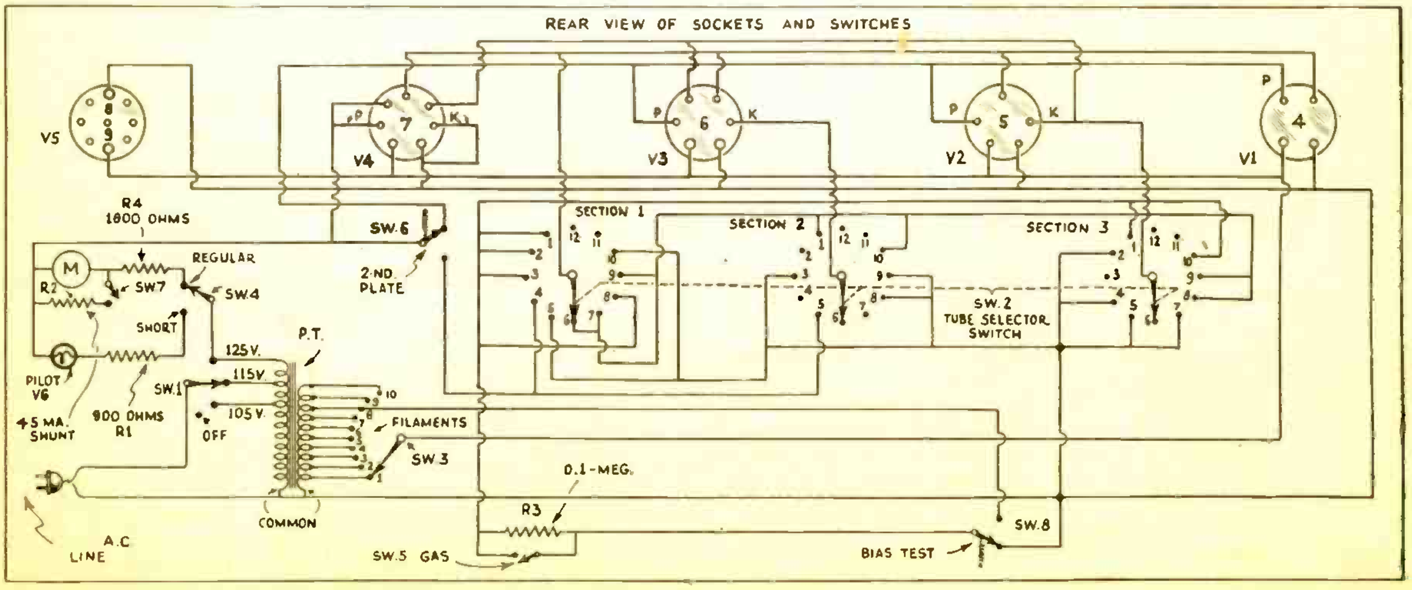


Fig. 2
Complete schematic circuit of the Dependable tube tester described here. See the List of Parts for further details.

FEATURES OF THIS TESTER

(1) May be fully constructed for about $13.50;
(2) Tests over 120 different types of tubes;
(3) Has a combination 8 and 9 prong socket, thus providing for future new tubes;
(4) Present switching arrangement will accommodate about 50 additional tubes;
(5) Has all tube numbers etched on the panel, eliminating the necessity for cumberson tube charts;
(6) Is provided with "grid-shift" and "gas" tests;
(7) Has a pilot light for "short" tests.

model. Experience has proved that it does not pay, in the long run, to use such a meter, even though many users will testify to the good results they are getting with it. There is now available a high grade line of d'Arsonval type moving coil meters which are used in the new Model 303 checkers.

It will be a pleasant surprise to learn that, including all the improvements and changes incorporated in the new instrument, it may easily be constructed at a cost of not more than $13.50. This includes the d'Arsonval type meter and a neat portable carrying case covered in leatherette.

A tube is rated according to relative mutual conductance, which serves as the best all around indication of its general performance. As was explained in the April issue, the mutual conductance, or transconductance, of a tube is the change in plate current per unit change in grid potential. The circuit is designed to give large arbitrary changes in deflection of the meter so that the relative mutual conductance of a good tube is easily and quickly determined. The meter scale is calibrated in arbitrary values so that the optimum indices of relative mutual conductance are obtained.

Description of the Tester

The tester includes a line-voltage adjusting switch, Sw.1, so that readings can be standardized regardless of whether the tester is operated from A.C. lines of 105, 115 or 125 volts. Without this provision, a tube would test differently when the instrument is connected to supply lines of different voltages and it would be difficult to tell its true condition. The line-voltage switch merely connects to different primary taps of the transformer, so that when properly adjusted it will maintain a constant voltage supply to the plate and filament of the tube regardless of the line voltage (within reasonable limits).

A distinct advantage is the layout and special etching on the panel shown at Fig. 1. There is only one socket for all four-prong tubes, V1; one for all five-prong tubes, V2; one for all six, V3; seven, V4; and eight and nine prong tubes, V5. The combination eight and nine prong socket is perhaps a surprise to most dealers, but this tester provides for projected developments that reach somewhat into the future. The tube numbers etched on the panel are arranged in numerical order in columns terminating at points on the tube selector switch, Sw.2. The switch is set to the point corresponding to the tube to be tested.

To further simplify matters, the correct position of the filament switch, Sw.3, is etched on the panel immediately following the number of the tube. This makes all guesswork and reference to charts entirely unnecessary. No adapters are required and ten different filament voltages are provided, including 15 and 25 volts.

The other features include a short test switch, Sw.4. This switch is labeled "short-regular" and should be thrown to the "short" position before regularly testing a tube. If the

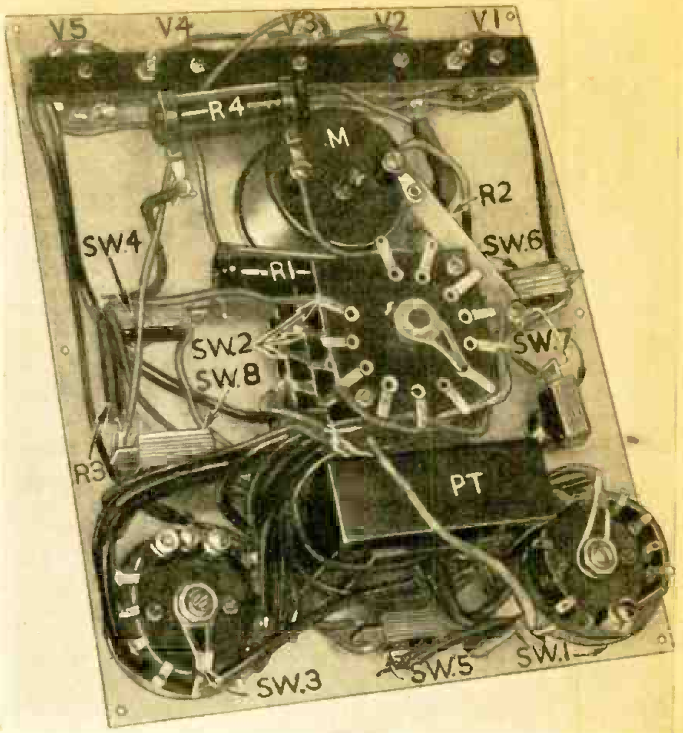


Fig. B
Rear view illustrating the location of the parts. See Fig. 1.

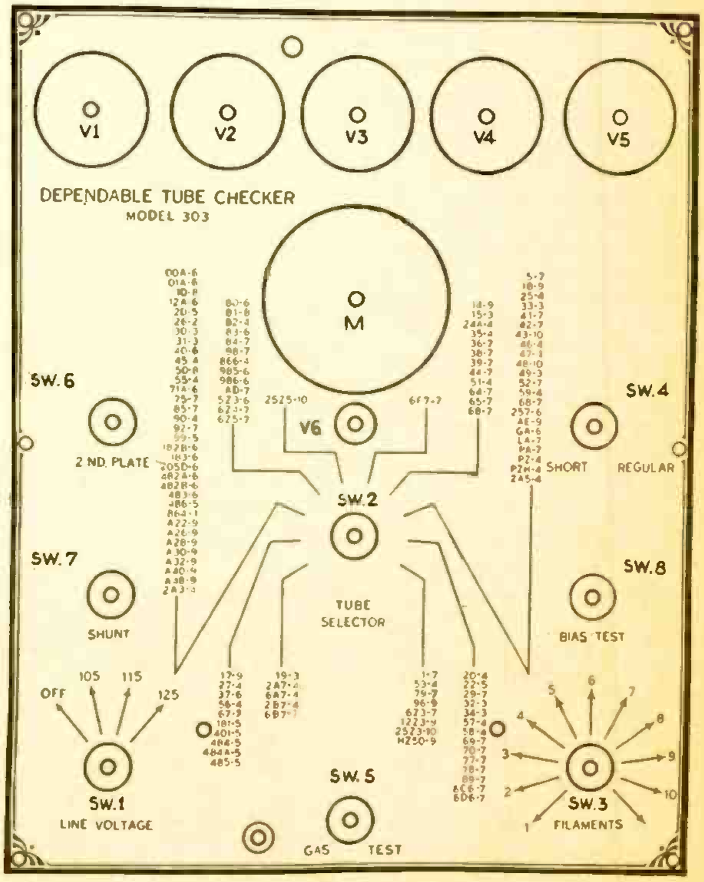


Fig. 1
Drawing of the panel of the tester which further illustrates the tube markings.

tube is shorted, the pilot light will glow. This will not only indicate that the tube is worthless, but will protect the instrument from damage which would occur if the shorted tube should be tested in the "regular" testing procedure. There is also a separate "gas" test, manipulated by a switch, Sw.5, which will indicate the presence of gas by the change in current flow when a high resistance is cut in and out of the grid circuit.

The "second plate" test, Sw.6, for rectifiers will give the second plate current for all types of full-wave rectifiers

(Continued on page 106)

HOW TO MAKE A HIGH POWER A.C.-D.C. 6-VOLT P.A. AMPLIFIER

New tubes and associated equipment have made possible the construction of a versatile power amplifier for mobile or stationary operation. Two type 2A3 tubes in push-pull develop 20 watts! A 33 1/3 and 78 R.P.M. phonograph turntable, and a dual-field dynamic reproducer are included in the amplifier to be described.

LOUIS GANCHER*

HERETOFORE, amplifier systems employed in sound trucks have been of either of two types, *viz.*, completely battery operated, or, "standard," 110 V., A.C. operated—the power, in the latter design, being obtained from a rotary converter, a fan-belt-driven generator, or a gas-engine driven rotary converter. The upkeep of the former type is costly, since the "B" batteries must be replaced at frequent intervals. The latter, too, is expensive to keep in operation; for instance, if a rotary converter is used, at least two 6 V. storage batteries are required, and their charge does not last long, because of the high current drain of high-power amplifiers.

However, all this is a thing of the past, for the advent of the type 2A3 power amplifier tube has completely revolutionized the design of sound-truck amplifier systems; the exceptional improvements in amplifier design which this new tube makes possible are incorporated in the public-address power amplifier which is the subject of this article. A view of the complete system is Fig. A; the amplifier schematic circuit is Fig. 1.

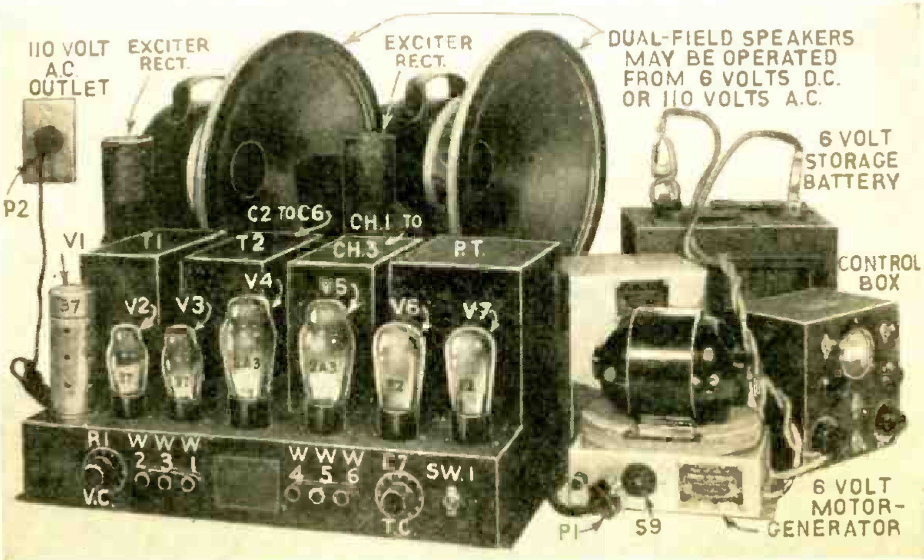


Fig. A

Front view of the Coast-To-Coast 20-watt amplifier showing the amplifier, special speakers, motor-generator unit, control box, and storage battery.

Economy of Operation

The low voltage and current characteristic of the type 2A3 tube has made possible the inexpensive operation of an amplifier, equipped with two type 2A3 tubes in push-pull from a motor-generator operating from a *single 6 V. storage battery.* (As usual, the filaments of all the tubes connect directly to the battery.) The superiority of the "2A3" amplifier becomes even more apparent by comparing the output characteristics with those of the nearest equivalent design. The "2A3" "fixed bias" amplifier has an undistorted power output of *20 watts*. To obtain this degree of power, with the same high degree of tone quality, would require the use of two type 50 tubes in push-pull, but the plate current requirement of the 50's would be 100 ma. at 400 V.

Continuing the comparison, we find that a real monetary saving is affected, inasmuch as all the components employed in the construction of this amplifier, such as the power transformer, electrolytic condensers, chokes, etc., may be obtained at relatively low cost. Whereas, if type 250 tubes were employed, it would not be possible to use, for instance, standard electrolytic condensers, as only 1,000-volt-rating, paper-dielectric condensers could be utilized; savings in fact, may be made in the cost of *all* the accompanying apparatus.

20 Watts Output

The 110 V., A.C. power pack, Fig. 2A, is incorporated in the amplifier chassis and requires two full-wave type 82 mercury-vapor rectifiers for its operation, instead of the conventional use of a single rectifier tube. Amplifiers of common design incorporating the type 2A3 tube employ only one full-wave rectifier. Use of the heretofore conventional "self-bias" on the type 2A3 tubes would result in a maximum output of only 10 W. However, by using *"fixed bias," a maximum output of 15 watts is thereby available.* At this point it may be well to call attention to the difference between these two methods of amplifier operation.

A tube which is "self biased" depends for its control-grid voltage upon the drop across a resistor in the plate-current return-circuit of a tube biased for class A operation. As long as the input circuit of the tube is not overloaded this voltage remains steady; however, it begins to fluctuate as soon as the point of overload is exceeded. A tube which is "fixed biased" also depends for its control-grid voltage upon the drop across a resistor in the plate-current return-circuit, but with the difference that the bias of the tube is fixed, regardless of signal strength.

(In this connection the author calls attention to the article, "Constructing a 40 Watt, Class AAA, P. A. Amplifier," on p. 536 of the March, 1933, issue of RADIO-CRAFT. The amplifier is designed around the "fixed bias" circuit, and the principle of operation is clearly described in the article, to which reference should be made. Note, particularly, that part of the power-handling ability of this

*President, Coast-To-Coast Radio Corp.

amplifier is due to the use of a *separate* source of energy for the control-grid bias, in lieu of a resistor in the common return circuit. It is this feature which accounts for an added 5 W. of power output in the "2A3" job.)

Our laboratories have perfected the independent "C" bias section (requiring its own, separate type 82 rectifier tube) of the A.C. power unit, Fig. 2A to furnish an absolutely stable potential of 65 V. as bias for the two type 2A3 output tubes, thereby assuring the production of *20 W.* of undistorted power.

This novel bias circuit arrangement requires a specially designed power transformer, P.T., having two high voltage windings, one of 75-75 V. for the "C" bias, the other of 335-335 V. for the main plate power supply. There are also provided two separate 2.5 V. filament windings for the type 82 rectifier tubes, as well as a 6.3 V. filament winding for the A.F. amplifier tubes.

Battery or A.C. Operation

When this system is operated either from a storage battery or from a 110 V. A.C. power pack, the filaments of the three type 37 and two type 2A3 tubes are lit by approximately the same voltage, *i.e.*, 6.3 V.; these filaments function with equal efficiency operating from either D.C. or A.C. However, since the type 2A3 tubes are of the 2.5 V. filament variety, these two tubes must be wired in series (along with a special resistor R7, which drops the 6.3 A.C. or D.C. voltage to the necessary 5.0 V.), thereby distributing 2.5 V. D.C. or A.C. to the filament of each 2A3 tube. All the type 37 tube filaments are connected in parallel and, along with the filament leads of the type 2A3 tubes, are brought to two prongs on the current supply plug, P1, on the rear of the amplifier chassis. The connections are shown at B in Fig. 2.

The A.C. filament and D.C. plate voltages from the power pack are brought to a special socket, S8, as shown at A in Fig. 2. Protruding from the rear of the amplifier chassis, as shown in Fig. B, is a 5-conductor cable and plug, P1, which is connected to the filament, "B" plus, "C" minus, and ground terminals within the amplifier. It follows, therefore, that P1 is inserted into S8 when it is desired to operate this amplifier from 110 V., A.C. On the base of the motor-generator is fastened a 5-prong socket, S9, into which the same plug, P1, is inserted when it is desired to operate this amplifier from a 6 V. storage battery; the external "C" bias battery of 65 V., connected to the correct prongs of S9 on the motor-generator, as shown at C in Fig. 2, is not required when the amplifier is operated on 110 V., A.C.

It is suggested that a two-way polarized flush outlet be mounted (when used in an automobile) and connected to the car's storage battery; connect the input leads of the motor-generator to the corresponding polarized male plug. This affords neat and speedy connections in place of battery clips. The generator itself may be mounted anywhere within the car or truck to suit your convenience; if desired, it may be set right alongside the amplifier.

Motor-Generator "B" Unit

Note that the generator section of the diminutive 32 W. motor-generator incorporated in this amplifier produces 100 ma. at 320 V., D.C., with an input of *only* 6 V., D.C. Do not confuse this device with rotary converters which produce 110 V., A.C., and with operating power capacities limited by the D.C. input voltage. (As a rule, 6 V. input rotary converters of the latter type produce 65 W. at 110 V., A.C.; at 12 V. input the output is 150 to 160 W., at 110 V., A.C. The latter connection imposes far too heavy a drain on two 6 V. storage batteries, and approximates 18 to 22 A. at full load!)

The D.C. generator employed in this amplifier system consumes at full load only 9¾ A. from *one* 6 V. storage battery; however, if two 6 V. batteries are available and are connected in parallel, then a load of only 4⅞ A. is imposed on each battery. This fact is mentioned for the benefit of those who intend to use the amplified system over long stretches of time. The motor-generator is of inexpensive

(Continued on page 115)

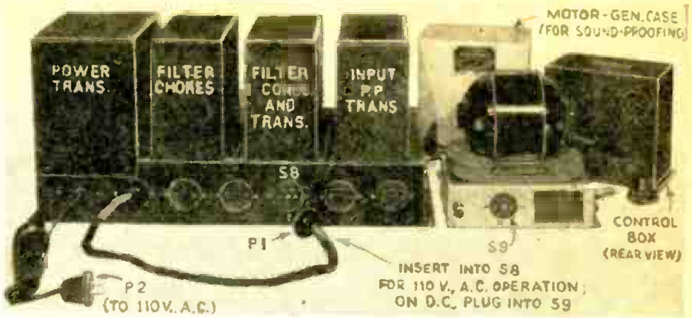


Fig. B
Rear view of the amplifier and accessories. The plug P1 is inserted into S8 for 110 volt A. C. operation, and plugs into S9 for battery operation. In the latter connection the motor-generator is used; it is driven by the storage battery.

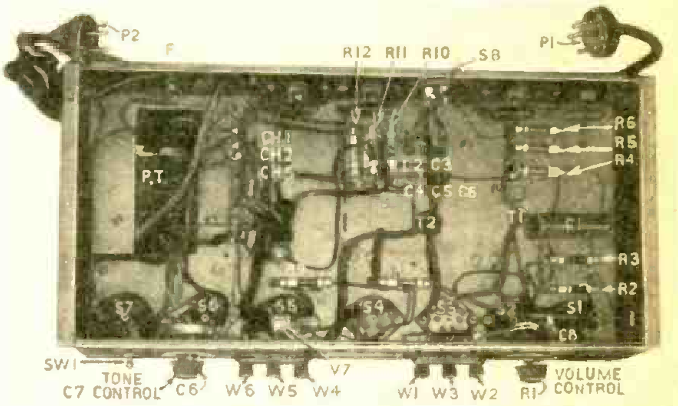


Fig. C
Under view of the amplifier. Condensers C2 to C6, inclusive, are located in one can, as shown in another photograph. All other parts are labeled clearly.

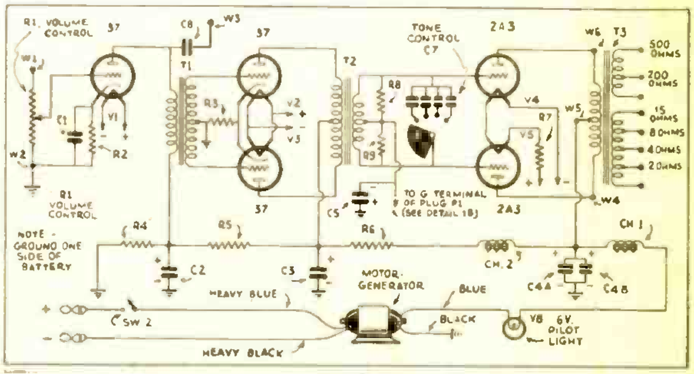


Fig. 1
Schematic circuit of the amplifier. The "C" bias for the two 2A3 tubes are obtained from a separate power unit to insure fixed bias when the input signal is large. The tone control is a single unit, and each of its fixed condensers may have a capacity of approximately .001-mf.

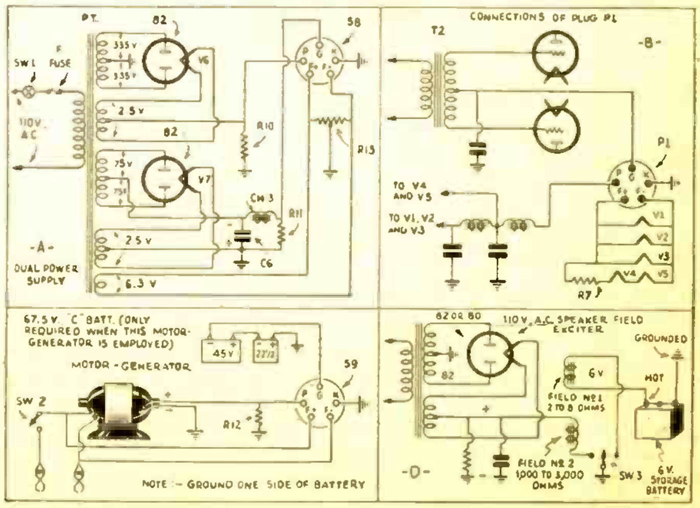


Fig. 2
Detail drawings of the amplifier. At A, connections of the double power unit; at B, circuit showing the filament connections and those of plug P1; at C, connections of socket S9; and at D, connections of the special field windings.

THE BEGINNER'S POWER CRYSTAL SET— —WITH R. F.

Another version of the "breadboard" crystal set. A stage of radio-frequency amplification has been added ahead of the crystal detector and audio-frequency amplification system described in previous issues of RADIO-CRAFT.

FRANCIS R. HARRIS

STARTING with the June issue of RADIO-CRAFT we have been describing a series of simple beginners' sets incorporating the 2 V. series of tubes and a crystal detector. These sets have been so designed as to constitute a sort of ascending series of difficulties, so that each one involves slightly more complicated problems in hook-up and demonstrates slightly more involved theory than the preceding layout.

However, we have also kept in mind the fact that the average radio experimenter's financial condition (if it can be dignified by so grandiose a title) is—shall we say—slightly strained? Hence, the outlay for parts has been kept down to the absolute minimum by so designing each circuit that it makes use of practically all the parts used in the one before, with just enough added to take care of the new features. The physical layout, too, has been kept practically identical in each case so that the work involved in the change-over is slight. If you are a beginner and have followed this series through, building each set in turn and getting it to function properly, you will find that, after building the set described this time, there will be very few parts left over (and I wouldn't worry too much about them because we'll find a way to use them shortly). Not only that, but your knowledge of radio theory and practice is vastly greater than before, embracing the fundamentals of practically every type of simple receiver circuit except the tube detector. The "superheterodyne" circuit is not considered here; maybe we'll take that up next. What say?

Incidentally, a tip to those beginners who, for some reason, have not seen the previous articles. We would not advise trying to build this circuit without referring to the previous ones; otherwise, you will probably get into a jam. Get the two previous articles and follow them through *carefully*, building the sets as described. Do not try to hurry it, but get each job working perfectly before changing over to the next. Then, when you do come to this one, you will be ready for it and will stand a better chance of success; and by the time you have finished we will have something else for you to worry about.

Theory

The audio amplifier design described last month (the type 32 and 33 tubes, capacitatively coupled) is about the best that can be done with the tubes available in the 2 V. line; and, hence, will be used intact in the present set. Since no improvement can be made here, the only other possibilities for boosting the signal strength are radio-frequency amplification, or regeneration. Regeneration as used last month is strictly limited if we are to retain tone quality, since it sharpens the tuning to such an extent, *when used to the limit*, as to prevent the reception of the higher audio frequencies. It also has the further defect of causing radiation from the antenna at radio frequencies, which interferes with the reception on every radio set for blocks around. This form of interference is so serious that regenerative sets are forbidden by city ordinances in some localities.

R.F. Amplification

A single stage of radio-frequency amplification, on the other hand, *will give just as much gain*, or build up the signal just as much, *as regeneration pushed to the limit, and* it will do it *without causing radiation or affecting audio quality.*

Now, radio frequency, or "R.F." amplification may be used in two forms: tuned, and untuned. The tuned circuit, such as our input circuit in the two previous layouts, is simply a combination of a coil (or inductance) and a condenser (or capacitance) of such values that they offer an extremely *high* reactance (or resistance) to the flow of R.F. currents at a certain definite frequency, and a very *low* reactance to currents of any other frequency. The result of this is that a high voltage is built up across the circuit at the frequency in question and practically none at other frequencies. Now, if we make the condenser variable we can shift the position of this point of high reactance over a rather broad band of frequencies—and we have a tuned circuit.

Untuned R.F., on the other hand, simply consists of some form of reactance, usually inductance, whose reactance at the lowest frequency to be used is high enough to act as an effective "load" (the reactance, of course, increasing with the frequency). Untuned R.F. has the distinct advantage that it takes up but little space, requires no variable components and re-

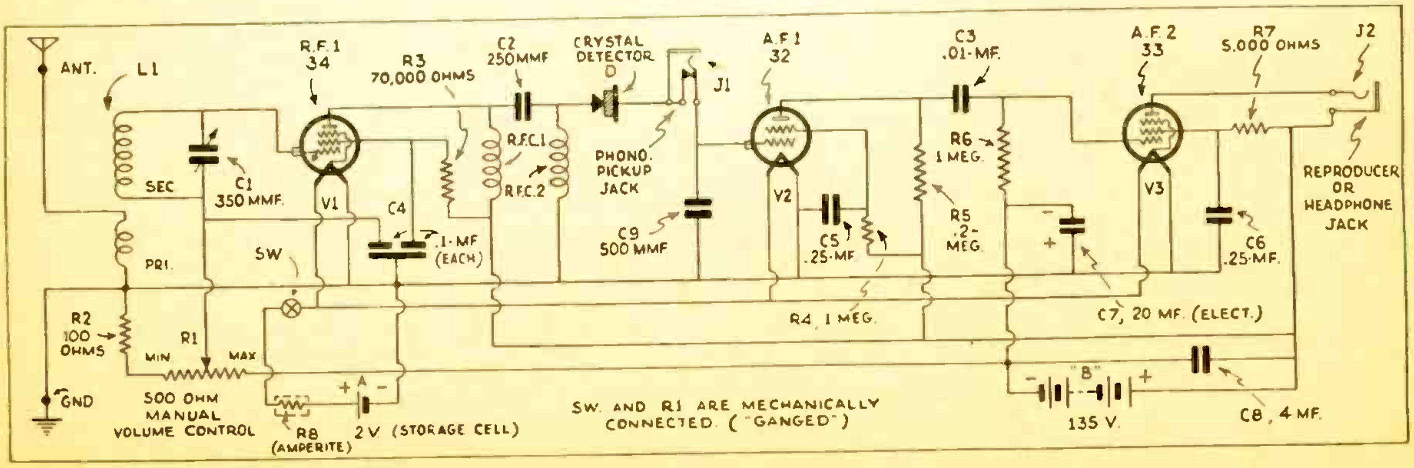


Fig 1

Schematic circuit of the receiver. See Fig. A for layout.

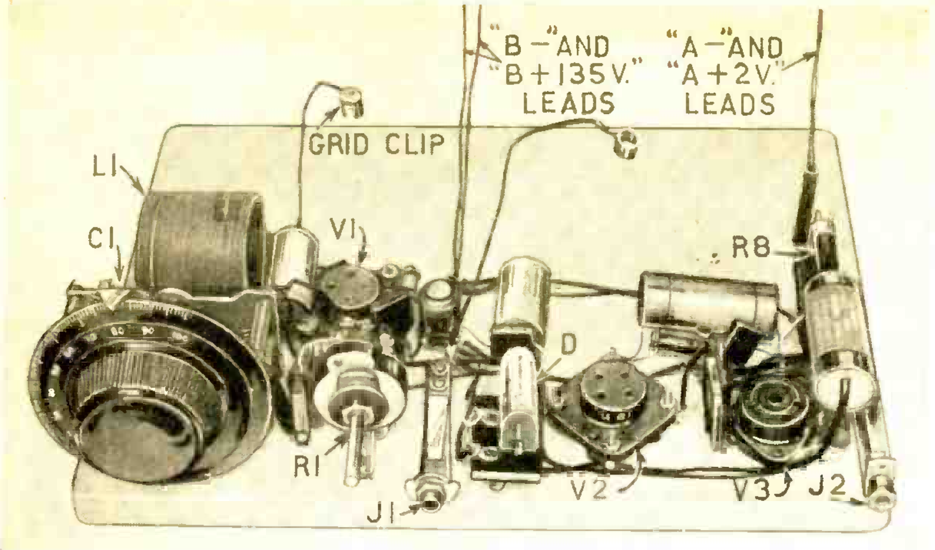


Fig. A

Pictorial view of the beginner's set; simplicity is the keynote.

quires no service adjustment or precise lining-up when originally built. It has, however, the disadvantage that the gain per stage (input "load," tube, and output "load") is considerably less than with tuned circuits; and the difference in gain between the high and low end of the band is much greater.

With these differences in mind we come to the conclusion that for our purpose—which is to get as effective a circuit as possible *while still maintaining the greatest simplicity*—we will stick to the original single tuned circuit and dodge the difficulties of lining up two tuned circuits by using one untuned stage instead.

Having thus decided, there are still two more questions open: just how, or in what order, we will arrange our tuned and untuned stages; and what type of tube we shall use for the added stage.

In both our previous circuits we had the tuned stage feeding directly into the crystal detector. Is there any good reason why we should make a change in the present case? Well, let us see. We will refer again to the characteristics of a tuned circuit.

The Tuned Circuit

The tuned circuit is a very high impedance device and, in common with all other forms of electrical circuits, will work most effectively into a load equalling its own impedance; such is supplied by the grid circuit of a vacuum tube. If we put a low resistance across the tuned circuit, say several hundred ohms, we destroy its effectiveness entirely, it becomes very inefficient and, furthermore, broad in tuning, which explains why crystal sets are noted for their lack of selectivity since a crystal, having a resistance of a few hundred or, at most, a few thousand ohms, constitutes just such a low resistance load.

This would seem to answer, sufficiently, the question as to where to put the tuned circuit in our case; but. there is *another* consideration which makes the case even stronger for putting the tuned circuit ahead of the first tube rather than ahead of the crystal.

As was pointed out before, the untuned circuit shows little discrimination as to what signal it will respond to. Everything within range, including all static and electrical noise, is treated with equal favor. Hence, if this type of circuit is placed ahead of the first tube we will simply be amplifying all this collection of noise and making the job of the following tuned circuit just that much harder. And if this tuned circuit is working into a crystal and is, therefore, broad in tuning it doesn't require much imagination to see that such a procedure would be mighty poor practice. And one more point: with all this collection of signals being applied at once to the grid of the first tube, it is quite possible to seriously overload it and cause the effect known as "cross modulation" or the "riding through" of a weaker signal on the back, as it were, of the stronger. If this occurs, no amount of tuning in later stages can get rid of the undesired signal.

Selecting the Tube

The remaining point, that of the type of tube to be used, is settled very simply by the requirement that the set have some form of volume control. The type 34 tube is almost identical in all respects to the type 32, with the exception that it is a pentode having three grids: a control-grid, a screen-grid and a suppressor-grid, this last (as in the type 33 tube) being permanently connected inside the tube to the filament, as shown on the diagram.

(Incidentally, the writer observes that the A.F. pentode, V2, in Fig. 1, page 36, of the July, 1933, issue of RADIO-CRAFT, is shown without a suppressor-grid. However, as just stated,

(Continued on page 116)

MR. RADIO BEGINNER:

Have You Read These Radio Receiver Construction Articles?

"A Pocket Radio Set," December, 1932, pg. 354. A unique crystal set contained in a headphone.

"A Sensitive Crystal Set," December, 1932, pg. 354. A selective and sensitive, tubeless, crystal receiver.

"Building A 1-Tube, Portable, Universal-Current Set," January, 1933, pg. 400. A duodiode-triode receiver which exemplifies the principle of universal A.C.-D.C. operation—with a few added "kinks" to interest the constructor.

"A Super-Selective Crystal Receiver," January, 1933, pg. 419. Complete details for a band-selector suitable for use with a crystal detector are given; the constructor may adjust the selectivity to suit his "taste."

"A Dynatron 1-Tube Electric Set," January, 1933, pg. 419. An experimental receiver which discloses several interesting ideas.

"The Trautonium—A New Musical Instrument," March, 1933, pg. 523. A fundamental design of extreme simplicity.

"An Improved Regenerative Circuit," March, 1933, pg. 546. A 1-Tube radio set of exceedingly simple design.

"The Megadyne 'N' Receiver," April, 1933, pg. 604. An easy-to-build 2-tube receiver; exceptional performance is its feature.

"A Super-Sensitive, All-Wave Crystal Set," May, 1933, pg. 680. An improved version of the "Sensitive Crystal Set" which was described in the December, 1932, issue, and which created a sensation.

"A 110 V., D.C., 'Megadyne,'" May, 1931, pg. 691. A circuit for the resident of districts powered by direct current.

"How to Make the Beginner's Power Crystal Set," June, 1933, pg. 724. A 2-Tube set. Both tubes amplify the audio output of a crystal detector.

"An Improved Power Crystal Set," July, 1933, pg. 36. Two tubes amplify the audio output of a crystal detector. The circuit incorporates the fundamental features of big sets. "Crystal clear" loudspeaker operation from local stations is obtained.

Many of these receiver designs have been "graduated" so that, as the beginner's knowedge increased, he would not experience any difficulty in building sets of slightly advanced design. Thus, the article, "The Beginner's Power Crystal Set—With R.F.," a 3-tube set design, incorporates most of the equipment specified in two previous articles, with the added feature of radio frequency amplification ahead of the crystal detector. Forthcoming issues of RADIO-CRAFT will describe some "hum dinger" sets; sorry we can't tip you off, "Young Timer," but just keep your eyes open, and tell your friends to help you watch for some amazing and simple receivers which you can build in one night.

THE ANALYSIS OF RADIO RECEIVER SYMPTOMS

OPERATING NOTES

BERTRAM M. FREED

TODAY, more than at any other time, the most serious and difficult problems encountered in radio servicing are those of an intermittent nature, amongst which are fading and irregular reception—complaints which may be due to a host of causes. With the new circuits, employing automatic volume control and silent tuning, it is necessary that many bypass and coupling condensers be used for correct operation, as well as numerous resistors of the carbon variety, the writer having counted no less than twenty of each of these units in the average radio set.

Only a short time was required to check the comparatively few fixed condensers in receivers of two or three years ago for open circuits, the "discharge" method usually sufficing because of the higher and non-critical capacities used. With the modern receiver, however, the testing of fixed condensers has become more difficult and more important because of their position in the circuit. As a direct consequence, the capacity meter will soon take its place with the ohmmeter as a necessary adjunct to the equipment of every able Service Man.

RCA Victor 75

Several cases of fading on the RCA Victor model 75 receiver were reported recently. One receiver had been taken to the shop on two separate occasions for a complete check and life-test; but no amount of effort could reproduce the symptoms of sudden "cutting off" or lowering of volume and recovery, experienced in the customer's home. Only one fact was established. At very low volume, any change or break in the antenna was readily discerned, but with the volume control advanced, this variation in the antenna was not noticeable because of the A.V.C. action of the 55 tube, used in this model as combination second detector and A.V.C.

Every condenser in the receiver capable of producing this effect was painstakingly checked. It was found that even the removal of the screen or cathode bypass condensers in the R.F. and first-detector stages, to obtain the same condition occasioned by an open-circuited condenser, failed to produce the condition complained of; although ordinarily, an open-circuited unit in either of these circuits would cause a drop in volume. On the other hand, when either of the condensers connected in the secondary return circuits of the first—detector or intermediate amplifier were removed, the volume dropped considerably.

Although, as in the case with carbon

WHAT THIS DEPARTMENT IS FOR

It is conducted especially for the professional Service Man. In it will be found the most unusual troubles encountered in radio service work, written, in a practical manner, by Service Men for you.

Have you, as a professional man, encountered any unusual or interesting Service Kinks that may help your fellow workers? If so, let us have them. They will be paid for, upon publication, at regular space rates.

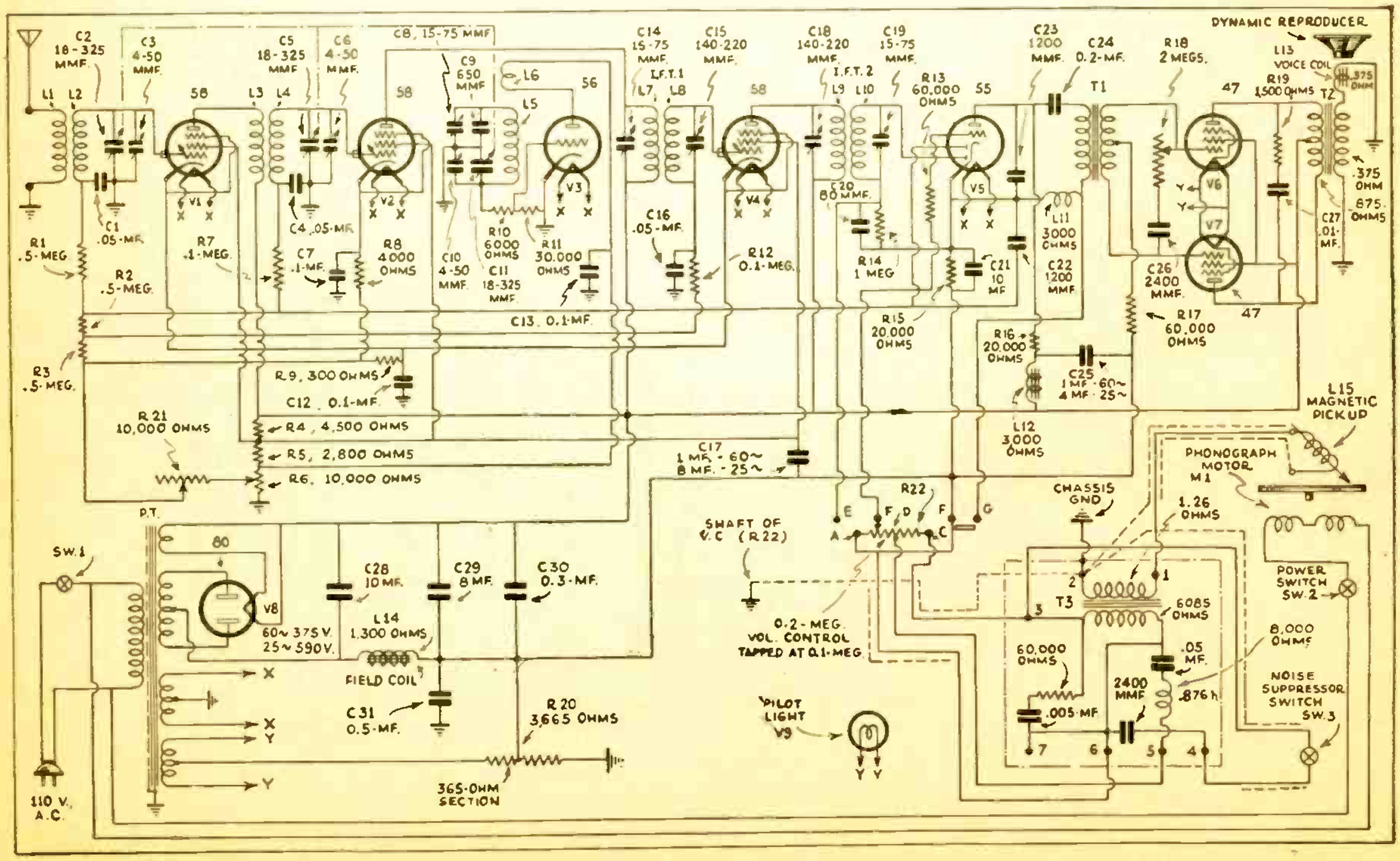


Fig. 1

Schematic circuit of the RCA-Victor RE-80 receiver. Note that this receiver is different from the RCA model 80.

resistors, it is well known that condensers used in radio receivers often vary more or less from their rated capacity, experiments carried on from time to time indicate that condensers which had open-circuited intermittently, when measured with a capacity meter, would show a wide deviation from their rated value. It is true that the procedure of bridging the suspected unit with another of known value, used by many Service Men, is both speedy and efficacious; but this method is only valuable when the condenser has open-circuited and remains in that condition at the moment of test. The capacity meter, however, has many times revealed the faulty condenser even though the receiver is in operating condition.

With this fact in mind, all .05-mf. units in the secondary return circuits of the R.F., first detector, and the intermediate stages were checked, and the condenser in the first-detector circuit was low, producing a reading of less than .01-mf. on the capacity meter. A new unit was installed, and the receiver was returned after several days of life-test to the customer, who reported, after a few weeks, that reception had not been marred by any fading since the set had been returned to him.

Other cases with the same complaint were treated similarly and a repair was affected by replacement of one or two of the three aforementioned condensers. A reason for this perhaps peculiar condition is apparently in order; but the only explanation that can be advanced rests on the supposition that when a condenser intermittently open-circuits, it is the result of a poor contact or connection within the unit which sets up a high resistance at the point, so that when the capacity is checked, the true value is not obtained, but one that is lower because of the resistance.

Making use of an old stunt described by the writer in the October, 1929 issue of RADIO-CRAFT, several of these open-circuited condensers were flashed with high A.C. voltage. One or two completely healed, but had a resulting lower capacity; some broke down, and others became permanently open-circuited.

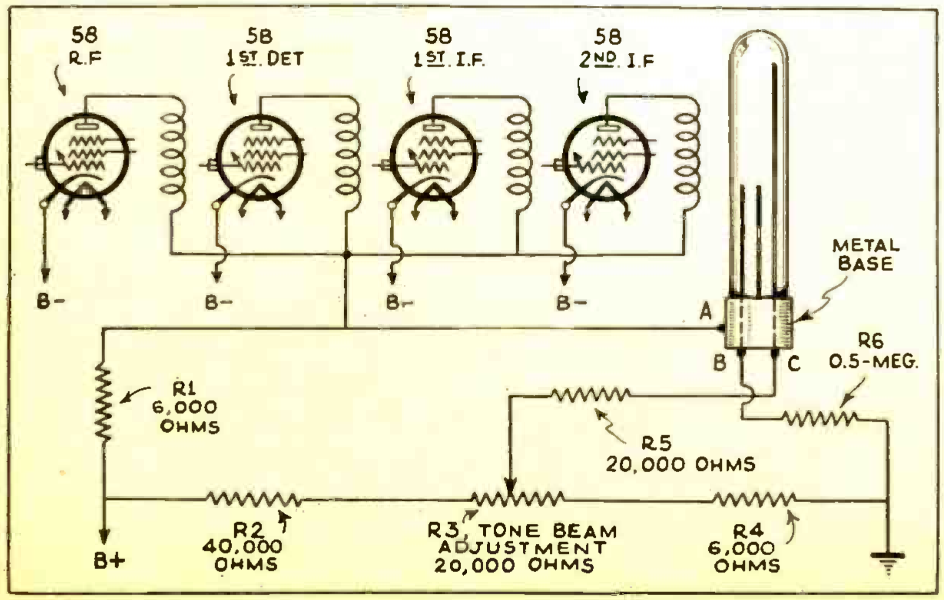
RCA Victor 77

An RCA Victor model 77 receiver was serviced recently, because of a rushing or "shushing" sound upon resonance, sometimes called resonance or station hiss. This hiss is usually experienced with receivers operating with insufficient or no antenna. In this case, as the aerial and lead were over 100 feet long, it seemed hardly possible that the trouble lay in this direction. However, breaks or defects in an antenna system were not improbable, and after a complete socket analysis failed to reveal any complications, a careful check was made, which finally terminated with the erection of an entire new aerial system to forestall all doubts on this score, but the noise was still present.

Attention was then again turned to the receiver; the chassis was removed from the cabinet to facilitate free access to all component parts. Before a point-to-point resistance check was made—since this procedure necessarily involved the expenditure of no little time—the bypass condensers in the radio-frequency portion of the receiver were tested by bridging all units with .1-mf. condensers, this size being sufficient as the values used ranged from .05- to .5-mf. When the condenser in the secondary return circuit of the intermediate-frequency stage, which is in the A.V.C. circuit, was shunted, the "shushing" resonance noise cleared up. Its value, when checked with the capacity meter, proved to be approximately .008-mf. A new .05-mf. unit was installed and the job was done.

On this same model, a frequent cause for complaint is noisy reception on the higher frequencies, especially when tuning from station to station. Due to the automatic volume control action, a fairly large input signal, because of a long antenna, will cause a

(Continued on page 109)



How the "Free Radio Inspection" Racket Works

The set owner, lured by the offer of free radio inspection, calls in the repairman offering this type of service. After examining the set the "gyp" repairman usually insists upon taking the chassis with him for a more thorough check-up with shop testing equipment.

Later the repairman telephones to inform the set owner that his radio needs extensive repairs, and that the cost will be ten to fifteen dollars. Actually the trouble may be so slight that only a new fuse is required!

Another variation of this racket is the door-to-door "free" service man who tells you that your set needs new tubes. Beware. He may install your neighbor's old tubes, and "sell" yours to the next neighbor.

Working from a private home, the Bureau has investigated a number of "free" inspection service men who were called in to check up a set which had already been tested and thoroughly serviced. The service man went through his "routine" and suggested extensive repairs in addition to new tubes which were not necessary.

This free service racket thrives due to the misconception of the cost factors involved in radio repair work. Contrary to popular opinion, the service man derives most of his profit from his labor. For this reason the legitimate radio service man makes a specified fixed charge for a call, and a standard charge for the various service operations.

This "free radio inspection" racket is one of many trade evils which must be combated in the interest of safeguarding the public and protecting the legitimate businessman. The Better Business Bureau, through ceaseless investigation and prosecution, is carrying on an aggressive campaign to protect you against loss from this type of fraud. You are invited to cooperate with the Bureau by reporting shady and dishonest trade practices.

When in doubt remember the slogan of the Better Business Bureau: "Before You Invest—Investigate."

BETTER BUSINESS BUREAU
OF SAN FRANCISCO
15 STOCKTON ST. SUtter 2170

A reproduction from an advertisement which appeared in a California newspaper. We have no additional comment to make, as the advertisement is self-explanatory.

Fig. 2, left.
Schematic of the neon tonebeam tuning indicator used in the Atwater Kent model 812 receiver.

MAJESTIC CHASSIS MODELS 380 A.C. T.R.F., AND 400 A.C.-D.C. SUPERHETERODYNE

(The model 380 chassis is used in receiver model 381 Pirate Chest; the 400, in receiver models 411 Deluxe Travel Super-Six and 413 Super-Six "Knockabout.")

Model 380

A feature of this set is the wide tuning range of 525 to 1,730 kc. which makes convenient the reception of police calls. Overlapping of station signals may be corrected by reducing the length of the antenna. Otherwise, its length should be about 100 to 150 ft.; use a ground connection, if convenient.

The new Majestic types G-57A-S and G-58A-S tubes are identical in all electrical respects to the types G-57-S and G-58-S except that their filament requires 6.3 V. instead of 2.5 V. As usual, the "S" on Majestic tubes designates "spray shield"; thus, to use ordinary, non-spray shield tubes may result in circuit oscillation. Tube operating voltages, at a line potential of 115 V., and measured to ground, appear in the following tabulation. Filament A.C. potential of V1 to V3 is 5.9 V.; V4, 2.4 V.

Tube Type	Cath. Volts	S.-G. Volts	Heat. Volts	Plate Volts
V1	2.4	....	....	178
V2	1.4	18.4	....	80
V3	18.4	183.	....	171
V4	....	....	285	350*

*A.C. All other values are D.C.

Following is the color code of P.T.: Primary, stranded yellow; secondary, X, X, solid yellow; V4 fil., black; V4 plate, red.

To align the receiver circuits, set the dial so that the gauge mark below 1,500 kc. is in line with the pointer when the gang condenser is completely unmeshed. Align for maximum output at 1,500 kc. A model G-25-A reproducer is used in this set; its field coil has a resistance of 3,000 ohms. The primary of transformer T. measures 660 ohms.

This chassis has a sensitivity of 1,000 microvolts-per-meter; the undistorted power output is .75-W.; power consumption, 35 W.

Model 400

Following are the operating voltages of the tubes in the model 400 chassis. The A.C.-D.C. filament voltage of V1 to V3 is 6.3 V.; V4, V5, 25 V.; the drop across V6 is 46.1 V. The figures are for a line potential of 115 V., A. C. The cathode voltage of V2 will vary in accordance with the setting of the volume control, R1. All readings are taken to "B" minus; adjust R1 for maximum volume.

Tube Type	Cath. Volts	S.-G. Volts	Plate Volts
V1	13	105	105
V2	3	105	105
V3	2	18	18
V4	16	105	96
V5	118	....	....

If a resistance test of the circuits is made, note that the readings will vary according to the polarity of the test leads, due to the presence of electrolytic condensers. Use polarity giving the highest readings.

Resistor R2 is rated at 5W. It shunts the filaments of V4 and V5; they consume only 300 ma., while tubes V1, V2, V3 and V6 require 400 ma.

A Majestic type G-26-C reproducer is used in this chassis; the field coil resistance is 2,600 ohms. Tube V6 is spray shielded in order to reduce the glow; however, no connection is made to the shield.

The sensitivity is 50 microvolts per meter, undistorted power output, .75-W.; power consumption, 60 W. On A.C., reverse the line plug for least noisy operation. Also, connect a ground wire to the receiver; at the rear left side of the chassis a terminal is provided; only three chassis connections are indicated in the diagram.

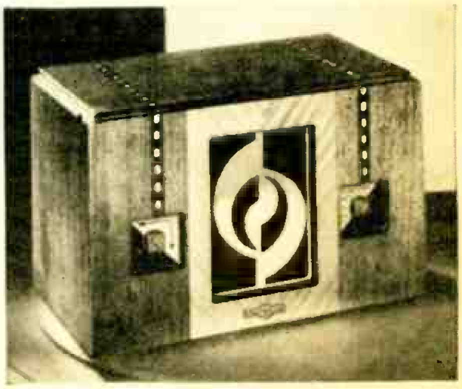
Note that the model 413 receiver should not be operated in its carrying case without first opening the back of the case to permit heat dissipation.

To adjust the I.F. circuits set R1 for maximum volume and tune for maximum output with an I.F. of 456 kc.

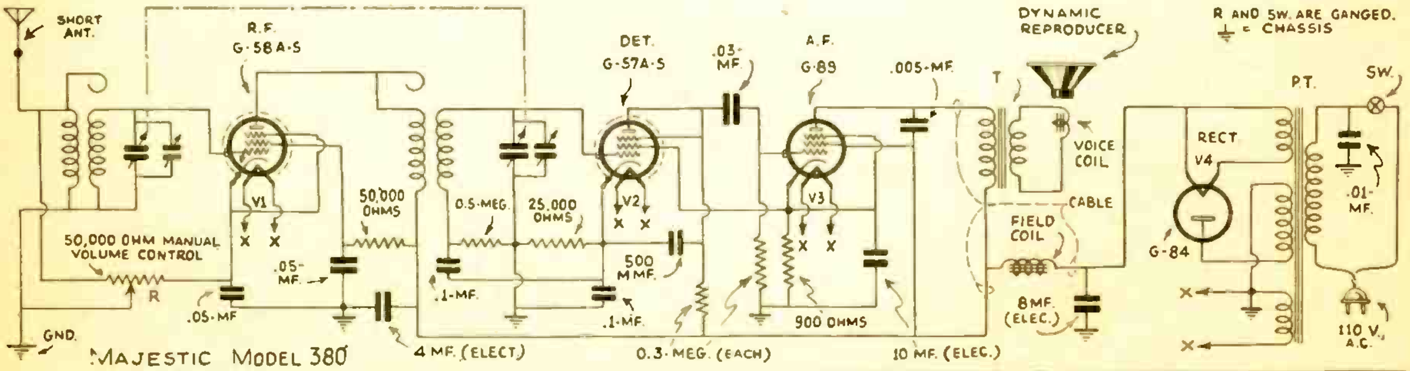
To align the R.F. circuits set R1 for maximum volume and resonate the circuits for maximum output of a 1,730 kc. signal.

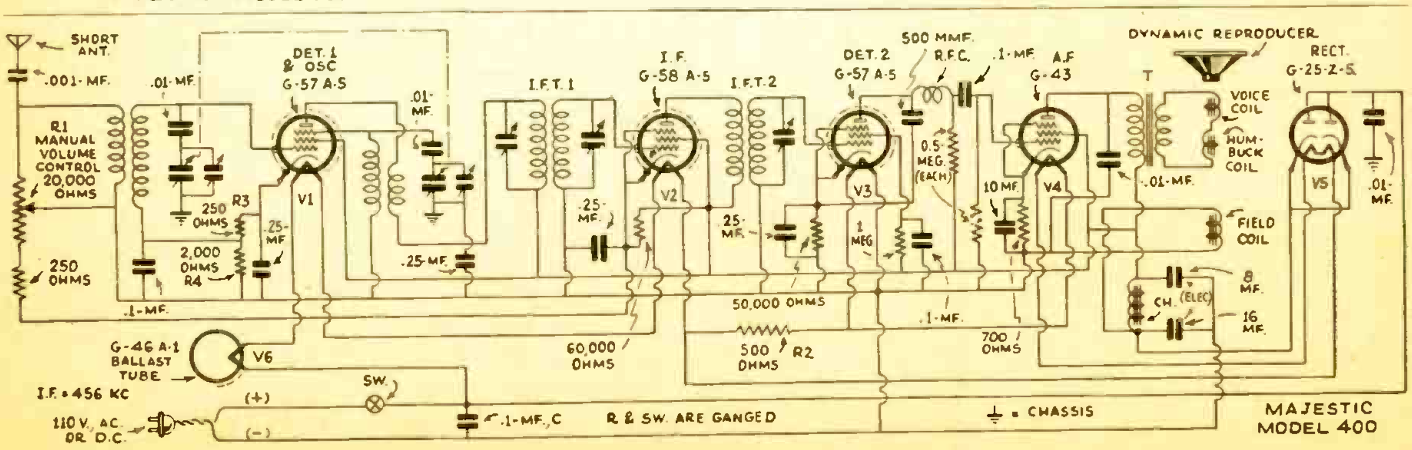
In some receivers resistor R3 has a value of 160 ohms, and R4, 2,500 ohms. The purpose of this change was to make V1 oscillate more readily. If the values of these units are those indicated in the diagram it may be necessary to try two or three different tubes in the position of V1, before a tube is found which will oscillate over the entire band. A change in the value of R3, R4, or both, should correct the fault.

In some chasses the value of C will be found to be .05-mf. However, if a service replacement becomes necessary use the value indicated in the diagram.



Majestic model 411 A.C.-D.C. superheterodyne





SILVER-MARSHALL MODEL Z-13 ALL-WAVE 13-TUBE SUPERHETERODYNE

(The Z-13 Round-the-World receiver incorporates automatic volume control, silent tuning control, beat-tuning oscillator, parallel type 56 driver tubes, push-pull type 59 A. F. output, tone control, and a diode second-detector. The wavelength range is 15 to 545 meters, in four steps.)

Technicians and, particularly, Mr. Consumer, are acquainted with the tedious technique of short-wave tuning, as compared with the operation at the "broadcast" wavelength range of 200 to 545 meters. It is to overcome this objection that the model Z-13 receiver was designed, in an effort to popularize short-wave reception. A full-vision tuning dial, with color bands to correspond with the setting of the frequency-band selector switch, Sw.1 to Sw.4, a ganged unit, gives accurate indication of the frequency to which the receiver is tuned. On each color band the position of police, television, aviation, amateur, and broadcast channels are marked.

Instant location of even the weakest stations is accomplished by means of an electron-coupled heterodyne oscillator: this beat-tuning oscillator is designated in the diagram as V10. The action of this tube is controlled by a pendant push-button, Sw.7.

The use of a silent-tuning control circuit results in quite operation during the period of tuning from one station to another, but at the expense of sensitivity; therefore, switch Sw.5, a panel-operated unit, is provided to control the operation of the silent-tuning tube, V12.

Resistor R1, a tapered manual volume control, 5,000 ohms; R2, tone control, log taper, 0.5-meg.; R3, 2 W., 3,000 ohms; R4, 0.23-meg.; R5, 60,000 ohms; R6, 11,000 ohms; R7, R21, 0.1-meg.; R8, R9, 0.5-meg.; R10, 0.25-meg.; R11, R14, 1 meg.; R12, 2 meg.; R13, 0.3-meg.; R15, 6,000 ohms; R16, 8,000 ohms; R17, R18, R19, R20, 2,600, 340, 1,840 and 5,750 ohms, respectively, wire wound; R22, 150 ohms.

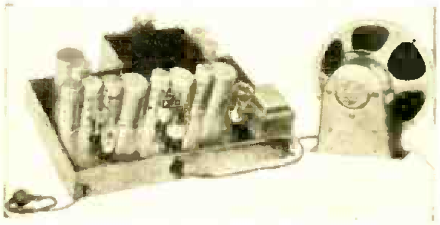
Condensers C1, C4, C5, C15, .01-mf.; C2, .25-mf.; C3, C7, C8, C9, .5-mf.; C6, C14, 0.1-mf.; C10, mica dielectric, .01-mf.; C11, .15-mf.; C12, C19, mica dielectric, 100 mmf.; C13, .0-25-mf.; C16, C32, mica dielectric, 250 mmf.; C17, mica dielectric, 50 mmf.; C18, C33, mica dielectric, .002-mf.; C20, dry electrolytic, 450 V., 8 mf.; C21, dry electrolytic, 450 V., 12 mf.; C22, .002-mf.; C23, mica-dielectric trimmers, 20 to 65 mmf.; C24, mica-dielectric trimmer, 6 to 30 mmf.; C25, mica-dielectric trimmer, 25 to 65 mmf.; C26; C29, tuning condensers, 410 mmf.; C27, C30, trimmers; C28, mica dielectric, 350 to 500 mmf.; C31, mica dielectric, 70 to 125 mmf.

Instead of operating voltage and current figures for the tubes in this receiver the following voltage figures, measured on a high-resistance meter, connected from chassis to the points indicated, are given. Point A, 250 V.; B, 100 V.; C, 5 V.; D, 150 to 180 V.; E, 3 V.; F, 3 V.; G, 60 V.; H, 18 V.; I, 3 V.; J, 40 V.; K, 47 V.; L, 100 V.; M, 250 V.; N, 250 V.; O, 250 V.

In the center, directly below the tuning knob, is the switch controlling the silent tuning or quiet A.V.C. circuit. When this knob is turned to the left, or counter-clockwise, the S.T.C. circuit is in operation. Only the louder broadcast stations are now heard. When the tuning dial is rotated off the local station, the inter-carrier noise usually heard on A.V.C.-equipped receivers is muffled or entirely silent. Thus, the listener is not bothered with static and other spurious noises when only reception from the louder stations is desired.

When distant broadcast or short-wave reception is desired, this switch should be turned to the right and the S.T.C. circuit will be inoperative. *It is imperative that the switch be turned to this position for short-wave reception*, otherwise it is very possible to miss stations in tuning, due to the sharpness of tuning.

The electron-coupled beat-oscillator is weak-coupled to the I.F. amplifier section of the receiver in such a way that when the pushbutton on the pendant cord is depressed the oscillator is connected in circuit. If any station carrier is crossed during the turning of the tuning dial while the oscillator is in operation, there will be heard, from the reproducer, a musical note, or whistle, of varying pitch. When this note is tuned to the lowest possible pitch, "zero beat," the receiver will be very closely adjusted to the distant station signal and the pendant switch should be released. If the signal is that of a radiophone station, the voice or music will now be heard and only the slightest readjustment will be necessary to bring it in at its maximum volume. For code reception, continue to press button.



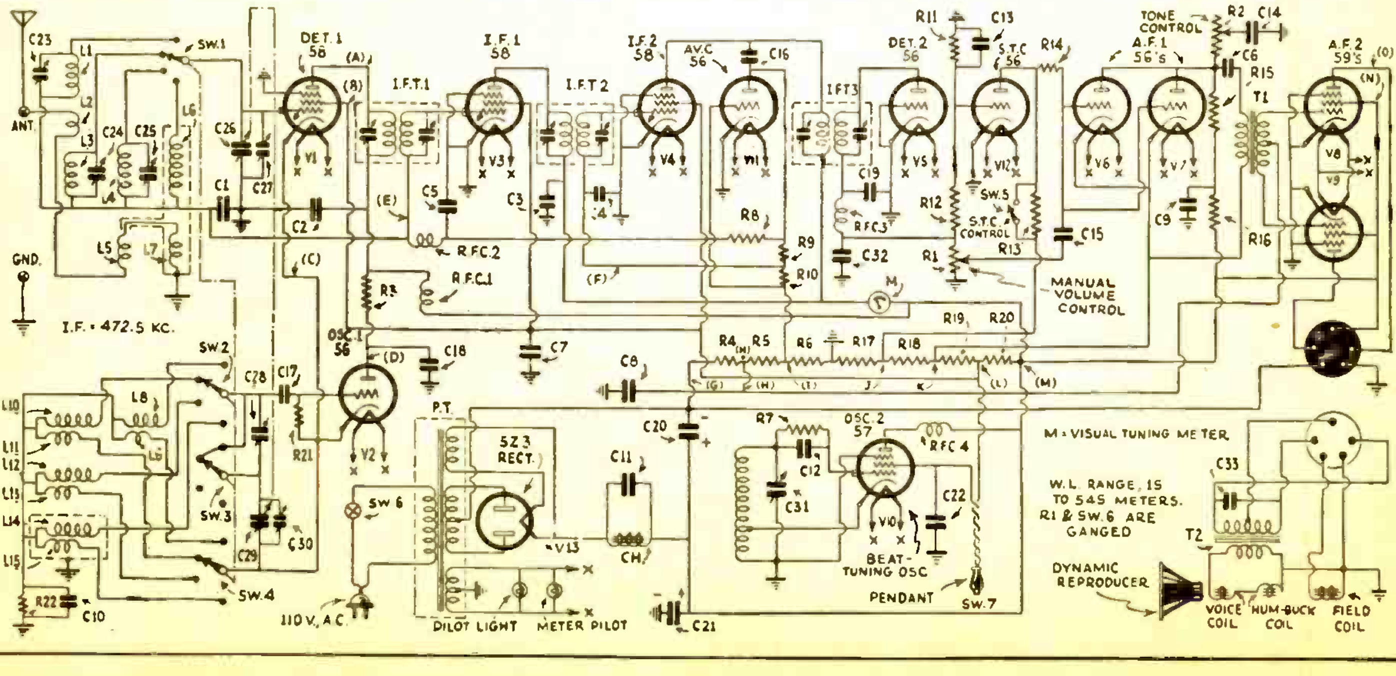
The tuning dial should be operated *very slowly* when tuning for short-wave stations, particularly when in the green and purple bands, for the receiver is extremely selective and faint signals may be passed.

This receiver is designed to be used on an antenna with a length of about 40 to 100 ft. It is imperative that a good ground connection be used with this receiver in order to obtain stable operation.

The receiver is shipped with a kit of selected tubes. If it becomes necessary to replace tubes, carefully select the oscillator. Test two or three tubes until a type 56 for V2 is found which will operate satisfactorily in the purple band.

The model Z-13 receiver has a sensitivity of .45-microvolt-per-meter, a power output of 6.9 W., and power consumption of 120 W.

The first R.F. and oscillator input circuits of this receiver are unusual. The antenna circuit includes three primaries in series: L2, L5, and L7; L2 feeds two secondaries, L1 and L3, while primaries L5 and L7 feed only one apiece, L4 and L6, respectively. The latter primary and secondary are used for tuning in the 200 to 550 meter band, and it is only in this range hat trimming condenser C27 is to be aligned; trimmers for each of the other ranges are provided in shunt to the individual secondaries. Since the two gang tuning condenser has sections of equal capacity, a padding circuit is required; condenser C28 is the padding condenser for this circuit and is to be aligned at the highest wavelength to which the receiver will tune, or about 545 meters. Since, at the shortest wavelength to which the receiver will tune the frequency tracking of the oscillator tuning condenser is close to that of the signal-frequency tuning condenser, padding condenser C28 is not required on the first two short-wave bands and, therefore, is shorted out of the circuit by one of the sections, Sw.3, of the band-selector switch.



MODERNIZING THE MAJESTIC 15

MORRIS LANDAU

Here is an article which tells you exactly what to do to modernize the famous Majestic 15. Tubes are replaced, connections are changed, and the receiver emerges as modern as possible.

THE Majestic Model 15 receiver was presented to the public in August, 1931 and was a marvel of efficiency, at the time, for a set having only five tubes. The circuit, as can be seen at Fig. 1, is a superheterodyne with the first tube acting as a combination oscillator and first detector.

When the new tubes came out, the set was inspected to see if they could be used in this receiver. A type 58 tube was inserted in the I.F. socket and a type 57 tube was used in the oscillator-detector socket. The 58 made no noticeable change, but the 57 nearly doubled the volume.

While the changes were made on this midget, which sold for $44.50 in 1931, the same changes can be made on all good screen-grid sets, and there is much profit to be made in remodeling them. The work may be done by any competent Service Man who knows the theory of design. A knowledge of radio theory is essential, inasmuch as the Service Man will be called upon to make many changes in the design of sets in order to work the new tubes at maximum efficiency.

Remodelling the R.F. Section of the Set

The first step in the reconstruction of the set is to chisel out the old five-prong sockets and insert six-prong sockets in their places. The suppressor grids are tied to the cathodes; and the plate, heater, and screen-grid leads connected to their respective lugs on the sockets. This operation is performed quite easily as the sockets fit right in place.

The plate winding of the I.F. stage is untuned in the original version of the set, and since the plate circuit of the 58 tube *must have a high impedance in order to work the tube at high gain*, a new second I.F. transformer is installed. In this new transformer the primary and secondary are tuned. An appreciable improvement can be noticed after this replacement.

Before proceeding further, a word about the tubes is in order. The Majestic company is now issuing all tubes, used in R.F. circuits, with a sprayed shield on their surfaces connected internally to the cathode. This method of shielding is very efficient and does away with the shield cans heretofore used. Other types of tubes can be used, but they must be shielded, which is a disadvantage in the small space available.

The gain in the R.F. end of the set is now great enough to allow a reserve so that A.V.C. can be used. With this thought in mind, a type 55 duo-diode triode is installed in the second detector socket and wired as a half-wave rectifier, the triode section biased by the diode rectifier. The circuit is the same as the one in the August, 1932 issue of RADIO-CRAFT. The triode grid lead is the one enclosed in a wire shield and brought to the tube through a small hole conveniently located on the side of the chassis near the detector socket. This lead is connected to the junction of the two resistors, R6 and R7 in Fig. 2, forming the diode load. The diode return lead is the green wire, coming from the I.F. transformer in the back of the set, and is connected to the chassis. Unsolder this lead and connect it to the diode load resistance, R6. The black wire from the first I.F. transformer is the grid return lead. This is connected to the diode load resistance, as shown in Fig. 2. The cathode lead of the 55 is brought out to one terminal of a jack, the other side of which is grounded. This jack is shunted by a switch Sw.2 which is open for phono and closed for radio.

In the original circuit the volume control is in the cathode lead of the I.F. stage and controls the grid bias of the I.F. tube. It is also part of the voltage divider that furnishes voltage to the screen grids. Since the sensitivity of the set changes with signal strength, the volume control must be transferred to the audio end of the set. This procedure will be discussed later.

The old volume control is removed from the set and R2, Fig. 2, is connected to ground through R11. The voltage applied to the screen grids by the divider is now about 80 volts, which is quite sufficient.

Although the 58, I.F. stage, is biased by the detector, provision must be made for a minimum bias with no signal. This is provided by the resistor R5 in the cathode lead of the 58, which gives a voltage of about —2 volts. The antenna lead, shown in Fig. 1 as connected to the volume control, is cut off, and the antenna is connected to the antenna coil alone.

Revising the Audio Section

The R. F. end of the circuit is now complete, so that we will now concentrate on the set's audio channel. Although the R.F. input to the rectifier is quite large, the output efficiency of the diode is so small that even the triode amplifier, enclosed in the same

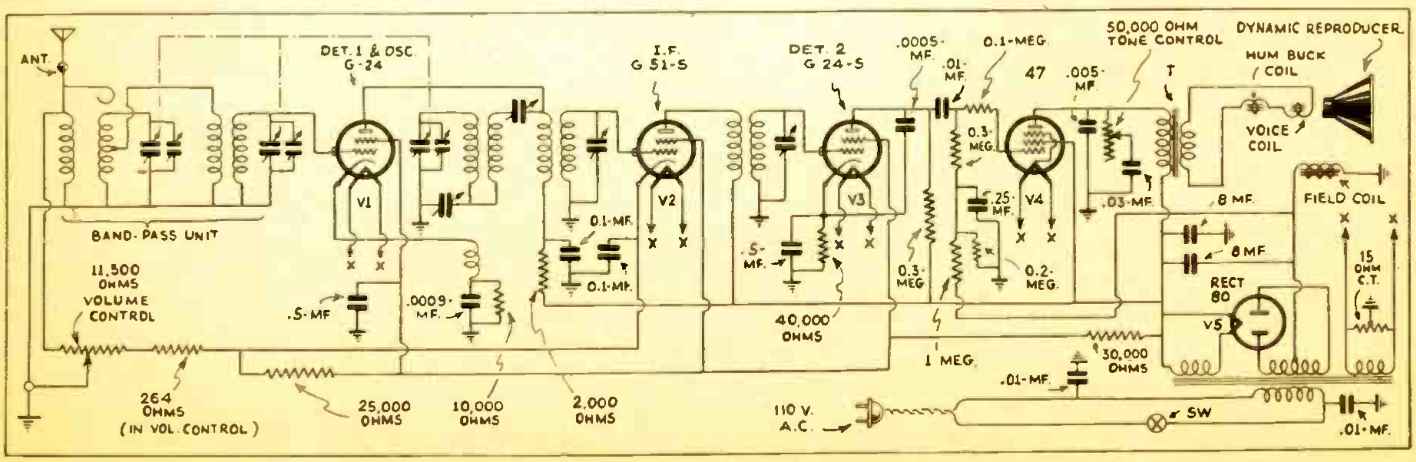


Fig. 1
Schematic circuit of the Majestic 15 before the change.

envelope, is insufficient to bring the output up to any reasonable volume. Another amplifier stage is needed to load up the power amplifier. A type 56 is ample. The only place where a tube can be placed in this receiver is near the antenna coil, above the tone control. Two holes are drilled in the chassis and a 5 hole, sub-panel socket is mounted. The grid, heater, and cathode leads are connected to the socket through the hole in the condenser-gang mounting. The new volume control is inserted in place of the old one and the grid is connected to the center lug through a .1-meg. resistor, R10. One end of the volume control, R9, is grounded and the other end is connected to the coupling condenser C-10. The plate resistor of the 56 tube, R12, and the tubular coupling condenser, C12, are soldered together and the plate lead is soldered to the junction of the two. After this is done, the condenser and resistor are wrapped with tape.

The two dry electrolytic filter condensers are now dismounted and the resistor—condenser combination is inserted in the upper edge of the chassis and held in place by a soldering lug conveniently placed there. The grid end of the condenser is now soldered to the grid leak (R13) lead and the resistor, R14, which connects to the grid of the type 47 output tube.

The electrolytic condensers are put back and the B+ end of the plate resistor, R12, is soldered to their common positive lug. The cathode of the 56 is connected to the junction of R2 and R11. The voltage drop across R11 furnishes the grid bias for the 56 audio stage; this drop is about 9 volts. R11 is bypassed by the .5-mf. condenser C2 which formerly bypassed the second detector bias resistor.

The power output stage is left intact except for the 1 mf. condenser, C15, which is used to operate an additional loudspeaker.

CHANGES TO BE MADE IN ORIGINAL SET

(1) The first-detector—oscillator tube is replaced by a 57, resulting in a large increase in volume.

(2) The I.F. tube is replaced by a 58 and the volume control is shifted from its cathode circuit, resulting in increased all-around performance.

(3) The detector tube is removed and replaced by a 55, a duo-diode triode. Automatic volume control is added; this change makes the set really modern.

(4) An additional audio stage is added to compensate for the slight decrease in volume caused by the A.V.C.; the volume is greater now than ever before.

All of these changes are made on the original chassis; no "appendages" outside the cabinet are required.

Aligning the Tuned Circuits

The revision of the set is now completed and all that remains is to align the tuned circuits. The alignment is done by inserting a milliammeter in the cathode lead of the I.F. tube. The meter should read about 10 ma. with no signal, the combined plate and screen currents of this tube. Now, tune in a local station and line up the trimming condensers for minimum reading on the meter. This method of aligning A.V.C. circuits is very accurate and prevents the presence of double peaks which occur when each I.F. transformer is tuned to a slightly different frequency. (When this latter condition is present, the needle will kick back for each peak.) The set should be aligned so that there is a single peak and the rate of needle movement is the same on both sides of the channel. After alignment, the meter is disconnected and the cathode connected as before. The meter can be left in the circuit and used as a resonance meter if so desired.

The meter is not necessary, however, as the set has seven tuned circuits and is very sharp. On locals, for instance, the meter registers .5-milliampere at resonance, and the maximum current of 10 mills at 10 kilocycles off resonance on either side.

Description of the Cabinet

The writer's set has three switches and two jacks on the side of the radio cabinet: Sw. 1 shuts off the power, Sw. 2 switches from phono to radio and Sw. 3 is in the voice coil lead and shuts off the loudspeaker. Jack J1 is the phono jack and J2 is used for an additional loudspeaker or for a cutting head when making home recordings. Phonograph connection is made when the plug is inserted in J1 and Sw. 2 opened. The resistance of the pickup coil in series with the cathode causes a voltage drop which biases the diode plates and stops rectification. The triode grid is also biased by this same action. The secondary of a microphone-phono transformer can be substituted for the pickup coil when a low impedance pickup is used.

As the set is now, it may be used to play records, make recordings, act as a public-address system where the power output of 2.5 watts is sufficient, and act as a modulator for a low-power transmitter. It may also be used as a one-way communication system in an office.

The volume control, R9, is a .25-meg. potentiometer used as the grid leak of the 56 audio stage. This method of volume control is very smooth. The same control is used for both radio and phonograph. The .1-meg. resistors in

(Continued on page 108)

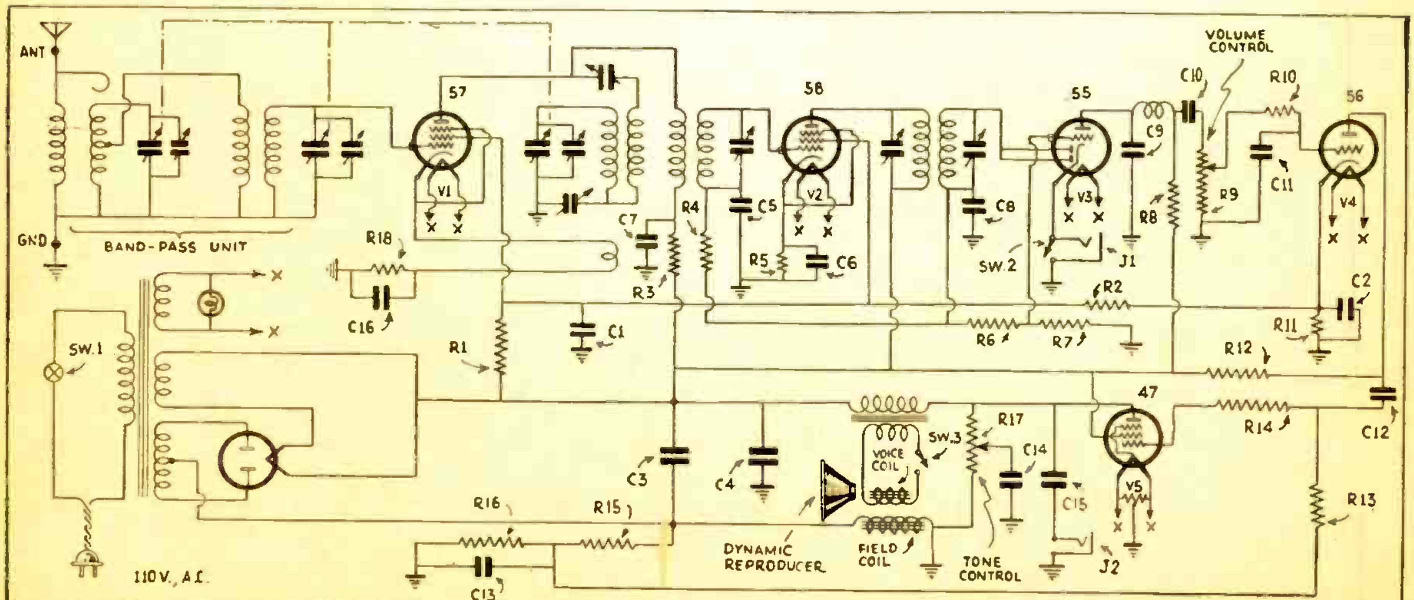


Fig. 2
Schematic circuit of the Majestic 15 after the change.

BROADCAST STATIONS OF THE U. S.

A list of all the broadcast stations in the U. S. as licensed by the Federal Radio Commission and brought up to date to May 1, 1933. Abbreviations: T, location of transmitter; C. P., construction permit authorized; LS, power until local sunset.

Call Letters	Location	Power (watts)	Freq. kc.	Wave-length (meters)
KABC	San Antonio, Tex	100	1420	211.3
KALE	Portland, Ore	500	1300	230.8
KARK	Little Rock, Ark	250	890	337.1
KASA	Elk City, Okla	100	1210	247.9
KBPS	Portland, Ore	100	1420	211.3
KBTM	Paragould, Ark	100	1200	250
KCMC	Texarkana, Ark	100	1420	211.3
KCRC	Enid, Okla	100	1370	219
KCRJ	Jerome, Ariz	100	1310	229
KDB	Santa Barbara, Calif	100	1500	200
KDFN	Casper, Wyo	500	1440	208.3
KDKA	Pittsburgh, Pa	50kw	980	306
	T-Saxonburg			
KDLR	Devils Lake, N. D.	100	1210	247.9
KDYL	Salt Lake City, Utah	1kw	1290	232.6
KECA	Los Angeles, Calif	1kw	1430	209.8
KELW	Burbank, Calif	500	780	385
KERN	Bakersfield, Calif	100	1200	250
KEX	Portland, Ore	5kw	1180	254.2
KFAB	Lincoln, Nebr	5kw	770	390
KFAC	Los Angeles, Calif	1kw	1300	230.8
KFBB	Great Falls, Mont	1kw	1280	234.4
KFBI	Abilene, Kans	5kw	1050	285.7
	T-Milford			
KFBK	Sacramento, Calif	100	1310	229
KFBL	Everett, Wash	50	1370	219
KFDM	Beaumont, Texas	500	560	536
KFDY	Brookings, S. D.	1kw	550	545
KFEL	Denver, Colo	500	920	326
	T-Edgewater			
KFEQ	St. Joseph, Mo	2½kw	680	441
KFGQ	Boone, Iowa	100	1310	229
KFH	Wichita, Kans	1kw	1300	230.8
KFI	Los Angeles, Calif	50kw	640	469
	T-Buena Park			
KFIO	Spokane, Wash	100	1120	267.9
KFIZ	Fond du Lac, Wis	100	1420	211.3
KFJB	Marshalltown, Iowa	100	1200	250
KFJI	Klamath Falls, Ore	100	1210	247.9
KFJM	Grand Forks, N. D.	100	1370	219
KFJR	Portland, Ore	500	1300	230.8
KFJZ	Fort Worth, Tex	100	1370	219
KFKA	Greeley, Colo	500	880	341
KFKU	Lawrence, Kan	500	1220	245.9
	T-Tonganoxie			
KFKX-KYW	(See KYW-KFKX)			
KFLV	Rockford, Ill	500	1410	212.8
KFLX	Galveston, Tex	100	1370	219
KFNF	Shenandoah, Iowa	500	890	337
KFOR	Lincoln, Nebr	100	1210	247.9
KFOX	Long Beach, Calif	1kw	1250	240
KFPL	Dublin, Tex	100	1310	229
KFPM	Greenville, Tex	15	1310	229
KFPW	Ft. Smith, Ark	100	1210	247.9
KFPY	Spokane, Wash	1kw	1340	223.9
KFQD	Anchorage, Alaska	250	1230	243.9
KFRC	San Francisco, Calif	1kw	610	492
KFRU	Columbia, Mo	500	630	476
KFSD	San Diego, Calif	1kw	600	500
KFSG	Los Angeles, Calif	500	1120	267.9
KFUO	Clayton, Mo	500	550	545
KFVD	Los Angeles, Calif	250	1000	300
KFVS	Cape Girardeau, Mo	100	1210	247.9
KFWB	Hollywood, Calif	1kw	950	316
KFWF	St. Louis, Mo	100	1200	250
KFWI	San Francisco, Calif	500	930	323
KFXD	Nampa, Idaho	100	1200	250
KFXF	Denver, Colo	500	920	326
KFXJ	Grand Junction, Colo	100	1200	250
KFXM	San Bernardino, Calif	100	1210	247.9
KFXR	Oklahoma City, Okla	100	1310	229
KFYO	Lubbock, Texas	100	1310	229
KFYR	Bismarck, N. D.	1kw	550	545
KGA	Spokane, Wash	5kw	1470	204.1
KGAR	Tucson, Ariz	100	1370	219
KGB	San Diego, Calif	1kw	1330	225.6
KGBU	Ketchikan, Alaska	500	900	333
KGBX	Springfield, Mo	100	1310	229
KGBZ	York, Nebr	500	930	323
KGCA	Decorah, Iowa	100	1270	236.2
KGCR	Watertown, S. D.	100	1210	247.9
KGCU	Mandan, N. D.	250	1240	241.9
KGCX	Wolf Point, Mont	100	1310	229
KGDA	Mitchell, S. D.	100	1370	219
KGDE	Fergus Falls, Minn	100	1200	250
KGDM	Stockton, Calif	250	1100	272.7

Call Letters	Location	Power (watts)	Freq. kc.	Wave-length (meters)
KGDY	Huron, S. D.	250	1340	223.9
KGEK	Yuma, Colo	100	1200	250
KGER	Long Beach, Calif	1kw	1360	220.6
KGEZ	Kalispell, Mont	100	1310	229
KGFF	Shawnee, Okla	100	1420	211.3
KGFG	Oklahoma City, Okla	100	1370	219
KGFI	Corpus Christi, Tex	100	1500	200
KGFJ	Los Angeles, Calif	100	1200	250
KGFK	Moorhead, Minn	100	1500	200
KGFL	Raton, N. Mex	50	1370	219
	C. P. Roswell			
KGFW	Kearney, Nebr	100	1310	229
KGFX	Pierre, S. D.	200	630	476
KGGC	San Francisco, Calif	100	1420	211.3
KGGF	Coffeyville, Kans	500	1010	297
	T. South Coffeyville, Okla			
KGGM	Albuquerque, N. M.	250	1230	243.9
KGHF	Pueblo, Colo	250	1320	227.3
KGHI	Little Rock, Ark	100	1200	250
KGHL	Billings, Mont	1kw	950	316
KGIR	Butte, Mont	500	1360	220.6
KGIW	Trinidad, Colo	100	1420	211.3
KGIX	Las Vegas, Nev	100	1420	211.3
KGIZ	Grant City, Mo	100	1500	200
KGKB	Tyler, Tex	100	1500	200
KGKL	San Angelo, Tex	100	1370	219
KGKO	Wichita Falls, Tex	250	570	526
KGKX	Sandpoint, Idaho	100	1420	211.3
	C. P. Lewiston			
KGKY	Scottsbluff, Nebr	100	1500	200
KGMB	Honolulu, Hawaii	250	1320	227.3
KGNF	North Platte, Nebr	500	1430	209.8
KGNO	Dodge City, Kans	250	1310	223.9
KGO	San Francisco, Calif	7½kw	790	380
	T-Oakland			
KGRS	Amarillo, Tex	1kw	1410	212.8
KGU	Honolulu, Hawaii	2½kw	750	400
KGVO	Missoula, Mont	100	1200	250
KGW	Portland, Me	1kw	620	484
	T-Faloma			
KGY	Olympia, Wash	100	1210	247.9
KHJ	Los Angeles, Calif	1kw	900	333
KHQ	Spokane, Wash	1kw	590	509
KICA	Clovis, N. M.	100	1370	219
KICK	Red Oak, Iowa	100	1420	211.3
KID	Idaho Falls, Idaho	250	1320	227.3
KIDO	Boise, Idaho	1kw	1350	222.2
KIDW	Lamar, Colo	100	1420	211.3
KIEM	Eureka, Calif	100	1210	247.9
KIEV	Glendale, Calif	100	850	353
KIFH	Juneau, Alaska	100	1310	229
KIT	Yakima, Wash	100	1310	229
KJBS	San Francisco, Calif	100	1070	280.4
KJR	Seattle, Wash	5kw	970	309
KLCN	Blytheville, Ark	100	1290	232.6
KLO	Ogden, Utah	500	1400	214.3
KLPM	Minot, N. D.	250	1240	241.9
KLRA	Little Rock, Ark	1kw	1390	215.8
KLS	Oakland, Calif	250	1440	208.3
KLX	Oakland, Calif	1kw	880	341
KLZ	Denver, Colo	1kw	560	536
KMA	Shenandoah, Iowa	500	930	323
KMAC	San Antonio, Texas	100	1370	219
KMBC	Kansas City, Mo	1kw	950	316
	T-Independence			
KMED	Medford, Ore	100	1310	.....
KMJ	Fresno, Calif	500	580	517
KMLB	Monroe, La	100	1200	250
KMMJ	Clay Center, Neb	1kw	740	405
KMO	Tacoma, Wash	250	1330	225.6
KMOX	St. Louis, Mo	50kw	1090	275.2
KMPC	Beverly Hills, Calif	500	710	423
KMTR	Los Angeles, Calif	500	570	526
KNOW	Austin, Tex	100	1500	200
KNX	Los Angeles, Calif	25kw	1050	285.7
KOA	Denver, Colo	12½kw	830	361
KOAC	Corvallis, Ore	1kw	550	545
KOB	Albuquerque, N. M.	10kw	1180	254.2
KOCW	Chickasha, Okla	250	1400	214.3
KOH	Reno, Nev	500	1380	217.4
KOIL	Councils Bluffs, Iowa	1kw	1260	238.1
KOIN	Portland, Ore	1kw	940	319
KOL	Seattle, Wash	1kw	1270	236.2
KOMA	Oklahoma City, Okla	5kw	1480	202.7
KOMO	Seattle, Wash	1kw	920	326
KONO	San Antonio, Tex	100	1370	219

Call Letters	Location	Power (watts)	Freq. kc.	Wave-length (meters)
KOOS	Marshfield, Ore	100	1370	219
KORE	Eugene, Ore	100	1420	211.3
KOY	Phoenix, Ariz	1kw-LS	1390	215.8
KPCB	Seattle, Wash	100	650	462
KPJM	Prescott, Ariz	100	1500	200
KPO	San Francisco, Calif	5kw	680	441
	T-Near Belmont	C.P.50kw		
KPOF	Denver, Colo	500	880	341
KPPC	Pasadena, Calif	50	1210	247.9
KPQ	Wenatchee, Wash	100kw	1500	200
KPRC	Houston, Tex	1kw	920	326
	T-Sugarland	2½kw-LS		
KQV	Pittsburgh, Pa	500	1380	217.4
KQW	San Jose, Calif	500	1010	297
KRE	Berkeley, Calif	100	1370	219
KREG	Santa Ana, Calif	100	1500	200
KRGV	Harlingen, Tex	500	1260	238.1
KRKD	Los Angeles, Calif	500	1120	267.9
KRLD	Dallas, Tex	10kw	1040	288.5
KRMD	Shreveport, La	100	1310	229
KROW	Oakland, Calif	500	930	323
	T-Richmond	1kw-LS		
KRSC	Seattle, Wash	100	1120	267.9
KSAC	Manhattan, Kans	500	580	517
KSCJ	Sioux City, Iowa	1kw	1330	225.6
KSD	St. Louis, Mo	500	550	545
KSEI	Pocatello, Idaho	250	900	333
KSL	Salt Lake City, Utah	50kw	1130	265.5
	T-Saltair			
KSO	Des Moines, Iowa	100	1370	219
KSOO	Sioux Falls, S. D.	2½kw	1110	270.3
KSTP	St. Paul, Minn	25kw-LS	1460	205.5
	T-Radio Center			
KTAB	San Francisco, Calif	1kw	560	536
	T-Oakland			
KTAR	Phoenix, Ariz	500	620	484
KTAT	Fort Worth, Tex	1kw	1240	241.9
	T-Birdville			
KTBS	Shreveport, La	1kw	1450	206.9
KTFI	Twin Falls, Idaho	1kw-LS	1240	241.9
KTHS	Hot Springs National Park, Ark	10kw	1040	288.5
KTM	Los Angeles, Calif	500	780	385
	T-Santa Monica	1kw-LS		
KTRH	Houston, Tex	500	1120	267.9
KTSA	San Antonio, Tex	1kw	1290	232.6
KTSM	El Paso, Tex	100	1310	229
KTW	Seattle, Wash	1kw	1220	245.9
KUJ	Walla Walla, Wash	100	1370	219
KUMA	Yuma, Ariz	100	1420	211.3
KUOA	Fayetteville, Ark	1kw	1260	238.1
KUSD	Vermillion, S. D.	500	890	337
KVI	Tacoma, Wash	500	570	526
	T-Des Moines			
KVL	Seattle, Wash	100	1370	219
KVOA	Tucson, Ariz	500	1260	238.1
KVOO	Tulsa, Okla	5kw	1140	263.2
KVOR	Colorado Spgs., Colo	1kw	1270	236.2
KVOS	Bellingham, Wash	100	1200	250
KWCR	Cedar Rapids, Iowa	100	1420	211.3
KWEA	Shreveport, La	100	1210	247.9
KWG	Stockton, Cal	100	1200	250
KWJJ	Portland, Ore	500	1060	283
KWK	St. Louis, Mo	1kw	1350	222.2
	T-Kirkwood			
KWKC	Kansas City, Mo	100	1370	219
KWKH	Shreveport, La	10kw	850	353
	T-Kennonwood			
KWLC	Decorah, Iowa	100	1270	236.2
KWSC	Pullman, Wash	1kw	1220	245.9
KWWG	Brownsville, Tex	500	1260	238.1
KXA	Seattle, Wash	250	760	395
KXL	Portland, Ore	100	1420	211.3
KXO	El Centro, Calif	100	1500	200
KXRO	Aberdeen, Wash	100	1310	229
KXYZ	Houston, Tex	250	1440	208.3
KYA	San Francisco, Calif	1kw	1230	243.9
KYW	Chicago, Ill	10kw	1020	294.1
KFKX	T-Bloomingdale Twsp.			
WAAB	Boston, Mass	500	1410	212.8
	T-Quincy			
WAAF	Chicago, Ill	500	920	326
WAAM	Newark, N. J.	1kw	1250	240
WAAT	Jersey City, N. J.	500	940	319
WAAW	Omaha, Neb	500	660	455
WABC-	New York, N. Y.	50kw	860	349

Call Letters	Location	Power (watts)	Freq. kc.	Wave-length (meters)
WBOQ	T-Wayne, N. J.			
WABI	Bangor, Maine	100	1200	250
WABO-WHEC	(See WHEC-WABO)			
WACO	Waco, Tex	1kw	1240	241.9
WADC	Tallmadge, Ohio	1kw	1320	227.3
WAGM	Presque Isle, Maine	100	1420	211.3
WAIU	Columbus, Ohio	500	640	469
WALR	Zanesville, Ohio	100	1210	247.9
WAMC	Anniston, Ala	100	1420	211.3
WAML	Laurel, Miss	100	1310	229
WAPI	Birmingham, Ala	5kw	1140	263.2
WARD	Brooklyn, N. Y	500	1400	214.3
WASH	Grand Rapids, Mich	500	1270	236.2
WAWZ	Zarephath, N. J	250	1350	222.2
WAZL	Hazelton, Pa	100	1420	211.3
WBAA	W. Lafayette, Ind	500	1400	214.3
WBAK	Harrisburg, Pa	1kw	1430	209.8
WBAL	Baltimore, Md	10kw	1060	*283
	T-Pikeville, Md.			
WBAP	Fort Worth, Tex	50kw	800	375
	T-Grapevine			
WBAX	Wilkes-Barre, Pa	100	1210	247.9
	T-Plains Twp.			
WBBL	Richmond, Va	100	1210	247.9
WBBM-WJBT	Chicago, Ill	25kw	770	390
	T-Glenview			
WBBR	Brooklyn, N. Y	1kw	1300	230.8
	T-Rossville			
WBBX	New Orleans, La	100	1200	250
WBBZ	Ponca City, Okla	100	1200	250
WBCM	Bay City, Mich	500	1410	212.8
	T-Hampton Twp.			
WBCN-WENR	(See WENR-WBCN).			
WBEN	Buffalo, N. Y	1kw	900	333
	T-Martinsville			
WBEO	Marquette, Mich	100	1310	229
WBHS	Huntsville, Ala	100	1200	250
WBIG	Greensboro, N. C	500	1440	208.3
WBIS-WNAC	(See WNAC-WBIS)			
WBMS	Hackensack, N. J	250	1450	206.9
WBNX	New York, N. Y	250	1350	222.2
WBOQ-WABC	(See WABC-WBOQ)			
WBOW	Terre Haute, Ind	100	1310	229
WBRC	Birmingham, Ala	500	930	323
WBRE	Wilkes-Barre, Pa	100	1310	229
WBSO	Needham, Mass	500	920	326
WBT	Charlotte, N. C	25kw	1080	277.8
WBTM	Danville, Va	100	1370	219
WBZ	Boston, Mass	25kw	990	303
	T-Millis Twp.			
WBZA	Boston, Mass	1kw	990	303
	T-East Springfield			
WCAC	Storrs, Conn	250	600	500
WCAD	Canton, N. Y	500	1220	245.9
WCAE	Pittsburgh, Pa	1kw	1220	245.9
WCAH	Columbus, Ohio	500	1430	209.8
WCAJ	Lincoln, Neb	500	590	509
WCAL	Northfield, Minn	1kw	1250	240
WCAM	Camden, N. J	500	1280	234.4
WCAO	Baltimore, Md	250	600	500
WCAP	Asbury Park, N. J	500	1280	234.4
	T-Whitesville			
WCAT	Rapid City, S. D	100	1200	250
WCAU	Philadelphia, Pa	50kw	1170	256.4
	T-Newton, Square Co.			
WCAX	Burlington, Vt	100	1200	250
WCAZ	Carthage, Ill	50	1070	280.4
WCBA	Allentown, Pa	250	1440	208.3
WCBD	Zion, Ill	5kw	1080	277.8
WCBM	Baltimore, Md	100	1370	219
WCBS	Springfield, Ill	100	1210	247.9
WCCO	Minneapolis, Minn	50kw	810	370
	T-Anoka			
WCDA	New York, N. Y	250	1350	222.2
	T-Cliffside, N. J.			
WCFL	Chicago, Ill	1½kw	970	309
WCKY	Covington, Ky	5kw	1490	201.3
	T-Crescent Springs			
WCLO	Janesville, Wis	100	1200	250
WCLS	Joliet, Ill	100	1310	229
WCOA	Pensacola, Fla	500	1340	223.9
WCOC	Meridian, Miss	500	880	341
WCOD	Harrisburg, Pa	100	1200	250
WCRW	Chicago, Ill	100	1210	247.9
WCSC	Charleston, S. C	500	1360	220.6
WCSH	Portland, Me	1kw	940	319
	T-Scarboro	2½kw-LS		
WDAE	Tampa, Fla	1kw	1220	245.9
WDAF	Kansas City, Mo	1kw	610	492
WDAG	Amarillo, Tex	1kw	1410	212.8
WDAH	El Paso, Tex	100	1310	229
WDAS	Philadelphia, Pa	100	1370	219
WDAY	Fargo, N. D	1kw	940	319
	T-West Fargo			

Call Letters	Location	Power (watts)	Freq. kc.	Wave-length (meters)
WDBJ	Roanoke, Va	250	930	323
WDBO	Orlando, Fla	250	580	517
WDEL	Wilmington, Del	250	1120	267.9
WDEV	Waterbury, Vt	500	550	545
WDGY	Minneapolis, Minn	1kw	1180	254.2
WDOD	Chattanooga, Tenn	1kw	1280	234.4
	T-Brainerd	2½kw-LS		
WDRC	Hartford, Conn	500	1330	225.6
	T-Bloomfield			
WDSU	New Orleans, La	1kw	1250	240
	T-Gretna			
WDZ	Tuscola, Ill	100	1070	280.4
WEAF	New York, N. Y	50kw	660	455
	T-Bellmore			
WEAN	Providence, R. I	250	780	385
WEAO	Columbus, Ohio	750	570	526
WEBC	Superior, Wis	1kw	1290	232.6
WEBQ	Harrisburg, Ill	100	1210	247.9
WEBR	Buffalo, N. Y	100	1310	229
WEDC	Chicago, Ill	100	1210	247.9
WEEI	Boston, Mass	1kw	590	509
	T-Weymouth			
WEEU	Reading, Pa	1kw	830	361
WEHC	Charlottesville, Va	500	1350	222.2
WEHS	Cicero, Ill	100	1420	211.3
WELL	Battle Creek, Mich	50	1420	211.3
WENC	Americus, Ga	100	1420	211.3
WENR-WBCN	Chicago, Ill	50kw	870	345
	T-Downers Grove			
WEPS-WORC	(See WORC-WEPS)			
WERE	Erie, Pa	100	1420	211.3
WESG	Elmira, N. Y	1kw	1040	288.5
	T-Ithaca			
WEVD	New York, N. Y	500	1300	230.8
	T-Brooklyn			
WEW	St. Louis, Mo	1kw	760	395
WEXL	Royal Oak, Mich	50	1310	229
WFAA	Dallas, Tex	50kw	800	375
	T-Grapevine			
WFAB	New York, N. Y	1kw	1300	230.8
	T-Carlstadt, N. J.			
WFAM	South Bend, Ind	100	1200	250
WFAS	White Plains, N. Y	100	1210	247.9
WFBC	Greenville, S. C	250-LS	1200	250
WFBE	Cincinnati, Ohio	100	1200	250
WFBG	Altoona, Pa	100	1310	229
WFBL	Syracuse, N. Y	1kw	1360	220.6
	T-Collamer	2½kw-LS		
WFBM	Indianapolis, Ind	1kw	1230	243.9
WFBR	Baltimore, Md	500	1270	236.2
WFDF	Flint, Mich	100	1310	229
WFDV	Rome, Ga	100	1500	200
WFEA	Manchester, N. H	500	1430	209.8
WFI	Philadelphia, Pa	500	560	536
WFIW	Hopkinsville, Ky	1kw	940	319
WFLA-WSUN	Clearwater, Fla	250	620	484
WGAL	Lancaster, Pa	100	1310	229
WGAR	Cleveland, Ohio	500	1450	206.9
	T-Cuyahoga Heights	1kw-LS		
WGBB	Freeport, N. Y	100	1210	247.9
WGBC-WNBR	(See WNBR-WGBC)			
WGBF	Evansville, Ind	500	630	476
WGBI	Scranton, Pa	250	880	341
WGCM	Mississippi City, Miss.	100	1210	247.9
WGCP	Newark, N. J	250	1250	240
WGES	Chicago, Ill	500	1360	220.6
WGH	Newport News, Va	100	1310	229
WGL	Ft. Wayne, Ind	100	1370	219
WGLC	Glens Falls, N. Y	50	1370	219
	C.P. Hudson Falls	C.P.100-LS		
WGMS-WLB	(See WLB-WGMS)			
WGN-WLIB	Chicago, Ill	25kw	720	417
	T-Elgin			
WGNY	Chester Twnsp., N. Y.	50	1210	247.9
WGR	Buffalo, N. Y	1kw	550	545
	T-Amherst Twp.			
WGST	Atlanta, Ga	250	890	337
WGY	Schenectady, N. Y	50kw	790	380
	T-South Schenectady			
WHA	Madison, Wis	1kw	940	319
WHAD	Milwaukee, Wis	250	1120	267.9
WHAM	Rochester, N. Y	5kw	1150	260.9
	T-Victor Twp.	C.P. 25kw		
WHAS	Louisville, Ky	25kw	820	366
	T-Jeffersontown			
WHAT	Philadelphia, Pa	100	1310	229
WHAZ	Troy, N. Y	500	1300	230.8
WHB	Kansas City, Mo	500	860	349
	T-North Kansas City			
WHBC	Canton, Ohio	10	1200	250
WHBD	Mt. Orab, Ohio	100	1370	219
WHBF	Rock Island, Ill	100	1210	247.9
WHBL	Sheboygan, Wis	500	1410	212.8
WHBQ	Memphis, Tenn	100	1370	219

Call Letters	Location	Power (watts)	Freq. kc.	Wave-length (meters)
WHBU	Anderson, Ind	100	1210	247.9
WHBY	Green Bay, Wis	100	1200	250
	T-West De Pere			
WHDF	Calumet, Mich	100	1370	219
WHDH	Boston, Mass	1kw	830	361
	T-Saugus			
WHDL	Tupper Lake, N. Y	100	1420	211.3
WHEB	Portsmouth, N. H	250	740	405
	T-Newington			
WHEC-WABO	Rochester, N. Y	500	1440	208.3
WHEF	Kosciusko, Miss	100	1500	200
WHET	Troy, Ala	100	1210	247.9
WHFC	Cicero, Ill	100	1420	211.3
WHIS	Bluefield, W. Va	250	1410	212.8
WHK	Cleveland, Ohio	1kw	1390	215.8
	T-Seven Hills	2½kw-LS		
WHN	New York, N. Y	250	1010	297
WHO	Des Moines, Iowa	5kw	1000	300
WHOM	Jersey City, N. J	250	1450	206.9
WHP	Harrisburg, Pa	500	1430	209.8
	T-Lemoyne	1kw-LS		
WIAS	Ottumwa, Iowa	100	1310	229
WIBA	Madison, Wis	500	1280	234.4
WIBG	Glenside, Pa	25	930	323
	T-Elkins Park			
WIBM	Jackson, Mich	100	1370	219
WIBO	Chicago, Ill	1kw	560	536
	T-Des Plaines	1½kw-LS		
WIBU	Poynette, Wis	100	1210	247.9
WIBW	Topeka, Kans	1kw	580	517
WIBX	Utica, N. Y	100	1200	250
WICC	Bridgeport, Conn	250	600	500
	T-Bridgeport	500-LS		
WIL	St. Louis, Mo	100	1200	250
WILL	Urbana, Ill	250	890	337
WILM	Wilmington, Del	100	1420	211.3
	T-Edge Moor			
WINS	New York, N. Y	500	1180	254.2
	T-Carlstadt, N. J.			
WIOD-WMBF	Miami, Fla	1kw	1300	230.8
	T-Miami Beach			
WIP	Philadelphia, Pa	500	610	492
WIS	Columbia, S. C	500	1010	297
WISN	Milwaukee, Wis	250	1120	267.9
WJAC	Johnstown, Pa	100	1310	229
WJAG	Norfolk, Nebr	1kw	1060	283
WJAR	Providence, R. I	250	890	337
WJAS	Pittsburgh, Pa	1kw	1290	232.6
	T-No. Fayette. Twp.	2½kw-LS		
WJAX	Jacksonville, Fla	1kw	900	333
WJAY	Cleveland, Ohio	500	610	492
WJBC	La Salle, Ill	100	1200	250
WJBI	Red Bank, N. J	100	1210	247.9
WJBK	Detroit, Mich	50	1370	219
	T-Highland Park			
WJBL	Decatur, Ill	100	1200	250
WJBO	New Orleans, La	100	1420	211.3
	C.P. Baton Rouge			
WJBT-WBBM	(See WBBM-WJBT)			
WJBU	Lewisburg, Pa	100	1210	247.9
WJBW	New Orleans, La	100	1200	250
WJBY	Gadsden, Ala	100	1210	247.9
WJDX	Jackson, Miss	1kw	1270	236.2
WJEJ	Hagerstown, Md	100	1210	247.9
WJEM	Tupelo, Miss	500	990	303
WJEQ	Williamsport, Pa	100	1370	219
WJJD	Mooseheart, Ill	20kw	1130	265.5
WJKS	Gary, Ind	1kw	1360	220.6
WJMS	Ironwood, Mich	100	1420	211.3
WJR	Detroit, Mich	10kw	750	400
	T-Sylvan Lake Village			
WJSV	Alexandria, Va	10kw	1460	205.5
	T-Mt. Vernon Hills			
	C.P. Near Alxnda., Va.			
WJTL	Oglethorpe Univ., Ga.	100	1370	219
	T-Atlanta			
WJW	Akron, Ohio	100	1210	247.9
WJZ	New York, N. Y	30kw	760	395
	T-Bound Brook, N. J.			
WKAQ	San Juan, P. R	1kw	1240	241.9
WKAR	E. Lansing, Mich	1kw	1040	288.5
WKAV	Laconia, N. H	100	1310	229
WKBB	Joliet, Ill	100	1310	229
	C.P. E. Dubuque	C.P. 1500		
WKBC	Birmingham, Ala	100	1310	229
WKBF	Indianapolis, Ind	500	1400	214.3
	T-Clermont			
	C.P. T-Nr. Indianapolis			
WKBH	La Crosse, Wis	1kw	1380	217.4
WKBI	Cicero, Ill	100	1420	211.3
WKBN	Youngstown, Ohio	500	570	526
WKBV	Connersville, Ind	100	1500	200
WKBW	Buffalo, N. Y	5kw	1480	202.7
	T-Amherst Twp.			
WKBZ	Ludington, Mich	100	1500	200
WKEU	La Grange, Ga	100	1500	200

Call Letters	Location	Power (watts)	Freq. kc.	Wave length (meters)
WKFI	Greenville, Miss.	100	1210	247.9
WKJC	Lancaster, Pa.	100	1200	200
WKRC	Cincinnati, Ohio	500	550	545
WKY	Oklahoma City, Okla.	1kw	900	333
WKZO	Kalamazoo, Mich.	1kw	590	509
WLAC	Nashville, Tenn.	5kw	1470	204.1
WLAP	Louisville, Ky.	100	1200	250
WLB-	Minneapolis, Minn.	1kw	1250	240
WGMS	T-St. Paul			
WLBC	Muncie, Ind.	50	1310	229
WLBF	Kansas City, Kans.	100	1420	211.3
WLBL	Stevens Point, Wis.	2½kw	900	333
	T-Nr. Ellis			
WLBW	Erie, Pa.	500	1260	238.1
	T-Summit Township	1kw-LS		
WLBZ	Bangor, Me.	500	620	484
WLCI	Ithaca, N. Y.	50	1210	247.9
WLEY	Lexington, Mass.	100	1370	219
WLIB-	(See WGN-WLIB)			
WGN				
WLIT	Philadelphia, Pa.	500	560	536
WLOE	Boston, Mass.	100	1500	200
	T-Chelsea	250-LS		
WLS	Chicago, Ill.	50kw	870	345
	T-Downers Grove			
WLVA	Lynchburg, Va.	100	1370	219
WLW	Cincinnati, Ohio	50kw	700	429
	T-Mason			
WLWL	New York, N. Y.	5kw	1100	272.7
	T-Kearny, N. J.			
WMAC-	(See WSYR-WMAC)			
WSYR				
WMAL	Washington, D. C.	250	630	476
WMAQ	Chicago, Ill.	5kw	670	448
	T-Addison			
WMAS	Springfield, Mass.	100	1420	211.3
WMAZ	Macon, Ga.	500	1180	254.2
WMBC	Detroit, Mich.	100	1420	211.3
WMBD	Peoria, Ill.	500	1440	208.3
	T-Peoria Heights	1kw-LS		
WMBF-	(See WIOD-WMBF)			
WIOD				
WMBG	Richmond, Va.	100	1210	247.9
WMBH	Joplin, Mo.	100	1420	211.3
WMBI	Chicago, Ill.	5kw	1080	277.8
	T-Addison			
WMBO	Auburn, N. Y.	100	1310	229
WMBQ	Brooklyn, N. Y.	100	1500	200
WMBR	Tampa, Fla.	100	1370	219
WMC	Memphis, Tenn.	500	780	385
	T-Bartlett	1kw-LS		
WMCA	New York, N. Y.	500	570	526
	T-Flushing			
WMIL	Brooklyn, N. Y.	100	1500	200
WMMN	Fairmont, W. Va.	250	890	337
WMPC	Lapeer, Mich.	100	1500	200
WMSG	New York, N. Y.	250	1350	222.2
WMT	Waterloo, Iowa	500	600	500
WNAC-	Boston, Mass.	1kw	1230	243.9
WBIS	T-Quincy			
WNAD	Norman, Okla.	500	1010	297
WNAX	Yankton, S. D.	2½kw-L.S.	570	526
WNBF	Binghamton, N. Y.	100	1500	200
WNBH	New Bedford, Mass.	100	1310	229
	T-Fairhaven	250-LS		
WNBO	Silverhaven, Pa.	100	1200	250
WNBR-	Memphis, Tenn.	500	1430	209.8
WGBC				
WNB	Carbondale, Pa.	10	1200	250
WNBX	Springfield, Vt.	250	1260	238.1
WNBZ	Saranac Lake, N. Y.	50	1290	232.6
WNOX	Knoxville, Tenn.	2kw-L.S.	560	536
WNYC	New York, N. Y.	500	570	526
WOAI	San Antonio, Tex.	50kw	1190	252.1
	T-Selma			
WOAN-	(See WREC-WOAN)			
WREC				
WOBU	Charleston, W. Va.	250	580	517
WOC	Davenport, Iowa	5kw	1000	300
WOCL	Jamestown, N. Y.	50	1210	247.9
WOOA	Paterson, N. J.	1kw	1250	240
WODX	Mobile, Ala.	500	1410	212.8
	T-Springhill			
WOI	Ames, Iowa	5kw	640	469
WOKO	Albany, N. Y.	500	1440	208.3
WOL	Washington, D. C.	100	1310	229
WOMT	Manitowoc, Wis.	100	1210	247.9
WOOD	Grand Rapids, Mich.	500	1270	236.2
WOPI	Bristol, Tenn.	100	1500	200
WOQ	Kansas City, Mo.	1kw	1300	230.8
WOR	Newark, N. J.	5kw	710	423
	T-Kearny	C.P. 50kw		
WORC-	Worcester, Mass.	100	1200	250
WEPS	T-Auburn			
WORK	York, Pa.	1kw	1000	300
	T-W. Manchester			
WOS	Jefferson City, Mo.	500	630	476
WOV	New York, N. Y.	1kw	1130	265.5
	T-Secaucus, N. J.			
WOW	Omaha, Nebr.	1kw	590	509
WOWO	Ft. Wayne, Ind.	10kw	1160	258.6
WPAD	Paducah, Ky.	100	1420	211.3
WPAP-	(See WQAO-WPAP)			
WQAC				
WPAW-	(See WPRO-WPAW)			
WPRO				
WPCC	Chicago, Ill.	500	560	536
WPCH	New York, N. Y.	500	810	370
	T-Flushing			
WPEN	Philadelphia, Pa.	100	1500	200
WPFB	Hattiesburg, Miss.	100	1370	219
WPG	Atlantic City, N. J.	5kw	1100	272.7
WPHR	Petersburg, Va.	100	1200	250
	T-Ettrick			
WPOR-	(See WTAR-WPOR)			
WTAR				
WPRO-	Providence, R. I.	100	1210	247.9
WPAW	T-Providence			
WPTF	Raleigh, N. C.	1kw	680	441
WQAM	Miami, Fla.	1kw	560	536
WQAN	Scranton, Pa.	250	880	341
WQAO-	New York, N. Y.	250	1010	297
WPAP	T-Cliffside, N. J.			
WQBC	Vicksburg, Miss.	500	1360	220.6
WQDM	St. Albans, Vt.	100	1370	219
WQDX	Thomasville, Ga.	100	1210	247.9
WRAK	Williamsport, Pa.	100	1370	219
WRAM	Wilmington, N. C.	100	1370	219
WRAW	Reading, Pa.	100	1310	229
WRAX	Philadelphia, Pa.	250	1020	294.1
WRBL	Columbus, Ga.	100	1200	250
WRBX	Roanoke, Va.	250	1410	212.8
WRC	Washington, D. C.	500	950	316
WRDO	Augusta, Me.	100	1370	219
WRDW	Augusta, Ga.	100	1500	200
WREC-	Memphis, Tenn.	500	600	500
WOAN	T-Whitehaven	1kw-LS		
WREN	Lawrence, Kans.	1kw	1220	245.9
	T-Tonganoxie			
WRHM	Minneapolis, Minn.	1kw	1250	240
	T-Fridley			
WRJN	Racine, Wis.	100	1370	219
WRNY	New York, N. Y.	250	1010	297
	T-Coytesville, N. J.			
WROL	Knoxville, Tenn.	100	1310	229
WRR	Dallas, Tex.	500	1280	234.4
WRUF	Gainesville, Fla.	5kw	830	361
WRVA	Richmond, Va.	5kw	1110	270.3
	T-Mechanicsville			
WSAI	Cincinnati, Ohio	500	1330	225.6
	T-Mason	1kw-LS		
WSAJ	Grove City, Pa.	100	1310	229
WSAN	Allentown, Pa.	250	1440	208.3
WSAR	Fall River, Mass.	250	1450	206.9
WSAZ	Huntington, W. Va.	250	580	517
WSB	Atlanta, Ga.	5kw	740	405
WSBC	Chicago, Ill.	100	1210	247.9
WSBT	South Bend, Ind.	500	1230	243.9
WSEN	Columbus, Ohio	100	1210	247.9
WSFA	Montgomery, Ala.	500	1410	212.8
WSIX	Springfield, Tenn.	100	1210	247.9
WSJS	Winston-Salem, N. C.	100	1310	229
WSM	Nashville, Tenn.	50kw	650	462
	T-Franklin			
WSMB	New Orleans, La.	500	1320	227.3
WSMK	Dayton, Ohio	200	1380	217.4
WSOC	Gastonia, N. C.	100	1210	247.9
WSPA	Spartanburg, S. C.	100	1420	211.3
WSPD	Toledo, Ohio	1kw	1340	223.9
WSUI	Iowa City, Iowa	500	880	341
WSUN-	(See WFLA-WSUN)			
WFLA				
WSVS	Buffalo, N. Y.	50	1370	219
WSYB	Rutland, Vt.	100	1500	200
WSYR-	Syracuse, N. Y.	250	570	526
WMAC				
WTAD	Quincy, Ill.	500	1440	208.3
WTAG	Worcester, Mass.	500-L.S.	580	517
WTAM	Cleveland, Ohio	50kw	1070	280.4
	T-Brecksville Village			
WTAQ	Eau Claire, Wis.	1kw	1330	225.6
	T-Twp. of Washington			
WTAR-	Norfolk, Va.	500	780	385
WPOR				
WTAW	College Station, Tex.	500	1120	267.9
WTAX	Springfield, Ill.	100	1210	247.9
WTBO	Cumberland, Md.	100	1420	211.3
WTEL	Philadelphia, Pa.	100	1310	229
WTFI	Athens, Ga.	500	1450	206.9
WTIC	Hartford, Conn.	50kw	1060	283
	T-Avon			
WTJS	Jackson, Tenn.	100	1310	229
WTMJ	Milwaukee, Wis.	1kw	620	484
	T-Waukesha	2½kw-LS		
WTNJ	Trenton, N.J.	500	1280	234.4
WTOC	Savannah, Ga.	500	1260	238.1
WTRC	Elkhart, Ind.	100-L.S.	1310	229
WWAE	Hammond, Ind.	100	1200	250
WWJ	Detroit, Mich.	1kw	920	326
WWL	New Orleans, La.	10kw	850	353
	T-Kenner			
WWNC	Asheville, N. C.	1kw	570	526
WWRL	Woodside, N. Y.	100	1500	200
WWSW	Pittsburgh, Pa.	100	1500	200
	T-Wilkinsburg	250-LS		
WWVA	Wheeling, W. Va.	5kw	1160	258.6
WXYZ	Detroit, Mich.	1kw	1240	241.9

POLICE STATIONS ALPHABETICALLY BY CALL LETTERS

Call Letters	Location	Freq. kc.
KGHO	Des Moines, Iowa	1534
KGJX	Pasadena, Calif.	1712
KGOZ	Cedar Rapids, Iowa	2470
KGPA	Seattle, Wash.	2414
KGPB	Minneapolis, Minn.	2416
KGPC	St. Louis, Mo.	1712
KGPD	San Francisco, Calif.	2470
KGPE	Kansas City, Mo.	2422
KGPG	Vallejo, Calif.	2422
KGPH	Oklahoma City, Okla.	2450
KGPI	Omaha, Neb.	2470
KGPJ	Beaumont, Tex.	1712
KGPL	Los Angeles, Calif.	1712
KGPM	San Jose, Calif.	2470
KGPN	Davenport, Iowa	2470
KGPO	Tulsa, Okla.	2450
KGPP	Portland, Ore.	2442
KGPQ	Honolulu, T. H.	2450
KGPS	Bakersfield, Calif.	2414
KGPW	Salt Lake City, Utah	2470
KGPX	Denver, Colo.	2442
KGPY	Shreveport, La.	1574
KGPZ	Wichita, Kans.	2450
KGZB	Houston, Tex.	1712
KGZD	San Diego, Calif.	2430
KGZE	San Antonio, Tex.	2506
KGZF	Chanute, Kans.	2450
KGZH	Klamath Falls, Ore.	2442
KGZI	Wichita Falls, Tex.	1712
KGZL	Shreveport, La.	1712
KGZM	El Paso, Tex.	2414
KGZN	Tacoma, Wash.	2414
KGZP	Coffeyville, Kans.	2450
KGZR	Salem, Ore.	2442
KSW	Berkeley, Calif.	2422
KVP	Dallas, Tex.	1712
WCK	Belle Island, Mich.	2414
WKDU	Cincinnati, Ohio	1712
WMDZ	Indianapolis, Ind.	2442
WMJ	Buffalo, N. Y.	2422
WMO	Highland Park, Mich.	2414
WMP	Framingham, Mass.	1574
WPDA	Tulare, Calif.	2414
WPDB	Chicago, Ill.	1712
WPDC	Chicago, Ill.	1712
WPDD	Chicago, Ill.	1712
WPDE	Louisville, Ky.	2442
WPDF	Flint, Mich.	2442
WPDH	Richmond, Ind.	2442
WPDI	Columbus, Ohio	2430
WPDK	Milwaukee, Wis.	2450
WPDL	Lansing, Mich.	2442
WPDM	Dayton, Ohio	2430
WPDN	Auburn, N. Y.	2458
WPDO	Akron, Ohio	2458
WPDP	Philadelphia, Pa.	2470
WPDR	Rochester, N. Y.	2458
WPDS	St. Paul, Minn.	2416
WPDT	Kokomo, Ind.	2470
WPDU	Pittsburgh, Pa.	1712
WPDV	Charlotte, N. C.	2458
WPDW	Washington, D. C.	2422
WPDX	Detroit, Mich.	2414
WPDY	Atlanta, Ga.	2414
WPDZ	Fort Wayne, Ind.	2470
WPEA	Syracuse, N. Y.	2458
WPEB	Grand Rapids, Mich.	2442
WPEC	Memphis, Tenn.	2470
WPEE	New York, N. Y.	2450
WPEF	New York, N. Y.	2450
WPEG	New York, N. Y.	2450
WPEH	Somerville, Mass.	1712
WPEI	E. Providence, R. I.	1712
WPEK	New Orleans, La.	2422
WPEL	W. Bridgewater, Mass.	1574
WPEP	Arlington, Mass.	1712
WPET	Lexington, Mass.	1712
WPEV	Portable, Mass.	1574
WPFA	Newton, Mass.	1712
WPFC	Muskegon, Mich.	2442
WPFD	Highland Park, Ill.	2430
WPFE	Reading, Pa.	2442
WPFF	Toms River, N. J.	2430
WPFG	Jacksonville, Fla.	2442
WPFH	Baltimore, Md.	2414
WPFI	Columbus, Ga.	2414
WPFJ	Hammond, Ind.	1712
WPFK	Hackensack, N. J.	2430
WPFL	Gary, Ind.	2470
WPFM	Birmingham, Ala.	2414
WPFN	Fairhaven, Mass.	1712
WPFO	Knoxville, Tenn.	2470
WPFP	Clarksburg, W. Va.	2414
WPFQ	Swathmore, Pa.	2470
WPFR	Johnson City, Tenn.	2470
WRDH	Cleveland, Ohio	2458
WRDR	Grosse Point Village, Mich.	2414
WRDQ	Toledo, Ohio	2470

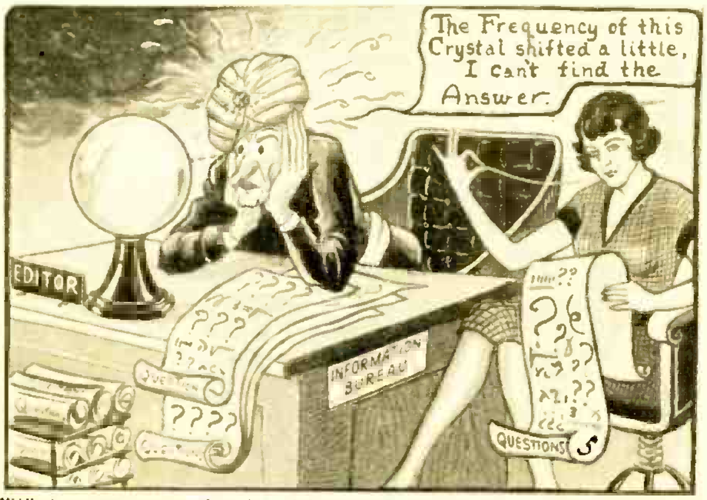
READERS' DEPARTMENT—ADVICE TO SERVICE MEN

DURING the past two years the technical staff of the Gernsback Publications has answered something like 15,000 individual letters from owners of the various editions of the OFFICIAL RADIO SERVICE MANUAL. With the number of questions per letter averaging about 3½, you can imagine how many stenographer's pencils and typewriter ribbons were worn out and how many packages of throat lozenges were consumed by ye hoarse editors.

In going through the huge stacks of correspondence, it is interesting and instructive to notice the very definite recurrence of certain questions and problems and to observe the methods employed by Service Men in handling customers, analyzing trouble and collecting their bills.

Fading

Without question the most annoying and most frequently encountered technical problem is that of mysterious fading or fluctuation; not fading in the sense of carrier wave variation, but fading that apparently is due to something in the receiver or the entire installation. A related trouble is a tendency on the part of many receivers to die out completely after short or long periods of satisfactory operation, and to snap back instantly to full volume when a light or other electric appliance on the same power circuit is turned on or off.



"What are we supposed to be, clairvoyants? Anyone who can answer questions of this kind should be on the vaudeville stage, not in the radio business."

We have followed up many cases of this kind and, as a result of reading long and detailed reports from various Service Men, we have come to the conclusion that the fading may be due to one or more of the following causes:

(1) A loose aerial that swings against some grounded or partially grounded object. Careful inspection of the antenna, and also a "wiggling" test on the lead-in strip under the window, will quickly tell if this is to blame.

(2) Thermostatic tubes. Irregular emission by the cathodes or sporadic ionization due to gas causes lots of trouble. Ordinary tests made with a tube checker don't always indicate defective tubes of this kind, as the action is creepy and usually doesn't develop until the set has warmed up thoroughly . . . and many of those $13.95 midgets work just under the boiling point!

(3) Leaky bypass condensers or condensers that can't decide whether they're shorted or not. Here is, probably, the main reason for most of that "fading." The operating temperature of modern sets is so high, and so little provision is made for ventilation, that leaks are bound to develop in cheap condensers, particularly in cheap electrolytic condensers. The "dry" electrolytic filter and bypass condensers that are now so popular are not really dry: the electrolyte is a thick and jelly-like substance that is just as susceptible to heat as the electrolyte of so-called "dry" batteries.

As with thermostatic tubes, the location of leaky condensers of this kind is a tedious matter, because at normal room temperatures, with the set turned off, the microscopic gas film that is the actual dielectric of electrolytic condensers reforms itself, and the condenser tests OK. The replacement method seems to be about the most effective; that is, first try a brand new bunch of tubes, if this doesn't help, take a handful of new bypass condensers and simply install them one at a time, starting at the R.F. end of the set and working toward the audio. It is not necessary, of course, to remove the present condensers entirely; merely unsolder the ungrounded ends temporarily. It's slow and aggravating work, we admit, but it must be done if all other expedients fail.

Small fixed resistors also have a habit of changing their characteristics under the influence of heat. Carbon, you know, has a negative temperature coefficient; that is, its resistance goes down as the material gets hotter. Measurements made on some sets when they are cold, and again after they have warmed up thoroughly, reveal some very startling differences in resistor values. Wire wound resistors, of course, are not subject to this trouble.

Test Equipment

Too many Service Men are trying to get along with inadequate technical equipment. They do not seem to realize that the days are gone when a man could "service" an ailing receiver with nothing more than a screwdriver, a voltmeter, and a lot of nerve. This was possible when all sets used 201A's and a storage battery, and when 90% of customers' troubles were cured merely by reversing the "A" leads. An astonishing number of letters read something like this: "I have a Stupordyne 8 in for repairs. The volume is weak and it motorboats at the low end of the tuning scale. I have no analyzer but the wiring looks OK. Can you tell me where to look for the trouble?"

What are we supposed to be, clairvoyants? Anyone who can answer questions of this kind should be on the vaudeville stage, not in the radio business!

Good test apparatus was never as cheap as it is today. The man who attempts to get along without an analyzer of some sort is wasting his own time and doing nothing toward building up a business. This is not advertising talk; it is good business advice.

With the growing complexity of broadcast receivers and the bewildering prolificacy of tube manufacturers, many Service Men are tending to overlook the simple, fundamental things in trouble shooting, and to make their own jobs harder by tackling the worst end of the set first. A few years ago, when broadcast station shutdowns, due to distant SOS calls at sea, were much more frequent than they are now, many a Service Man tore a set completely to pieces before he discovered the real reason for its mysterious silence. How many men make sure that

(Continued on page 112)

Photograph of the Acratone model 770 amplifier.

A MOBILE SOUND SYSTEM

A description of a simple sound system suitable for automotive use and especially adapted for the radio Service Man.

CLIFFORD E. DENTON*

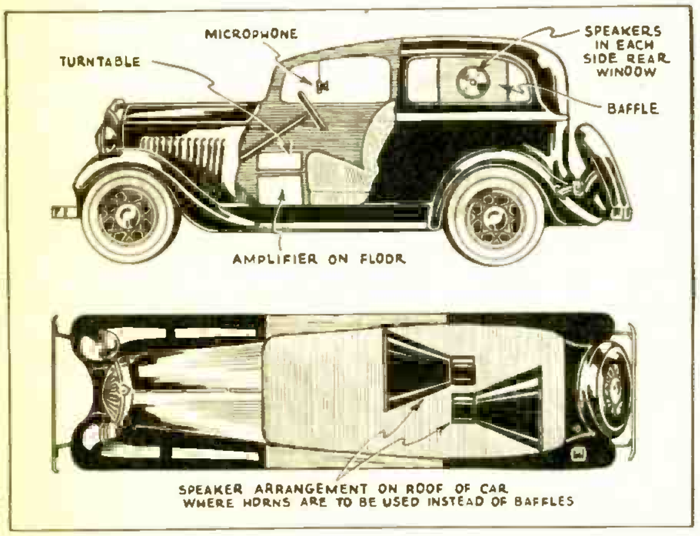


Fig. 3
A drawing suggesting ways and means of mounting portable apparatus.

EVERY radio Service Man who owns a car or truck should equip it with an advertising sound system. This equipment is highly profitable and productive, and is an ideal advertising medium for use while making service calls. In addition, a sound system may be rented out for advertising hundreds of other products.

Sound equipped motor cars are in great demand for ballyhooing new motion pictures and stage attractions. When the circus comes to town, it should be an easy matter to rent a mobile sound system to advertise this event. The motor car quickly transports the sound system to any location. Prospective users include airports, outdoor games, park festivals, baseball parks, amusement parks, political rallies, bathing beaches, etc. In fact, sound systems can be rented at any place where large crowds congregate.

Perhaps the most important reason why more Service Men have not equipped their cars with sound systems has been the high initial cost. This objection is entirely overcome in the amplifier illustrated, because new designs, new tubes, and ingenious new production methods have resulted in economies permitting the complete unit to be sold for less than $40.00, exclusive of tubes.

The amplifiers first employed for automotive work were merely crude adaptations to meet a new demand. Even now, many amplifiers which are being offered for automotive use are makeshifts, since it is obvious that they were originally designed for some other purpose.

A real automobile amplifier should employ the latest 6.3-volt, automotive tubes. It should be compact, with the motor-generator included as an integral part of the unit. Current drain should be kept at a minimum, so that the entire outfit can be operated readily from the car's storage battery. The amplifier to be described fulfills every one of these conditions, and, in addition, possesses many other features which render it ideal for all mobile usages.

Construction Details

This amplifier is built up on a rigid metal chassis, with all parts protected by a metal cover. It employs a powerful triple push-pull three stage circuit Two 36 tubes in push-pull in the first stage are coupled, by resistance bridge arrangement to 37 tubes which are also in push-

(Continued on page 113)

*Chief Engineer, Federated Purchaser, Inc.

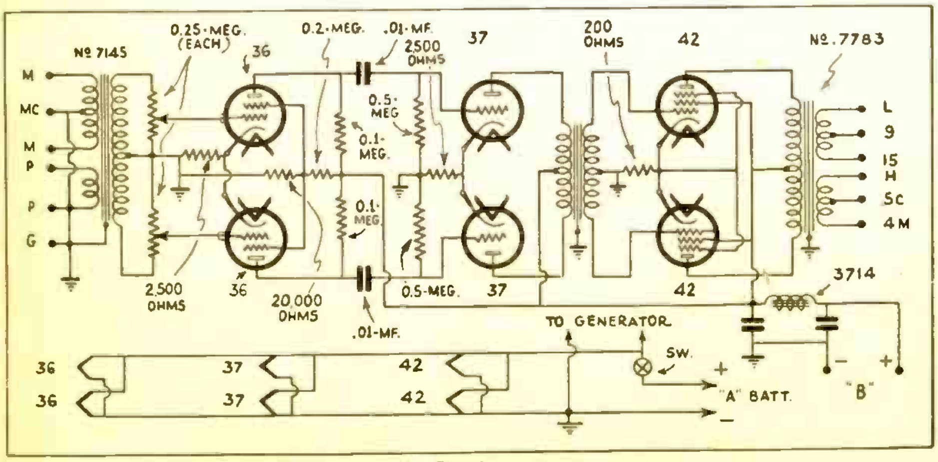


Fig. 1
Schematic circuit of the push-pull amplifier described here. The filter condensers may be 4 to 8 mf. each.

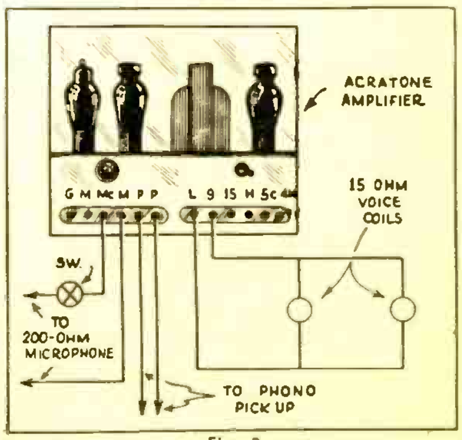


Fig. 2
A detail drawing showing the connection of the binding posts.

RADIO-CRAFT'S INFORMATION BUREAU

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Furnish sufficient information, and draw a careful diagram when needed, to explain your meaning; use only one side of the paper. List each question.

Those questions which are found to represent the greatest general interest will be published here, to the extent that space permits. At least five weeks must elapse between the receipt of a question and the appearance of its answer here.

Replies, magazines, etc., cannot be sent C. O. D.

Inquiries can be answered by mail only when accompanied by 25 cents (stamps) for each separate question.

Other inquiries should be marked "For Publication," to avoid misunderstanding.

NA-ALD TYPE 950-XYL ADAPTER—32-V. GENEMOTOR "B"

(205) Mr. Jack Christian, Vicksburg, Miss.

(Q.1) What is the schematic circuit used in the Na-Ald type 950-XYL Tube Adapter illustrated and described on page 652 of the May, 1933 issue of RADIO-CRAFT?

(A.1) The circuit of this interesting unit, which will now test over 90 types of tubes, is shown in Fig. Q205A.

(Q.2) In the May, 1933 issue of RADIO-CRAFT, on page 653, is described a dynamotor type of radio set "B" unit which is designed to be operated from a 32-V. "farm lighting" system. What is the schematic circuit of this power unit?

(A.2) In Fig. Q.205B is reproduced the diagram of connections employed in the Carter 32-V. supply "B" eliminator; this unit is cataloged as the Carter Genemotor No. 3280A. The output is 30 ma. at 180 V.; the current consumption is about 15 W.

MICROPHONE TECHNIQUE

(206) Mr. T. W. Cooper, Aurora, Ill.

(Q.) Since a carbon-type microphone is non-inductive, is it not true that its D.C. resistance is also its A.C. impedance?

(A.) The assumption does not always apply. More complete information on this topic follows; the data is furnished by courtesy of Mr. E. E. Griffin, Chief Engineer, Universal Microphone Co.

A continually irritating topic in sound transmission, that frequently bobs up to trouble technical men, has been the confusion as to the resistance of microphones and microphone buttons, yet, the explanation is not complicated—there is no "mystery" about the business.

In some cases the D.C. resistance is practically the same as the A.C. impedance, *while in others it is entirely different.*

Take the instance of a single-button microphone in series with a 1.5 V. dry cell. Considering the D.C. resistance of the microphone as 200 ohms, we will have a current of 7.5 ma. flowing in this circuit. This value of 200 ohms D.C. resistance is also its approximate A.C. resistance, or impedance. The A. C. impedance of a carbon microphone is not always its apparent talking resistance, but rather the ratio of the power absorbed by it to the square of the current flowing through it. The general assumption is that the A.C. resistance of a carbon microphone is about 80% of its apparent talking resistance.

In the case of a double-button microphone, an entirely different condition takes place. We have one source of current, a single dry cell, and the two buttons of the microphone in parallel. Thus, the microphone presents a parallel circuit, each leg of which being 200 ohms; therefore, the total over all resistance is 100 ohms; and thus, with 1.5 V. of battery in the circuit a total current of 15 ma. will flow. Its actual D.C. resistance, as far as battery supply is concerned, will be 100 ohms. Its A.C. impedance, however, as connected to the primary of the microphone transformer is entirely different since the two buttons in relation to the transformer are connected in series, thus presenting some 350 to 400 ohms A.C. impedance.

In regard to the transformer, the microphone is now considered an acoustically-driven A.C. generator, with an impedance of approximately 400 ohms, and thus the transformer, in order to efficiently match this value, must have a primary winding of approximately 400 ohms effective impedance and must be provided with a center-tap to take care of the microphone's D.C. exciting current.

(The following data, although coded especially for a given make, is representative of other makes of units having similar characteristics, and hence is useful as a general reference.—*Technical Editor.*)

This condition is adequately taken care of, for double-button microphones, in Universal microphone transformers Nos. 1089, 0089 and 1152; and for single-button microphones, in No. 0075. These transformers have extremely low D.C. resistance, with comparatively high A.C. impedance; this design insures flat frequency characteristics from well below 30 cycles to well over 12.000 cycles.

CALCULATING VOLTAGE DIVIDERS

(207) Mr. Robert Dhonau, River Forest, Ill.

(Q.) What is the procedure in finding the correct resistance and power rating of resistance units to be used in making a voltage divider, where the current drain and voltage conditions of each tube in the circuit are already known? In other words, how can the technician, interested in building a radio set or a power pack, pre-determine the correct resistor to use in each section of the power supply voltage divider so that this section of the instrument may be made at the lowest cost?

(A.) In Fig. Q.207 is shown a typical voltage divider connection, with the current and voltage in each part of the circuit clearly indicated. This illustration, together with the following explanation, appeared in the April, 1933 issue of THE OHMITE NEWS.

In Fig. Q.207, the section R1 is the "bleeder" through which the bleeder current completes its path through the divider from the positive side of the power supply. The object of closing the circuit through the bleeder resistor is to bring about a more stable condition in the divider system.

The current, I1, must be chosen so as to satisfy existing conditions both in the set and the power pack. Some of the factors which govern these conditions are as follows:

(1) Current required by reproducer field coil;

(2) Current required to secure a stable load on the rectifying tube;

(3) Current demand which will allow the correct output voltage on the power tube. (For a required output voltage the total current demand should not be in excess of that indicated on the voltage-current curve furnished with the tube);

(4) The total current, I, must be equal to the sum of Ia, Ib, Ic, Id, ... etc., depending upon the number of sections in the unit.

In calculating the resistance and power rating of the various sections of a divider, the following procedure is perhaps the simplest.

First, draw a sketch of the divider, as shown in Fig. Q.207; next, allow for the number of taps required by the instrument design. Then, write in their correct places, on the sketch, the voltage required at these taps. (The known voltages should be designated as Ec, E1, E2, E3, E4, ... etc. Check the voltages to make sure that the sum total will equal E.

The next step is to write-in the known currents, at the same time labeling them. Then, choose I1 so that it meets the conditions previously itemized. Now, calculate I2, I3, I4, etc., as follows:

I2 equals I1 plus Ib;
I3 equals I2 plus Ic;
I4 equals I3 plus Id.

Use Ohm's law to calculate the resistance value of each section, by the formula: Rc equals Ec divided by Ia. Follow this procedure for each section of the divider.

To arrive at the power, W, which each section will be called upon to dissipate, use the power formula: Power (in watts) equals current times voltage. Thus:

W (Rc) equals Ec times Ia;
W (R1) equals E1 times I1;
W (R2) equals E2 times I2;
W (R3) equals E3 times I3;
W (R4) equals E4 times I4.

This information determines the physical size of the unit since it is standard practice to allow seven watts of dissipation per square inch of surface area when the unit is operated in the *open air*. If the unit is to be enclosed it should be allowed to dissipate only about 2 watts per square inch of area to insure a satisfactory factor of safety.

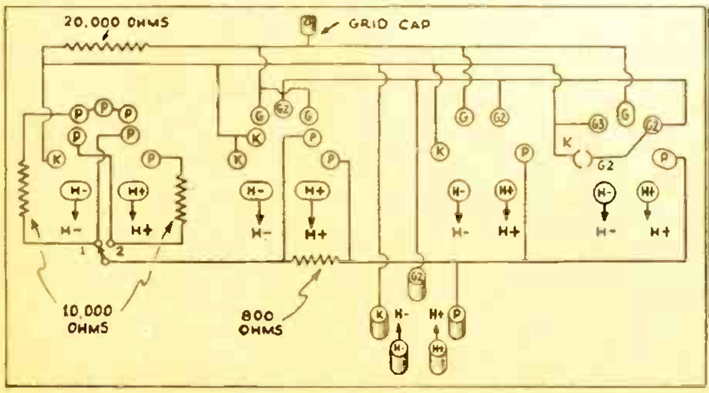

Fig. Q. 205A
Schematic circuit of the Na-Ald type 950-XYL adapter.

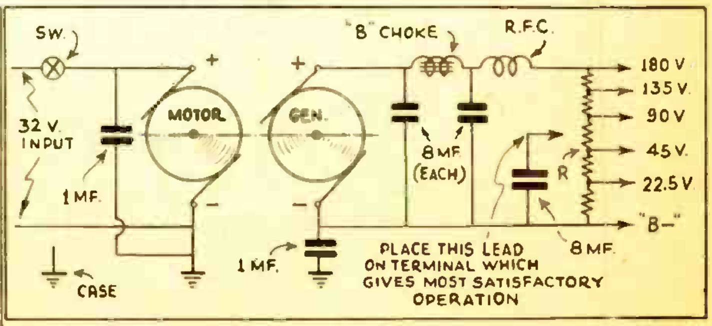

Fig. Q. 205B
Resistor R has a total resistance of 20,000 ohms. Inside the motor-generator case are four, 100-turn R.F. chokes (one in each lead), a 0.1-mf. condenser in shunt to the generator output (at the generator), and another connected from the generator negative terminal to the chassis. The motor winding is used for chokes.

AUTO-RADIO "B" LOAD-DELAY RELAY

(208) Mr. Raymond F. Horton, Baltimore, Md.

(Q.) What is the purpose of the "load-delay" relay incorporated in the Electronic type 331 vibrator-type "B" eliminator?

(A.) The connections of this eliminator are shown in Fig. Q.208. The load-delay relay is provided to delay the application of the voltage to the radio set until the tubes have reached normal temperature, thus protecting the set from high-voltage surges. It may be necessary to connect R.F. chokes at the points indicated at X. The output rating of the unit is 45 ma. at 180 V.

"A MODERN BENCH-TYPE TEST PANEL"

(209) Mr. E. A. Jozwick, Bayonne, N. J.

(Q.) In the April, 1933 issue of RADIO-CRAFT I noticed four errors in a wiring schematic shown on page 597, Fig. 1F. They are as follows:

(1) Contact points Nos. 10, 12, 19, and 22 on the rotary switch are strapped together but are not connected to any element on the test sockets;

(2) Contact points Nos. 15 and 26 are strapped together but, as in the above case, they are not connected to any element on the test sockets;

(3) The H terminal on the 6-prong socket is shorted to K of the same socket;

(4) There is no provision for testing H with the C.G. clip, or S.G. with the C.G. clip.

I am constructing the test panel, unit by unit, and I have started with F of Fig. 1 as that is the unit I need most at present. When finished, there will be eight panels which will be interconnected as one.

I rectified the above errors in the following manner:

(1) Contact points 10, 12, 19, and 22 were connected to terminals H of test sockets;

(2) Contact points 15 and 26 were connected to terminals P of test sockets.

(3) The short that existed between the K and H terminals of the 6-prong socket was removed and, instead both H terminals were shorted.

(4) Terminal C.G. on the 7-prong socket was tied to the C.G. clip, making it possible to test H with C.G., and S.G. with C.G.

Will you please inform me either by letter or by printing it in some future issue of RADIO-CRAFT, how the author intended the schematic to be shown?

The April issue of RADIO-CRAFT is about the most interesting so far, and I am hoping that the future issues are as good or better.

(A.) Our correspondent has received a personal reply (wonder how he liked our June, *auto-radio* number?); however, since the inquiry is of general interest we are publishing the following comments received from Mr. Sprayberry.

Upon checking the correspondence of Mr. Jozwick I find that there are several points in the article in question which require comment.

The 6-hole socket shows a connection from the heater terminal to the cathode; this is incorrect. The heater of this socket should connect to the common heater circuit exactly as the other heater circuits are connected.

The next error is the lack of a connection between contact 15 and any tube element; this wire should connect to the wire leading from terminals 4, 11 and 13.

The wire leading from terminal 17 should connect to the lead from terminals 10, 12, 19 and 22.

The lead from terminal 30 should connect to the common control-grid circuit or to the wire which makes contact to terminal 16 of the switch.

When these changes have been made the following positions of the switch indicate shorts between certain elements of the tube when a reading is obtained on the indicator connected to the switch.

Term Nos.	Short Between	Term. Nos.	Short Between
1- 2	S-G & C-G	11–12	P & F
3- 4	Cath & P	13–14	P & S-G or C-G
5- 6	Cath & S-G	15–16	P & C-G
7- 8	Cath & C-G	17–18	F & C-G or S-G
9-10	Cath & Fil	19–20	F & C-G

HIGH-VACUUM, LOW-INTERNAL-RESISTANCE RECTIFIERS

(210) Mr. Julius Bellaire, Brooklyn, N. Y.

(Q.) It is my understanding that mercury-vapor rectifiers were introduced as a means of obtaining high current output with low voltage drop in the tube, in contrast with previous "high vacuum," gas-less tubes. If this is correct, how is it possible to obtain such low voltage drop in the new high-vacuum rectifiers for use in, for instance, automotive receivers (to use in the example a cathode-type tube)? If the elements are brought too close together, as a means of reducing the internal resistance, it has been the writer's experience that spark-over results between the cathode and anodes.

(A.) The following interesting description of the theory involved in a tube of this type is published by courtesy of National Union Radio Corp. Although the description relates particularly to the National Union type NU-84 tube, the data is applicable to other makes of tubes of similar type.

The production of an automobile radio receiver that would perform satisfactorily under the strenuous operating conditions unavoidable in this type of installation was retarded to a great degree by the problem of suitable power supply.

"B" battery installation did not provide a practical solution. The installation of a motor generator presented difficulties as yet not surmounted.

The generation of alternating current by means of a vibrator, transformation to the proper voltage, rectification into pulsating current, then smoothing out into high voltage direct current seemed to be an ideal answer.

This method, however, necessitated the production of a rectifier tube which would necessarily have greater efficiency than a rectifier used in the stationary A.C. set. Such a rectifier would be required to meet certain requirements.

First—It must have a filament voltage of 6.3 volts so that it could be operated directly from the storage battery.

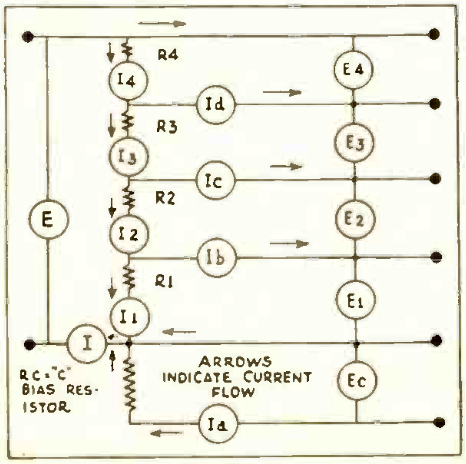

Fig. Q. 207
A typical voltage-divider section.

Second—It must be a heater type, since the cathode potential is above the cathode potential of the rest of the tubes.

Third—The voltage drop across the rectifier must be as low as possible (efficiency).

These requirements led primarily to the production of a small mercury-vapor rectifier with indirectly heated cathodes. Under certain conditions this tube is found to work efficiently in the proper eliminator and gives a smooth, direct current of about 180 volts. The only drawback to this tube is that, unfortunately, the voltage drop depends upon the mercury vapor pressure, which rises and drops with the temperature. It has been found, for instance, that a tube which gives 0.125-amp. plate current with only 10 volts drop at room temperature, when cooled to about 40° Fahrenheit showed a drop of 30 volts. This condition placed a limitation on the tube with regard to completely satisfactory operation in cold weather.

As soon as the limitation was recognized, experimentation was begun on the influence of temperature upon some inert gas—such as argon—but without success.

National Union engineers then turned to the idea of producing a *vacuum* rectifier tube, with low voltage drop. It was found that such a tube required extremely small cathode-plate distance. The manufacture of such a tube would be extremely difficult and in addition the excessive heat, radiated from a near-by cathode upon a plate with such small diameter, produced the danger of secondary or back-emission during that period in which the plate becomes negative. This idea was then discarded as impractical.

Theoretical investigations, however, showed that in a vacuum tube the plate current will not change, if a properly designed grid is put in the position of the plate, the plate made much larger and the grid and plate tied together. There is no unsurmountable difficulty in employing grids with comparatively small diameter, and the form and material of the grid can be selected so that there is no danger of back-emission. This situation permits the plate to be made large enough to avoid all the difficulties originally encountered.

Having worked out the details of these principles, a tube was produced using a filament which consumes 0.4-amp. and 6.3 volts, and with a voltage drop of less than 20 volts when drawing 50 ma. plate current. Since the average current consumption of an automobile receiver is about 40 ma., the voltage drop of this tube is practically ideal, even when the battery voltage drops below 6 volts during the course of fluctuation. The eliminator, originally designed for the mercury-vapor rectifier is found to deliver 180-185 volts, when used with this later tube development.

The number NU-84 has been assigned to the tube. It is sealed in an S12 bulb and has a small-five-prong base, two prongs for the filament leads, one for the cathode and two for the two plates. Between the filament and cathode a high grade insulation is used which withstands the heater cathode bias of 300 volts even when the filament voltage reaches high values at times when the automobile is traveling at high speed.

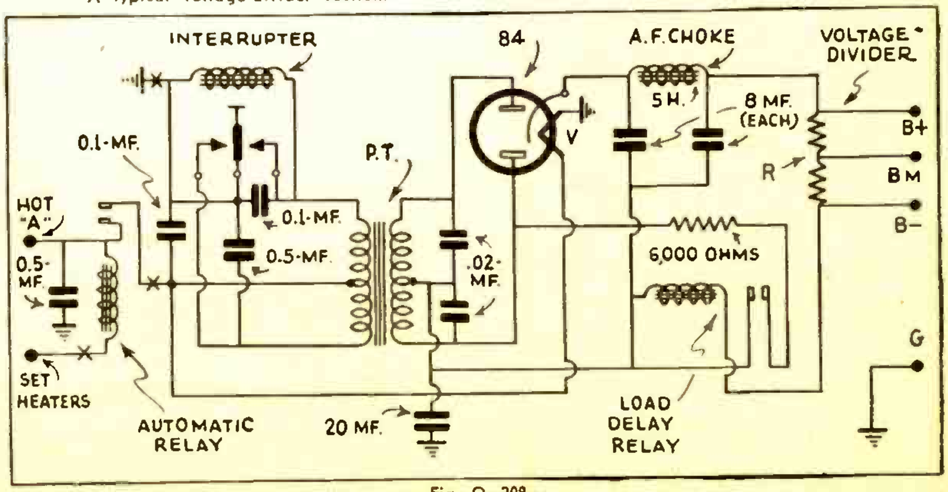

Fig. Q. 208
Connections of the Electronic type 331 vibrator-type relay showing the "load-delay" relay Resistor R measures 0.1-meg.

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DEPENDABLE TUBE TESTER

(Continued from page 87)

regardless of whether they are 4-, 5-, or 6-prong tubes. In order to provide the greatest range of readings, a shunt is provided for the meter. This is normally out of the circuit, but when the meter indications become too large, the shunt is connected across the meter by means of SW.7 and much larger currents may be read.

The panel measures 8 x 10 inches. It should be etched and drilled as shown in Fig. 2, which gives all locations. Panels may be procured that are completely etched and drilled to specifications. The entire assembly and wiring is simple as can be seen from Fig. B, a rear view of the finished tester.

Assembly and Wiring

Turn over the panel so that you face the unfinished or under side as indicated in Figs. B and 2. Mount the transformer, P. T. by means of screws and nuts. The portion of the coil containing the primary leads should face toward the top of the panel. The arrangement of leads on the transformer is shown in Fig. 3.

Mount the line voltage switch SW.1 and the filament switch, SW.3 as shown. Insert the knobs on the shafts of these switches so that their indicators will always point to the marking on the panel corresponding to the actual connection made by the switch. It is important that insulating, spacing washers be placed, at the proper height, between the panel and the knob for each switch. These washers elevate the metal pointer of the knob to prevent it from touching the mounting screws as it is rotated, and eliminates any danger of grounding the switch arms to the panel.

Following the wiring diagram, Fig. 2, connect the transformer leads to the proper switches. Be sure to use spaghetti tubing over these leads for better insulation than is ordinarily provided. Wire the three primary leads of the transformer to the 105-115-125 volt taps on the "Line Voltage" switch. Connect together the common leads of the primary and secondary. In accordance with the diagram, connect the leads from the secondary of the transformer to their respective points on the "Filament" selector switch, SW.3.

Insert the line-voltage rubber cable through the hole in the bottom of the panel and connect one of the wires to the two common leads of the transformer which are already connected together. The other wire in the cable is connected to the switch arm terminal of "Line Voltage" switch.

Fasten the miniature socket, V6, to the panel by fastening the rubber grommet, which secures to, and insulates, the shell from the panel. The vitreous enamel 900 ohm, 10 watt resistor, R1, is secured to the screw extending from the base of the miniature socket.

Mount the two momentary type S.P.D.T. toggle switches, SW.6 and SW.8 in their positions, "2nd Plate" and "Bias Test" as shown. The regular S.P.D.T. toggle switch, SW.4, is mounted in the "Short-Regular" position indicated. The S.P.S.T. momentary button switches SW.5 and SW.7 should be mounted as designated by "Shunt" and "Gas Test" in the diagram. Insert the meter, M, and fasten it securely to the panel.

Make all interconnections on the lugs of the three gang 12 point "Tube Selector" switch, SW2, before mounting it to the panel, because there will not be room enough to solder to its terminals after it is mounted. The gang or section of the switch furthest from the knob is Section 1, and Section 3 is the section nearest the knob.

Connect together points 1, 2, 3, and 8 on section 1, as per Fig. 2, the wiring diagram; connect points 10 and 5 together on Section 1; also, connect points 6, 7, and 9 together on this section. On Section 2, connect points 3, 8, and 9 together; connect points 1 and 10 together. Then connect points 2, 4, 5, and 7 together on Section 3; also wire points 8 and 9 together on Section 3; finally, on Section 3, connect points 1 and 10 together.

Solder leads about seven inches long to the terminals leading to the three moving arms, or switch levers. Then, as shown in the wiring diagram, connect point 7 of Section 3 with point 8 of Section 2, and connect point 9 of Section 3 with point 10 of Section 2. Following the diagram, connect 1 of Section 3 with point 1 of Section 1. Then connect point 10 of Section 2 with point 9 of Section 1. Point 5 of Section 2 is connected to point 4 of Section 1. Finally, point 9 of Section 2 is connected to point 10 of Section 1. Now fasten the 3-gang tube selector switch, SW.2, in place. It is important that the knob be set exactly correct so that the position of the indicator on the panel will correspond to the proper switch position. Be sure that the contacts are properly aligned and that no wires interfere with the moving arm.

Mount the shunt, R2, by soldering one terminal directly to the "Shunt" momentary switch SW.7. Complete the wiring of this switch as per the diagram.

Place the five sockets in their respective positions as shown, with their filament terminals toward the bottom of the panel. Wire the filament connections according to the diagram, making sure that the common side of the filament is always next to the cathode terminal. Complete the filament wiring to the common at the transformer and to the switch arm of the filament switch, SW.3.

Connect jumpers across the particular socket terminals as shown on the diagram. Connect the leads from the switch-arm terminals of the tube selector switch, SW.2, to the socket terminals, in strict accordance with the diagram.

Mount the 100,000 ohm resistor, R3, by soldering one terminal to the lug on the momentary toggle "Bias Test" switch, SW.8. Mount the 1,600-ohm plate-circuit resistor, R4, directly on the meter terminal.

Fasten the sockets rigidly to the panel by means of the mounting support strip, nuts, and screws as shown in Fig. B. Complete the wiring exactly as per the diagram for the grid circuit, making sure the "Gas Test" and "Bias Test" switches are correctly connected. Complete the wiring for the "2nd Plate" and "Short Regular" tests, as shown, making the necessary connections to the proper terminals of Section 1 of the 3 gang switch. Point 2 of Section 3 is connected to the common. Insert the lead with the control-grid cap through the hole at the top of the panel and connect as shown. The instrument is now completely wired. Check over all connections, following the diagram carefully. If everything is satisfactory, fasten the panel to the case and insert the pilot light. Insert the attachment plug in any 60-cycle socket, or receptacle, and the checker is ready to be tested. Turn the "Line Voltage" switch to the position corresponding to actual line voltage.

All tube numbers are marked in columns on the panel. Turn the tube selector switch to the column containing the tube number to be tested. After each tube number is a dash and a second number. The second number indicates the position of the filament switch.

Before inserting a tube in its socket, throw "Short Regular" switch to "short" position. The pilot light glows for a shorted tube. Throw this switch to "Regular" position for regular tests. "Regular" readings are now indicated on the meter. The presence of gas may be determined by the movement of the pointer when the "Gas Test" button is pressed.

Operate the "Bias Test" switch and take readings. The difference, or change, between Regular and Bias Test readings is an indication of transconductance—mutual conductance—of the tube. Normal readings of "change" for good tubes are listed on a chart supplied. Tubes are considered poor if the "change" differs by 25% from the "change" listed in the chart.

Second plates of rectifiers are tested by operating switch "2nd Plate." The shunt switch is used only when meter readings would go off scale.

If the line voltage does not correspond to the setting of the line-voltage switch, the readings will be, accordingly, higher or lower.

List of Parts

One Dependable line voltage selector switch, 4 points, Sw.1;

One Dependable tube selector switch, 12 points, 3-gang, Sw.2;

One Dependable filament voltage selector

switch, 10 points, Sw.3;
One S.P.D.T. toggle switch, Sw.4;
Two S.P.S.T. momentory switches, Sw.5, Sw.7;
Two momentary S.P.D.T. toggle switches, Sw.6, Sw.8;
One Dependable 900-ohm, 10 watt resistor, R1;
One Dependable 45 ma. shunt, R2;
One Dependable 100,000-ohm resistor, R3;
One 1,600-ohm resistor, R4;
One circular wafer type 4-prong socket, V1;
One circular wafer type 5-prong socket, V2;
One circular wafer type 6-prong socket, V3;
One circular wafer type 7-prong socket, V4;
One circular wafer type combination 8 and 9 prong socket, V5;
One 18-volt pilot light, V6;
One Dependable miniature socket and grommet for V6;
One Dependable d'Arsonval moving coil meter, M;
One Dependable panel, etched and drilled 8 x 10 inches;
One Dependable transformer, P.T.;
Three knobs with indicators;
One molded rubber plug and cable;
One mounting support for sockets;
Three feet of spaghetti tubing;
One Dependable portable leatherette covered carrying case;
One control grid cap, and lead;
Screws, nuts, washers, spacers, and wire.

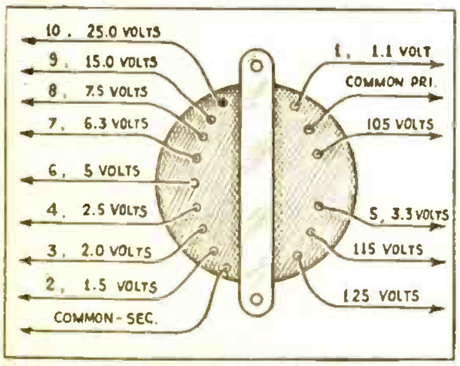


Fig. 3
Details of the transformer leads.

BAND SPREADING

What is generally meant by band spreading? Does one mean spreading the band over a greater portion of the tuning dial, the obvious interpretation? Well, yes, and then again, no, as the politician says. The phrase means spreading the band all right, but not spreading the band over the regular tuning condenser. Here's what it does mean:

Everyone knows that the total capacity of two condensers in parallel is the sum of the two individual capacities. This idea is made use of in band spreading. The ordinary tuning condenser—usually in short-wave receivers—has an additional, small three-plate condenser in parallel with it; this smaller condenser is so arranged that it may be tuned independently of the main tuning unit. Thus, the single assembly has two shafts, each going to separate dials on the panel of the set.

The larger, main unit of the two is tuned to the approximate frequency of the station to be heard, while the exact frequency is obtained by tuning the smaller, auxiliary unit. In this manner a small band of frequencies is spread over the entire dial of the smaller condenser, and band spreading is obtained. Here are some figures:

Suppose there is a 140 mmf. tuning condenser—a standard size—whose minimum capacity is 15 mmf.—also a somewhat standard figure. The change of capacity, then, is 140 minus 15, or 125 mmf. If the plates of the condenser are semi-circular, the change of capacity per degree of the tuning dial is 125 divided by 100, or 1.25 mmf, provided, of course, that the dial has 100 divisions.

Now suppose that the smaller unit has but three plates—a standard size—of the same size and shape of the larger unit. The capacity of this unit is, therefore, 35 mmf. The capacity change per degree on its dial is 35 divided by 100, or .35 mmf., assuming that the band spread dial also has 100 divisions. Thus, it is seen that one can get about 1.25 divided by .35, or 3.5 times as much spreading with the smaller than with the larger unit. A good idea, eh, what?

The Best NEWS of the Year will be found on the Inside Back Cover of this issue. Turn to this page NOW.

MODERNIZING THE MAJESTIC 15

(Continued from page 97)

series with the grids of the 56 and output stages effectively combat any audio oscillation that may be generated.

The unusual performance of the set can be attributed to the new tubes. The 57 oscillating detector is extremely sensitive, while the 58 covers itself with glory in the I.F. stage. (?-Editor.) Due to the fact that resistance coupling is used throughout, the tone is very good. The total filament current, used by the six tubes, is less than that used by the old five tubes, while the total plate current is only a few ma. more.

Although the work was undertaken more for the experience than anything else, the added power and the convenience of automatic volume control more than compensate for the work done. The set works without being grounded, the ground is substituted for the aerial. Stations all over the country are brought in at good volume.

An attempt was made by the writer to install a 58 R.F. stage before the first detector, but shielding difficulties presented themselves, so that the idea was abandoned.

A Philco 96 baby grand superhet also had its audio system changed by the writer. When the set was delivered, it had a pair of 45's in the output stage: but the speaker was designed for use with a single pentode. As a result, only one tube was used. Therefore, a single pentode was substituted by changing the socket to a five hole type and changing the bias resistor to 410 ohms, the correct value. The set now works exceptionally well.

Values of Parts

The values of the parts used in the circuit of Fig. 2 are listed. The numbers following the letter designations are in ohms and microfarads:

R1, 30.000; R2, 25,000; R3, 1,000; R4, 500.000; R5, 200; R6, 50,000; R7, 250.000; R8, 100.000; R9, 250,000 (a potentiometer); R10, 100,000; R11, 1.500; R12, 40.000; R13, 300,000; R14, 100.000; R15, 1,000,000; R16, 200,000; R17, 50,000 (a rheostat). The condensers have the following values: C1, .5-; C2, .5-; C3, 8; C4, 8; C5, .05-; C6, .1-; C7, .1-; C8, .0005-; C9, .00025-; C10, .01-; C11, .00025-; C12, .01-; C13, .25-; C14, .03-; C15, 1; C16, .0009-.

NEW HOME STUDY COURSE FOR PROFESSIONAL SERVICE MEN

A new home study course of instruction for professional Service Men, in which theory and practice are presented in a new way, has been prepared by the National Radio Institute, of Washington, D. C. This course, comprising 52 separate lessons, covers such subjects as the fundamentals of electricity, magnetism, energy conversion, tubes, all kinds of circuit measurements, testing and laboratory procedures, repair notes, practical application of accessories, mathematics in radio, photo-cells, and associated apparatus.

A lesson grading service, a series of 12 reference books, and 8 service manuals are all included as part of the course. Free consultation service is also available. Two years are needed to complete the full course, and the student is given a diploma at its termination. If requested, the Institute will send the student's employer periodic reports on his progress.

Service Men desiring to improve their professional standing by a systematic course of study will do well to consider this opportunity.

At a recent meeting of the Radio Club of America a paper was presented on Q.A.V.C. systems. It might be well to mention here that this paper treated in detail the effect of Q.A.V.C. on receiver performance. Such a paper can only be appreciated by the well-trained man, the man with a thorough background of radio knowledge, theoretical as well as practical.

The N.R.I. course is well suited to explain these things so that you don't have to guess—you'll *know*.

OPERATING NOTES

(Continued from page 93)

very high negative bias to be impressed upon the grids of the R.F., first detector, and I.F. tubes, thus decreasing the plate current flow and, consequently, the sensitivity of the receiver. As the volume control in the cathode circuit of the A.V.C. tube varies the grid bias, the sensitivity of the receiver will jump to maximum as the receiver is tuned off resonance. With a low setting of the volume control, very little or no A.V.C. action is secured, resulting in very little inter-station pickup, but only the powerful stations will be heard. As the control is advanced inter-station noise increases, as well as the noise on the high-frequency lowpowered stations, because of this A.V.C. action.

There was only one simple way, so far as we could see, to remedy this fault, and that was to limit the A. V. C. action. This could be done quite readily by reducing the heater voltage of the 56, A. V. C. tube by the insertion of a small filament resistor in one leg of the heater circuit, thereby preventing any action except on really strong signals or with a high setting of the manual volume control.

Another method of reducing this form of interference lies in cutting down the effective length of the aerial to decrease the signal input; but this method has the disadvantage of making the receiver less sensitive to weak signals. One customer, not desiring any changes in the chassis, was pacified by installing an S. P. S. T. knife switch at the window, so that the aerial could be disconnected at will, and using as the aerial the wire, about 20 feet long, from the window to the set. This method proved very effective. The correct length for the aerial will vary in each individual case, and is dependent upon both the location of the receiver and the automatic volume control action.

RCA Victor RE-80

A common complaint on the RCA Victor RE-80 receiver is oscillation, no A. V. C. action, loud volume, and motor-boating on the higher frequencies accompanied by distorted reproduction; often, the conditions are intermittent. In this receiver the manufacturer departs from the practice followed in a number of previous models and obtains voltage for the pilot light from the filament winding feeding the power amplifiers instead of using the common heater winding, where, should the pilot light socket or lugs become shorted to the chassis, either hum, because of disturbance of the center-tap, or a lowering of the heater voltage would result, or both.

In the RE-80, however, a pilot-light-socket short will short out the power amplifier bias resistor as well as remove the negative potential from the cathode of the duo-diode, 55 tube, as shown in Fig. 1. This will result in distorted reproduction; no A. V. C. action; and, because a high negative grid bias is not impressed upon the R. F., first detector, and I. F. tubes at resonance, loud volume, and oscillation.

Due to the additional control, which is a combination radiophone switch and phonograph volume control, which is placed on the front panel directly in front of the antenna coil, a metal shield is employed to prevent inter-action between these components. There is so little clearance between this shield and the pilot light socket lugs, that vibration often causes the lugs to short to the shield, producing the complaint. It is a simple matter to twist the lugs to a more advantageous position or, as some do, to wrap a layer of tape around the lugs, to prevent a recurrence.

Atwater Kent 812

To visually indicate resonance with an incoming signal, the Atwater Kent model 812 receiver employs a neon bulb or tonebeam. Frequently, the operation of this tonebeam is erratic, the light column falling slowly, wavering and disappearing down the long electrode, usually climbing suddenly to repeat the process.

At first, quite naturally, the neon bulb was suspected, so a new bulb was installed to allay our suspicions and, coincidently, as later proved, operation was again normal. However, after a few days, the same complaint was received. It did not appear likely that the neon bulb was at fault again, but another bulb was taken along, anyway. This time, while replacing the bulb or cleaning the socket contacts (the socket is a double contact unit, similar to those used in automobile headlights), the chassis was removed so that a careful check could be made of the tonebeam circuit, which is shown in Fig. 2.

An analysis soon disclosed that the tonebeam potentiometer (which is used in a voltage divider circuit to provide an adjustable initial bias to take care of the varying characteristics of different neon bulbs so that electrode A is positive with respect to the long electrode C) was being intermittently shorted out of the circuit. The two carbon resistors, R2 and R4, part of the tonebeam voltage divider system, along with the second resistor in the cathode circuit of the 55 tube, are mounted in a long, stiff "fish-paper" container, end to end; resistors R2 and R4 being insulated from one another with a small lump of pitch. This container may be found near the push-push, type 46 sockets beneath the chassis.

Due to the fact that the Woods-metal ends of these resistors are sharp, vibration causes them to work through the pitch and short one to the other, which circumstance shorts out the tonebeam potentiometer, R3, and disturbs the biasing arrangement, preventing the neon bulb from functioning. When this bulb was replaced on the first service call, the handling of the chassis must have cleared the short—for the time being.

The action of the tonebeam is interesting and an explanation of its operation may not be amiss at this point. At resonance, the negative bias on the R. F., first detector, and I. F. tubes is increased due to the action of the automatic volume control. Consequently, this reduces the voltage drop across the resistor R1, which produces a proportional increase in the voltage *differential* between the electrodes A and C of the neon bulb, thereby causing the light column to extend up the long electrode C, indicating resonance. The resistor R5 is placed in series with the arm of the potentiometer to make the tonebeam action more uniform with both weak and strong signals. The purpose of the short electrode B in conjunction with R6 is to secure more stable operation. Resistors R2 and R4, besides being part of the divider system, are used to limit the range of the tonebeam adjustment so that too large an initial bias may not damage or weaken the neon bulb.

Brunswick 17, 24, 25

An interesting case was encountered some time ago on a Brunswick model 17 receiver; the complaint being no control of volume and highly distorted reproduction. The fish paper, insulating the can of the first electrolytic condenser from the chassis—after the latter had been removed from the cabinet—was immediately checked for leakage, as this is the most common cause for this condition, described by the writer in the July, 1932 issue of RADIO-CRAFT; but the insulation passed inspection and test. Besides these symptoms, it was noticed that the tapped field coil, in the high voltage secondary return, had heated to such an extent that even the frame of the speaker became too hot to handle, a condition that had not been found in any previous case.

The large carbon resistor located between the two I. F. transformers, because of poor ventilation due to its proximity to the shield cans and its position in the circuit as part of a voltage divider system (this resistor drops the high voltage for the necessary voltage impressed on the screen of all four screen-grid tubes) was found badly charred. It was checked with an ohmmeter; and instead of the normal 14,000 ohms, a reading of about 3,500 ohms was obtained. The two 5,000 ohm, .5-watt resistors, because of the increased current flow through the large resistor completing the voltage divider circuit and used to procure the required oscillator plate voltage,

(Continued on following page)

also were found carbonized and charred and changed in value. All three units were replaced, the large resistor with a wire-wound 15,000-ohm affair; the receiver then performed as well as ever. (The diagram is shown on page 207 of the 1932 Official Radio Service Manual.—Editor.)

Hammarlund "Pro," "Comet"

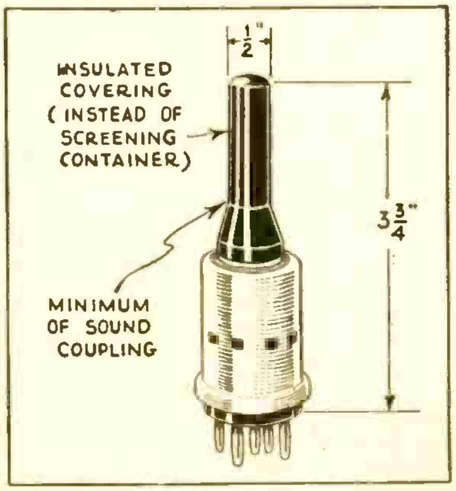
The Hammarlund "Pro" and "Comet," short-wave and broadcast band superheterodyne receivers, employing plug-in coils were serviced because of failure of the I. F. oscillator. These models use a second oscillator stage, which can be switched in or out, tuned to the I. F. frequency and coupled to the I. F. tube, for the reception of C. W. signals. In all cases, the fault lay in a high resistance connection to one of the secondary lugs on the coil of the I. F. oscillator. A hot iron soon remedied the defect, but only after some trouble in locating the source.

A NEW ENGLISH ALL-METAL TUBE

(Continued from page 75)

and the built-in rubber mounting should at least do away with the terribly annoying microphonic howling due to loudspeaker reaction, and the tubes last longer than usual. The greatly reduced overall size is also an important factor.

For portable and mobile radio installations of many kinds, the Catkins possess obvious advantages: tubes of this kind would give American manufacturers of auto—radio receivers a wonderful sales "talking point" and would enable them to keep their sets sold with fewer service worries: it is no secret that some of the new trick-combination tubes are altogether too critical for bouncy automobile service. For airplane use, something of the



sort is certainly needed to stand the terrific shock of repeated landings.

At the time this issue of Radio-Craft went to press (the middle of June) no Catkins were available in the United States, and none are expected, except, perhaps, as samples. If any American manufacturers grab the idea and turn out some tubes, for experimental purposes, if nothing else, we will be glad to herald their efforts in this magazine.

RESISTOR GUIDE

Electrad Inc. announces a 1933 edition of their Resistor Replacement Handbook, so popular last year. The new edition is worked up in an entirely different manner than the older editions, and is extremely concise and detailed.

All types of resistors, including those of the carbon type, are analyzed. It is possible to determine from the data given what replacement resistor or volume control value (including the physical size) is required for any current—model radio receiver—and a lot of old ones, too. The Handbook is kept up to date by supplements which are supplied free during the year.

Read the announcement on page 125 about the new OFFICIAL AUTO-RADIO SERVICE MANUAL. This is the greatest book of the year for Radio Service Men.

NEW TUBE DATA

(*Continued from page 79*)

The grids of the 53 are alternately operated sufficiently positive to cause grid current to flow in their input circuits. This feature imposes a further requirement on the preceding amplifier stage. It must supply not only the necessary input voltage, but it must be capable of doing so under conditions where appreciable power is taken by each grid of the class B amplifier tube. The design of a class B audio amplifier with its driver stage is, therefore, somewhat more involved than for a class A system and must be checked for each change in the component parts.

In the design of class B amplifiers, the interstage transformer is the link interconnecting the driver and the class B stage. It is usually of the step-down type; that is, the primary input voltage is higher than the secondary voltage supplied to the grids of the power output tubes. Depending upon conditions, the ratio of the interstage transformer primary is one-half its secondary and may range between 1.5/1 and 5.5/1. The transformer step-down ratio is dependent on the following factors: (1) type of driver tube; (2) type of power tube; (3) load on power tube; (4) permissible distortion; (5) transformer efficiency (peak power). The primary impedance of the interstage transformer should be essentially the same as if the transformer were to be operated with no load; that is, into an open grid. Since power is transferred, the transformer should have reasonable power efficiency.

The type of driver tube chosen should be capable of handling enough power to operate the class B amplifier stage. Allowance should be made for transformer efficiency. It is most important, if low distortion is desired, that the driver tube be worked well below its class A undistorted output rating, since distortion produced by the driver stage and the power stage will be present in the output.

As a class A amplifier triode, the 53 may be employed in the driver stage of class B amplifier circuits, and thus reduce the number of tube types necessary in a receiver. When operated in this way, with a plate supply of 300 volts and corresponding grid bias, the 53 is capable of supplying a power output of upwards of 400 milliwatts. The load into which the driver works will depend largely on the design factors of the class B amplifier. In general, however, the load will be between 20,000 and 40,000 ohms. For class A amplifier triode operation of the 53, the two grids are connected together at the socket; likewise, the two plates. These connections place the two triode units in parallel. Operation of the tube is then similar to any class A power amplifier triode.

The D.C. resistance in the grid circuit of the 53 when operated as a class A amplifier may be as high as 0.5 megohm with self-bias; with fixed bias, however, the resistance should not exceed .1-megohm.

Figure 6 shows a family of plate and/or grid current vs. plate voltage curves, and Fig. 7 shows the power output, percent distortion, and D.C. plate and grid current per triode as the driver signal voltage is varied. The following ratings and characteristics are obtained:

Heater Voltage (A.C. or D.C.)		2.5	Volts
Heater Current		2.0	Amperes
As Class B Power Amplifier			
Plate Voltage		300 max.	Volts
Dynamic Peak Plate Current (Per plate)		125 max.	ma.
Average Plate Dissipation		10 max.	Watts
Typical Operation:			
Heater Voltage		2.5	Volts
Plate Voltage	250	300	Volts
Grid Voltage	0	0	Volts
Static Plate Current (Per plate)	14	17.5	ma.
Load Resistance (Plate-to-plate)	8,000	10,000	Ohms
Nominal Power Output*	8	10	Watts
As Driver—Class A Amplifier			
(Both grids connected together at socket; likewise both plates.)			
Heater Voltage		2.5	Volts
Plate Voltage	250	294	Volts
Gride Voltage	-5	-6	Volts
Amplification Factor	35	35	
Plate Resistance	11,300	11,000	Ohms
Mutual Conductance	3.100	3.200	Mmhos.
Plate Current	6	7	ma.

*With average input of 350 milliwatts applied between grids.

The 18

This tube is a power output tube and is identical in construction and in electrical characteristics with the type 42, which characteristics were published in the RADIO-CRAFT Tube Chart in the July, 1932 issue. The only difference between the type 42 and the type 18 is in the filament rating which is 6.3 volts at .6 ampere for the 42 tube, and 14 volts, .3-ampere for the 18. For completeness the following characteristics obtain for both the type 42 and 18:

Heater Voltage	6.3 Volts
Heater Current	0.65-Ampere
Plate Voltage	250 Volts
Screen Voltage	250 Volts
Grid Voltage	-16.5 Volts
Amplification Factor	165
Plate Resistance	75.000 Ohms.
Mutual Conductance	2.200 Mmhos.
Plate Current	34 ma.
Screen Current	7.5 ma.
Load Resistance	9000 Ohms*
Max. Undistorted Power Output	3.0 Watts

*A Load Resistance of 7.000 Ohms gives the same power output and percentage distortion as 9,000 Ohms.

The 70

The type 70 is a special detector and A.V.C. tube designed for use for 6.3 volts, .3 ampere-service. This tube contains two grids, a heater, a cathode, and a plate. The heater, cathode, and plate connect to the usual prongs on the tube base sockets. The two grids connect to the other two prongs, interchangeably. The characteristics of this tube are as follows:

Heater Voltage	6.3 Volts
Heater Current	.3 Ampere
Detector Plate Voltage	180 Volts
Grid Return Lead to Cathode	
Plate Current	2.25 ma.
Grid Voltage	6.0 Volts
Mutual Conductance	500 Mmhos.
Voltage Amplification Factor	15.5

Type 25-S—A Duplex-Diode Triode

The type 25-S is a duplex-diode triode designed for use on air cell battery receivers. This tube is also intended for use as a detector and A.V.C. and contains a grid, a filament, a triode plate, and two diode plates. The socket connections for this tube are illustrated in Fig. 3D. The characteristics are as follows:

Filament Voltage	2.0 Volts
Filament Current	.06-Ampere
Plate Voltage	135 Volts
Negative Grid Voltage	3 Volts
Mutual Conductance	475 Mmhos.
Amplification Factor	20
Plate Current	1 ma.
Plate Resistance	42.000 Ohms

The 6A4—Power Amplifier Pentode

The 6A4 has characteristics identical with the type LA given in the July, 1932 issue of RADIO-CRAFT and is completely interchangeable with the type LA. For completeness the characteristics are as follows.

Filament Voltage (A.C. or D.C.)	....	....	....	6.3	Volts
Filament Current	....	....	....	0.3	Ampere
Plate Voltage	100	135	165	180 max.	Volts
Screen Voltage	100	135	165	180 max.	Volts
Grid Voltage*	–6.5	–9	–11	–12	Volts
Plate Current	9	14	20	22	ma.
Screen Current	1.6	2.5	3.5	3.9	ma.
Plate Resistance (Approx.)	83,250	52,600	48,000	45,500	Ohms
Amplification Factor (Approx.)	100	100	100	100	
Mutual Conductance	1.200	1.900	2,100	2.200	Mmhos.
Load Resistance	11.000	9,500	8,000	8,000	Ohms
Power Output**	0.31	0.7	1.2	1.4	Watts

*Grid volts measured from negative end of D.C. operated filament. If the filament is A.C. operated, the tabulated values of grid bias should each be increased by 4.0 volts and be referred to the mid-point of the filament.

**9% total harmonic distortion.

DIRECT-COUPLED A.F. AMPLIFIERS

(*Continued from page 81*)

tials between the elements of the tubes.

Since the very high potential necessary calls for more expensive parts, which are sometimes hard to obtain, we will, next month, go into more elaborate types of direct-coupled circuits which give high gain and even better tone without demanding other than the standard components in universal use today.

READER'S PAGE

(Continued from page 101)

there is juice at the primary of the power transformer before they shake their heads sagely and tell the customer that a new transformer is needed? Very few, if our mail is any indication. There is current at the wall outlet, so the set must be "shot," they figure. They forget that the flexible power cord is likely to be knotted by playful children, mishandled by maids, or otherwise mistreated until one of the wires breaks inside the insulation.

Why does Mr. Smith's set rattle so much? Is it a loose voice coil, a shorted bias resistor, or merely a loose tube shield that is shocked into resonant vibration by the strong sound waves from the speaker?

Little things like this should be investigated first before any probing is done in the circuit itself.

Adding Automatic Volume Control

Many wide awake Service Men on the lookout for new business are writing in for dope on adding automatic volume control to broadcast receivers not so equipped. Our invariable answer, in this regard, is the same as *Punch's* famous advice to people about to get married: "Don't."

Automatic volume control is a pretty tricky proposition, as some set manufacturers have learned to their sorrow, and it cannot be installed in any old set like a line-voltage regulator or a new tube. To be successful, A.V.C. requires that the set have considerable amplification, more in fact, than is available in the thousands of T.R.F. and neutrodyne receivers that are still giving good service in many homes. Some superheterodynes are more amenable in this respect; but then again, the A.V.C. is likely to work too well, and then the customer complains about the terrific noise between stations. A.V.C. was not really successful in commercial receivers until it was accompanied by interstation noise suppression, the system now being known as "quiet automatic volume control," or Q.A.V.C.

We don't intend to say that A.V.C. *can't* be added to old sets; some Service Men have done it, but the general experience of the men who have tried it indicates that the results are not worth the trouble.

Short-Wave Reception

The present boom in the short waves has created another remodeling problem, that of revamping old sets into short wave outfits. It looks pretty easy to unwind some of the wire from T.R.F. transformers and to pull out a couple of plates from each of the tuning condensers, but the result is by no means a short-wave receiver. The big demand for remodeling appears to be with old T.R.F. sets, whose original design couldn't possibly be more foreign to short-wave circuit requirements. As many Service Men will recall, practically all T.R.F. and neutrodyne sets were almost uncontrollably regenerative at the low wavelength end of the tuning scale, and required all sorts of crazy "suppressors" to keep them from breaking into violent oscillation. Very, very few sets of this type were usable, at all, below about 250 meters, the section of the broadcast band between 250 and 200 meters being known popularly as the "graveyard."

Well, start removing turns and cutting down the condensers and the problem becomes a thousand times worse. If the set uses triodes (01A's, 26's or 27's), such revision is absolutely hopeless; if it uses tetrodes (22's, 24's or 35's), there is a slightly better chance for success, but only down to perhaps 80 or 100 meters. The grid to plate capacity of tetrodes is low enough to permit respectable amplification on the short waves, but only in circuits in which special care has been taken to avoid interstage coupling effects. The shielding and the general mechanical construction of old T.R.F. receivers are not nearly adequate for high-frequency work. It is usually cheaper, less troublesome, and certainly more satisfactor from everyone's standpoint to build an altogether new short-wave receiver than to attempt to revamp an old broadcast instrument.

(Continued on following page)

The "Blue Book"

Many Service Men and dealers with previous experience in the automotive industry ask if there is any such thing as a "Blue Book" of second-hand radio set values, as there is of used cars. The publication of such a book was actually contemplated at one time by a man who knew nothing about the radio business. After making a few discreet inquiries he very wisely gave up the idea.

The dealer who makes an allowance of any kind on an old set when a new one is purchased is merely giving what amounts to a discount on the price of the latter. If the furnace in his house burns wood, he breaks up the cabinet and stacks the pieces in his cellar. He then tries to salvage as many parts as possibe from the chassis, and throws the pickings into the junk box under the bench.

Sell the old set over again? Dealers are having enough trouble selling brand new sets at the lowest prices that ever prevailed in the radio business. The reader who xkeeps RADIO-CRAFT on file is referred to page 146 of the September 1932 issue. ("Radio à la Cortlandt Street.")

ROBERT HERTZBERG.

MOBILE P.A. SYSTEM

(Continued from page 102)

pull. These, in turn, are transformer coupled to type 42 pentodes in push-pull in the output circuit. A dual gain control is connected in the control-grid circuit of the 36's, giving extremely smooth, even regulation of volume. A small, but powerful, motor-generator within the unit supplies 300 volts D.C. at 100 milliamperes. This unit is noiseless in operation and hum-free, due to accurate construction and through the use of a well-designed filter system.

The undistorted power output of this amplifier is 7 watts; the current drain is 8.4 amps; the motor draws .5-amp, while each speaker draws approximately .5-amp.

The amplifier may be used to drive from two to six speakers to normal maximum speaker undistorted output, and it has ample voltage amplification to work directly from a double-button carbon microphone without additional pre-stages or booster amplifiers. This amplifier, known as the Acratone model 770, is equipped with a built-in microphone and phonograph matching transformer, which matches any single or double button microphone. Connections are provided for pickups of different impedances, varying all the way from low impedance pickups to pickups of 5,000 ohms impedance. The output of the amplifier is conveniently tapped for connection to a 9-ohm voice coil, a 15-ohm voice coil, a 500-ohm line, or to a 4,,000-ohm magnetic speaker.

Figure 1 shows a schematic wiring diagram of the amplifier. Figure 2 is a complete pictorial wiring diagram showing how to connect a low impedance pickup, a 200-ohm impedance microphone and two loudspeakers. Of course, .the microphones must be disconnected while the pickup is in the circuit, and vice versa. Figure 3 shows the suggested arrangement of the various parts in a motor car. Of course, the physical arrangement of these parts may be varied to suit the individual circumstances. Obviously, these speakers would be placed differently on a truck than a car. In order to obtain satisfactory operation, the car storage battery must be kept fully charged, as it is impossible to obtain full power output if the voltage of the battery drops below 5 volts. The amplifier would still be operative at 4½ volts, but at reduced power output. The gain control of the amplifier should be kept at the lowest level consistent with clear reproduction, except where very large, heavy-duty speakers are used.

Two large clips are supplied with the 770 amplifier, marked with the "positive" and "negative" sign respectively. The amplifier cord and battery clip should be examined before making any connections in order to make sure that the positive side of the amplifier is connected to the positive terminal of the storage battery. The battery should be checked to determine which side is grounded.

In some cases, it may be necessary to change the ground wire, connecting one side of the filament circuit to the amplifier chassis. The base of the chassis is removed and connection is made to the colored wire.

As mentioned previously, a complete mobile sound system, employing the 770 amplifier, is very low in total cost as compared to other systems available for this same purpose. The total cost, including the amplifier, tubes, a microphone, two giant model speakers, baffles or horns, a 6-volt electric phonograph and all the necessary equipment is less than $115.00.

For the average sound equipped motor car, two good dynamic speakers should be ample. These may be installed inside the car with baffles or on the roof with horns, as indicated in the illustration.

ELECTRIC VIOLIN

(Continued from page 85)

The quality of the output, of course, depends upon the quality of the amplifier associated with the "electric violin." However, it might be mentioned that music from this violin has been broadcast through a nation-wide chain of stations of the National Broadcasting Company; both engineers and musicians, alike, have marveled at the tone.

This instrument has several advantages over the more common violin. First, a variable tone and volume control permits control of timbre and volume that will fill large auditoriums under optimum conditions; second, it is claimed that this electric violin is capable of producing the pure tones nearly over the entire audio-frequency range of the instrument, something the usual violin is incapable of doing—even including the old masters.

This device will soon be available on the market in the form of cellos, violins, guitars, ukuleles, and other stringed instruments, for the fundamental principle of operation is the same for all.

THE 19

The 19, like the types 53 and 79, combines in one bulb two triodes designed for class B operation. It is intended for use in battery-operated receivers (in the output stage) and is capable of supplying approximately two watts of audio power. The ratings and characteristics of this tube follow:

Filament Voltage (D.C.)....................2.0 Volts
Filament Current....................0.26 Ampere
Maximum Overall Length....................4¼"
Maximum Diameter....................1 3/16"
Bulb....................ST-12
Base (For connections, refer to Note 1)....................Small 6-Pin

Class "B" Power Amplifier

Plate Voltage....................135 max. Volts
Dynamic Peak Plate Current (per plate)....................50 Max. Milliamperes

Typical Operation:

Filament Voltage	2.0	2.0	2.0	Volts
Plate Voltage	135	135	135	Volts
Grid Voltage	—6	—3	0	Volts
Static Plate Current	1	4	10	Ma.
Load Resistance (P. to P.)	10000	10000	10000	Ohms approx.
Average Power Input*	95	130	170	Mw.
Nominal Power Output	1.6	1.9	2.1	Watts

*Applied between grids to give indicated values of power output.

Note 1: Pin 1-Grid (Triode T_2)
Pin 2-Plate (Triode T_2)
Pin 3-Filament
Pin 4-Filament
Pin 5-Plate (Triode T_1)
Pin 6-Grid (Triode T_1)

Pin numbers are according to RMA Standards.

*Courtesy RCA. Radiotron and E. T. Cunningham, Inc.

CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted at the cost of ten cents per word for each insertion—name, initials and address each count as one word. Cash should accompany all classified advertisements unless placed by a recognized advertising agency. No less than ten words are accepted. Advertising for the September 1933 issue should be received not later than July 9th.

FOR SALE, BARTER AND EXCHANGE

As an aid to our readers, all advertisements to be inserted in this department are accepted at 2c a word; name, address, street number, etc., each counting for one word. No advertisement for less than fifteen (15) words accepted.

The Publishers are not responsible for difficulties arising out of the trades. In this department, only advertisements for private individuals can be accepted.

RADIO-CRAFT reserves the right to reject any advertisement that conflicts with the policy of this magazine. Send all "Swap" advertisements to RADIO-CRAFT, 96-98 Park Place, New York, N. Y.

A HIGH-POWER AMPLIFIER

(*Continued from page 89*)

design, is practically fool-proof, and requires no attention whatsoever even if it is in constant daily use for eight to ten hours. Unless you intend to employ a radio tuner chassis in conjunction with this amplifier system, a filter on this motor generator is not essential.

Matching Circuits

In Fig. A there appears, on the extreme right, an All-Purpose Input Control Box for perfectly matching the impedances of microphone, photograph pickup, and radio tuner chassis output; this control box also permits the input sources either to be controlled individually, or mixed. This device permits the remote placement of the amplifier, out of sight, as all the controls are confined to this input box, necessitating merely one shielded conductor (such as shielded lead-in wire) extending between input posts W1, W2, on the amplifier, and the output terminals on the rear of the control box; the outer metallic shielding of this conductor is connected to W2, which is the ground side of the amplifier, as shown in Fig. 1. The microphone button current supply, generally 3 V., may be mounted within the control box.

If a control box is not employed, the secondary of a microphone or phonograph pickup input matching transformer is connected directly to input terminals W1 and W2, Fig. 1. Where enormous gain, or "pre-amplification" is not essential or desired, the input signal may be fed directly to the W2 and W3 input terminals, thereby utilizing the second stage, as the *input* stage; this gives two stages of A.F. amplification, instead of the three were posts W1 and W2 employed. A 500.000-ohm volume control, R1, is connected across terminals W1 and W2, and the center arm is connected directly to the grid terminal of V1, a type 37 tube.

The output of this pre-amplifier tube is transformer-coupled into two type 37 tubes, V2 and V3, which, in turn, are transformer-coupled into the two type 2A3 output tubes, V4, V5. The plates of these output tubes are connected to terminals W4 and W6, and W5 is, of course, connected to the "B" plus supply. These terminals permit the optional use of output transformers other than T3, which has a primary impedance to match the 6,000 ohm plate-to-plate load impedance of the type 2A3 output tubes; secondary windings of 500 ohms tapped at 200 ohms, and 15 ohms tapped at 8, 4, and 2 ohms are provided on this wide-utility transformer. Tone control C6 is particularly useful in the elimination of microphone feed-back howling. Each stage is separately filtered and bypassed, thereby assuring absolutely stable and hum-free performance. Resistors R8 and R9 improve the frequency response of the amplifier. Figure C is an underside view of the amplifier.

Novel Accessories

To permit universal operation from either a 6 V. storage battery or a 110 V. A.C. source, the dynamic speakers to be employed with this P. A. system must be equipped with *dual fields*, one of which (rated at from 2 to 8 ohms) is used only across a 6 V. storage battery: the other field (generally 1,000 to 3,000 ohms) should be designed for operation in conjunction with a 110 V., A.C. field-coil exciter. An S. P. D. T. toggle switch, Sw.3, should be provided on such dual-field speakers to permit the optional selection of either field and to make their performance absolutely foolproof. This field coil arrangement not only permits direct operation from a 6 V. D.C. supply but also insures perfectly hum-free operation when used in conjunction with a correctly designed 110 V., A. C. operated rectifier system, such as shown in Fig. 1D.

Also of great interest is the "Universal," 6 V. D.C., 110 V. A.C., phonograph motor which is designed to operate directly from a 6 V. storage battery but which can also be operated from 110 V. A.C. with the aid of a specially designed exciter. This phonograph motor is a most useful and valuable contribution to the sound truck industry, and fills a long felt need. Its motor consumes only 2.8 A.

In conclusion, the writer wishes to stress the point that this universal battery and A.C. P. A. system opens up a vast, virgin field wherein great money making possibilities await the ambitious. Advertisers of today are quickly turning to voice amplified outdoor advertising, for, after all, a billboard can only hold the eye that happens to glance in its direction, whereas, the spoken voice (that of a veritable giant, if need be) actually *demands* attention; what is more, a billboard does not "travel," to new and better territory, nor does its message change to accommodate the best interests of merchandising.

List of Parts

One Remington power transformer, type E654, P1;
One Coast-to-Coast 6 V. storage-battery-operated motor-generator, 100 ma. at 320 V.;
One Remington push-pull input transformer type T1E654, T1;
One Remington push-pull interstage transformer type T2 E654, T2;
One Remington type 2A3, 20 W. output transformer, T3;
One Remington filter choke, 100 ohms, 15 hy., 125 ma., Ch1;
One Remington filter choke, 200 ohms, 15 hy., 35 ma., Ch2;
One Remington filter choke, 500 ohms, 15 hy., 25 ma., Ch3;
One Centralab potentiometer, 0-500.000 ohms, R1;
One Lynch metallized resistor, 2.700 ohms, 1 W., R2;
One Lynch metallized resistor, 1.300 ohms, 1 W., R3;
One Lynch metallized resistor, 50.000 ohms, 1 W., R4;
One Lynch metallized resistor, 1.000 ohms, 1 W., R5;
One Lynch metallized resistor, 2.000 ohms, 1 W., R6;
One Coast-to-Coast wire-wound resistor, 0.5-ohm, 3 W., R7;
Two Lynch metallized resistors, 500.000 ohms, 1 W., R8, R9;
Two Lynch metallized resistors, 100.000 ohms, 1 W., R10, R12;
One Lynch metallized resistor, 10.000 ohm, 1 W., R11;
One Lynch wire-wound center-tap resistor, 60 ohm, R13;
One electrolytic condenser, 5 mf., 35 V., C1;
One electrolytic condenser, triple 4mf., 450 V., C2, C3, C6;
One electrolytic condenser, triple 8 mf., 450 V., C4A, C4B, C5;
One Coast-to-Coast multiple-condenser-tapped tone control, C7;
One mica-dielectric fixed condenser, .02-mf., 450 V., C8;
One 6 V. pilot bulb with socket, V8;
Five 5-prong wafer sockets, S1, S2, S3, S8, S9;
Four 4-prong wafer sockets, S4, S5, S6, S7;
One 5-prong plug and cable, P1;
One male plug and line cord, P2;
One 2 A. fuse and fuse mounting, F;
Three type 37 tubes, V1, V2, V3;
Two type 2A3 tubes, V4, V5;
Two type 82 tubes, V6, V7;
One Coast-to-Coast drilled and shrivel-finished chassis and four removable cans.

Accessories

Two Coast-to-Coast 6 V. and 110 V. dual-field dynamic reproducers;
Two Coast-to-Coast 110 V. A.C. exciters (for above speakers);
One Coast-to-Coast 6 V. D.C. 33⅓ and 78 R.P.M. phonograph motor;
One Coast-to-Coast 110 V. A.C. power pack (for phonograph motor).

(It may be well to mention here that recent trends in amplifier design make it imperative that Service Men understand the principle of all of the different classes of amplifier operation. To facilitate this, we wish to call the readers' attention to an article which appeared in the July, 1932, issue of RADIO-CRAFT entitled, "Pentode, Class B or Triode Audio Systems—Which," by McMurdo Silver.—*Editor.*)

BEGINNER'S SET

(Continued from page 91)

this element is connected internally, and therefore does not present to the experimenter any mechanical problems.)

But the characteristic of most interest to us at the moment is the mu or amplification factor of this tube which can be varied from its maximum to almost zero by the simple process of changing the grid bias over a range of from —3 V. to—22.5 V. In our present set this entire variation is not obtainable since the maximum bias obtainable will be the same as that of the power tube, or—13.5 V. But in view of the comparatively limited amplification following the first stage this should be more than sufficient. Variation is obtained by moving the slider along the potentiometer R1; the fixed resistor of 100 ohms is to prevent operating the tube with no bias whatever.

Construction

Not a great deal can be said in regard to construction as the job is identical with the previous model save for a few minor changes, as will be seen by comparing the photograph, Fig. A, with the previous set you built.

It was found necessary to move the antenna coil L1 more to the left to allow space for the tube socket; and to entirely remove the police-band switch to allow enough room to mount the volume control. If it is desired to retain the short-wave feature, it might be well to obtain one of the small, jack-type switches and mount it on a bracket at the rear of the tuning condenser.

The two choke coils, L2 and L3, are mounted in front and to the right of the tube socket, respectively, with their axes at right-angles to the tuning coil, L1, to prevent feed-back.

One very important point; *don't forget to break the connection between the frame of the tuning condenser, C1, and the negative filament lead which existed in the previous circuit;* if you permit this connection to remain there will be no "C" bias on the type 34 tube, which makes volume control impossible. The same battery combination is used as in the preceding design, "An Improved Power Crystal Set."

Operation

Getting the set into operation will be a process exacty similar to the routine followed in the previous receiver, save that, if there is difficulty, you know that it must be located in the R.F. stage as that was the only section in which a change was made.

Testing can be done in the same manner as before by touching the grid of the R.F. tube with your finger; this will result in a click or buzz, although not nearly so loud as that resulting from the grid of the first A.F. *An A.C. line held near this grid will, however, have no effect* as it is an *R.F.* circuit. Snapping the antenna across its post will result in faint clicks and scratches in the speaker if everything is O.K. These tests must, of course, be made with the volume control full on, or at the point giving minimum bias, marked min. in the circuit diagram. And that brings up an important point. The switch and volume control are in one unit and must be so connected that when the switch snaps, the sliding arm is at the end connected to "B—." Standard practice for such units is, that they be so connected that the volume increases when the knob is turned to the right.

Trouble

If the change-over is made from the previous model which has been operating satisfactorily, there should be no trouble; but, if it should refuse to operate, or is noisy, the simplest thing to do is to carefully check over every connection and make sure that it is exactly as shown in the diagram. One point, making for easier adjustments, is that with the added stage of R.F., the crystal detector is not at all critical; but a signal will come through no matter where the contact point is placed; but, of course, greater signal strength will be obtained and more distant stations brought in, just as before, by finding the most sensitive spot.

And now, as a final word, let us know how you like articles of this kind, what kind of results you are getting, and what you want in the future. Are we giving you the type of circuit in which you are interested? Are the articles too technical or not technical enough? Do you want more theory or less; would you like to

(Continued on page 121)

TEST KIT

(Continued from page 84)

constructed the tester, you will find that R2 is not critical in its setting; but there is an optimum point for each tube. Choose a voltage for a good tube (below its rated voltage) so that oscillation starts about the center of the green band, which best fits the characteristics of the tube as determined by a check against Mr. Prensky's chart. Using the same voltage, try a weak tube next, and see that it shows up as weak on some one of the yellow bands (this determines the proper band). Next insert the bad tube and note whether or not it checks in the red. In this way a great many tubes may be classified and logged. Be sure to take note of the setting of R2 and whether or not Sw.5 is on "high" or low." This notation, suitably printed on a card, may be glued to the lower portion of the carrying case, directly under R2, if so desired.

The Case

The entire instrument is 14 ins. long, 6 ins. wide and 10 1/16 ins. high. The lower portion is removable and serves as a tool box housing the various test cords and plugs necessary for the complete utilization of the instrument. The panels are 3/16 in. x 7 ins. x 14 ins., of bakelite, and are mounted at a slope as shown in Fig. 2C. The upper and lower portions of the instrument are secured together by means of latches obtainable at any hardware store. An old leather belt was used to make the carrying strap. No panel drilling dimensions are given because it is thought that sufficient information may be obtained from the photographic views to enable anyone to duplicate the layout of parts.

List of Parts

One transformer from an old type Jefferson tube checker as connected gives 2.0 V., 4.5 V., and 180 V., FT;
One harmonic audio transformer, AT;
One variable resistor with knob, R1;
Two 6-ohm rheostats complete with dials (one converted to form tap switch) Sw.T, R2;
One 1,000-ohm potentiometer, R3;
One 100-ohm potentiometer with knob, R4;
One 1 ohm; one 10 ohm; one 100 ohm; one 1,000 ohm; one 10,000 ohm; one .1-meg.; one 1-meg. resistor for Sw.T;
One 1,000 ohm; one 10,000 ohm; one 50,000 ohm multipliers for Sw.6;
One D.P.D.T. on-off switch, Sw.1;
Three S.P.D.T. push switches, Sw.3, Sw.4, Sw.5;
One Bud 4-prong socket, V1;
One Bud 5-prong socket, V2;
One Bud 6-prong socket, V3;
One 7-prong socket, V4;
Four Aerovox condensers, .00025, .01-, .1-, 1-mf., respectively, C, C1, C2, and C3;
One Weston 0-10 milliammeter, with 100 ma. shunt;
Eight binding posts, B1, B2, B3, B4, B5, B6, B7, B8;
One knob for R3, per Fig. 2B;
Four phone tip jacks, Ph. 1 and Ph. 2;
Thirteen switch points;
One flush receptacle for 110 V. A.C.;
Three switch arms and knobs for Sw.6, Sw.7, and Sw.8;
Two bakelite panels 3/16 in. x 7 ins. x 14 ins.;
Miscellaneous resistors, wire, leather belt (for handle), hardware, etc., as called for in text.

Accessories

One pair of head-phones;
One Na-ald 6-prong plug No. 906LH and adapters No. 965DS, 6 to 5 and No. 964DS, 6 to 4;
One 7½ volt "C" battery;
One pair test leads;
Additional adapters as required.

NOTICE

Readers who want information on auto-radio receivers are requested to read the June issue. Back copies are available from the office at 25 cents each.

LOOP RECEIVER

(Continued from page 74)

The Loop Antenna

Make a jig as shown at A in Fig. 3. It is described as a set of six blocks of wood, under-cut to the depth of a single turn of wire, and securely fastened at the four corners and two sides of a flat board covered with a layer of thin paper. The first turn of wire should be a rectangle measuring 5½x10½ in.; the total number of turns is 25, and the width of the total winding will be about ⅝ in. Use No. 24 D.C.C. or S.C.C. wire and as each turn is wound it should be held to the paper at 18 places (along the sides of the four blocks and at the six mid-way points) by means of a cellulose cement obtainable at the "five and dime" store. The winding procedure is illustrated at C in Fig. 3. When the loop has been completed and thoroughly dried for an hour under the evenly-applied pressure of a few heavy books, the paper should be very carefully pulled from the wire rectangle. The loop should then be celluloid-cemented (at the 18 places) into the lid of the carrying case, after the receptacle has been mounted.

This receptacle and the plug-adapter arrangement permits the loop to rotate through 360°. The plug is a composite device made by fitting the stem of a headphone plug into the male section of a power plug, as shown in detail at B in Fig. 3. To counteract the tendency of this plug unit to pull out of the receptacle, there is provided a little L-shaped piece of brass which bites into one side of the plug unit, filed to fit. This clamp is designed for easy removal; thus, the plug may be removed in a few seconds and plugged into the female receptacle screwed to the back, upper-right-hand corner of the cabinet for convenience in carrying.

General Data—Operation

Drill about 50, ⅛-in. holes in the rear of the carrying case and within a 4-in. circle as a sound outlet for the reproducer. Remove from the reproducer a thin slice of the 5-in. cardboard ring, cover it with grille cloth, and cement to the outside of the carrying case lid. A condenser is not required in shunt to the reproducer, since the acoustic characteristic of the cabinet counteracts the accentuation of the higher frequencies.

Insert an L-bracket in each corner of the cabinet to strengthen it. Also use L-brackets to mount the two tip-jack terminal strips.

The set chassis is held solidly in position inside the cabinet by means of two bolts. These screw into nuts which have been soldered to the two top angle brackets; place washers between the chassis and the case to keep them parallel.

If the "B" batteries are turned so that the connections are against the bottom edge of the carrying case, a smooth surface will be presented to the components on the underside of the set chassis, and it will not be necessary to put a cover-plate over these units.

As the first step in testing the set, connect long leads to the three power leads and the loop lead from the chassis, and terminate these leads in tip-jacks. Plug the "A" tip jacks into the terminal strip connections marked "A," turn the set on, and note whether the three cathodes become incandescent in a short time. Then, remove the "A" plus tip-jack, and merely touch the "B" plus tip-jack to the "B" plus terminal; if the cathodes have cooled sufficiently there should be no noise from the reproducer when the "B" connection is thus made. Finally, leaving the latter connection, plug the "A" tip-jack back into its terminal connection, plug the loop lead in place and plug the loop into its stocket. Solder the two loop leads to the receptacle in the lid.

Now turn the set on. Connect a short antenna to the loop lead which connects to the control-grid of V1; the short antenna acts as a "driver" during the initial adjustments. If local stations *cannot* be heard with sufficient volume to overload the magnetic reproducer, carefully check every possibility of faulty equipment or construction. (If received, the signals will tune broadly, since the circuit is not designed to be selective with an antenna connected to it, and since the loop has not yet been aligned to the second inductance, L2.)

If reception is satisfactory under these conditions, we are ready to check the efficiency of the loop plug assembly; excessive insulation leakage at this point will cause havoc to weak signals. Reduce the signal input to the loop by using an adjustable condenser in series with the short antenna until high-power stations are heard at low volume when completely tuned in. Then, unsolder the outside-turn connection (grid lead) of the loop to the female receptacle and solder it to a lead and test prod; connect the other end of this lead to the tip-jack which connects to the control-grid cap of V1. Now, touch the outside-turn lead of the loop to its terminal on the female receptacle; a considerable reduction in volume denotes excessive leakage in the plug system. A slight amount of leakage is permitted in order to make ganging more convenient, since this shunt resistance will produce the effect of a series resistance of lower value in the resonant circuit, thus making the tuning in this circuit slightly broader.

To determine the correct number of turns to be used in the loop, remove the short antenna and lightly prod through the loop wire insulation with a needle-point prod connected to the control-grid of V1 (the control-grid loop lead having been removed from the female receptacle). Find the turn which results in greatest signal strength from a weak station, cut the loop wire at this point, and remove the unused wire; during this operation, "rock" the tuning condenser roter to either side of the position of maximum volume to secure resonance at all times; the trimmers should be in a midway position.

The final step is to align the R.F. circuits. Adjust the trimmer condensers, C1A and C2A, for maximum signal strength. Holes in the top plate are provided for these adjustments. Be *sure* that all of the tubes are in good condition.

List of Parts

Chassis

One Try-Mo two gang condenser, 350 mmf. per section, with trimmers, ⅜-in. shaft (1⅞ x 3⅛ x 2½ in. deep, without shaft length), C1, C2;

Four midget paper-dielectric condensers, 0.1-mf., 400 V., D.C., C3, C4, C6, C7;

One Tobe Deutschmann tubular electrolytic condenser, 2 mf., 500 V., D.C., type T-512, C5;

One type midget, paper-dielectric condenser, 250 mmf., 400 V., C8;

One type Midget, paper-dielectric condenser, 500 mmf., 500 V., C9;

One Tobe Deutschmann tubular electrolytic condenser, 1 mf., 500 V., D.C., type T-511, C10;

One dry electrolytic condenser, size 1¼x2¼ (excluding lugs) x11/16-in. thick, 25 mf., 25 V., D.C., C11;

One Centralab volume control potentiometer (minimum diameter, 1½ ins.), .1-meg., R1;

One metallized resistor, 1,500 ohms, 0.5-W., R2;

Two metallized resistors, 50,000 ohms, 0.5-W., R3, R4;

One metallized resistor, 2 megs., 0.5-W., R5;

One metallized resistor, 25,000 ohms, 0.5-W., R6;

One Lynch metallized resistor, 500 ohms, 2 W., R7;

One high-gain R.F. transformer, L2;

One Radio Trading Co. unshielded R.F. choke, 250 mhy., R.F.C.;

One Radio Trading Co. A.F. replacement transformer, ratio 1:5, T;

One 5 in. magnetic reproducer;

Two Try-Mo midget knobs (R1 and C1, C2 controls), 7/16x1⅛-ins. in dia.;

One off-on switch, with escutcheon, Sw.;

One type 77 tube, V1;

One type 6F7 tube, V2;

One type 89 tube, V3;

One Try-Mo tube shield (for V1);

Two Try-Mo 6-prong wafer sockets (for V1, V3);

One Try-Mo 7-prong wafer socket (for V2);

Three control-grid-cap connectors (for V1 to V3);

Four Radio Trading Co. solder-type phone tips (for power leads and loop lead);

One sheet of aluminum, 7x12x1/16-in. thick;

Two ½x¾x½-in. double-L angle brackets (sub-panel rear feet);
One ¾x1-in. angle bracket (speaker-to-C1-C2 mounting);
Four 2x2 angle brackets (top-panel mountings);
One ⅞x3½ in. angle bracket (transformer T mounting);
One ½x3½ in. angle bracket (speaker-to-chassis mounting);
Miscellaneous screws, nuts and washers, and push-back and stranded wire.
Two midget escutcheons, one marked "Tuning," and the other, "Volume;" Carrying Case.
One Powertone carrying case, leatherette covered, 8⅝x12¼x5 ins. deep (inside dimensions);
One Radio Trading Co. speaker-grille cloth;
Four No. 6 dry cells, "A";
Four 45 V. batteries, 4⅝x2¼x3⅜ ins. high (exclusive of clips), "B";
One web strap, with friction-type buckle (battery retainer);
Four tip-jacks (mounted on two bakelite panels, 2x⅝x1/16-in. thick);
One ¼-lb. spool No. 24 D.S.C. or S.S.C. wire, for L1;
One Radio Trading Co. flush-mounting female receptacle (for loop plug);
One Radio Trading Co. headphone plug (for composite loop plug-adapter);
One male line plug (for composite loop plug adapter);
One Radio Trading Co. female base-mounting receptacle (for holding loop plug when not in use);
One Try-Mo single-circuit jack, J;
Four angle brackets, ½x½-in. (cabinet reinforcing);
Four angle brackets, ½x¾-in. (tip-jack panel mountings);
Miscellaneous screws, nuts and washers.

BEGINNER'S SET

(Continued from page 116)

know "what makes the wheels go 'round," or would you prefer simply mechanical layouts of specific sets, with point-to-point building instructions? In short, tell us what you want and you'll get it—that's what we are here for.

List of Parts

One two-circuit tuner (for 350 mmf. tuning condenser), L1;
Two 85 mh. R.F. choke coils, R.F.C.1, R.F.C.2;
One 350 mmf. tuning condenser, C1;
One mica-dielectric fixed condenser, 250 mmf., C2;
One mica-dielectric fixed condenser, .01-mf., C3;
One paper-dielectric fixed condenser (two .1-mf. units in one case), 250 V., C4;
Two paper-dielectric fixed condensers, .25-mf., 250 V., C5, C6;
One dry electrolytic condenser, 20 mf., 25 V., C7;
One paper-dielectric fixed condenser, 4 mf., 250 V., C8;
One mica-dielectric fixed condenser, 500 mmf., C9;
One 500 ohm potentiometer, with switch, Sw., attached, R1;
One 100 ohm, 1 W. fixed resistor, R2;
One 70,000 ohm, ½-W. fixed resistor, R3;
Two 1 meg., ½-W. fixed resistors, R4, R6;
One 0.2-meg., ½-W. fixed resistor, R5;
One 5,000 ohm, 1-W. fixed resistor, R7;
One Amperite, type 3H-1, R8;
One crystal detector (adjustable as to catwhisker position and pressure), D;
One type 34, 2 V. variable-mu R.F. pentode tube, V1;
One type 32, 2 V. screen-grid tube, V2;
One type 33, 2 V. output pentode, V3;
One 5-prong socket, base mounting type, for V1;
Two 4-prong sockets, base mounting type, for V2, V3;
One single, closed-circuit jack, J1;
One open-circuit jack, J2;
One full-vision dial and pointer, for C1;
Two connection clips for antenna and ground;
One roll push-back hook-up wire;
One baseboard (a breadboard), 10x14x¾ in. thick;
One type No. 6, 2 V. storage cell.
Three 45 V. "B" batteries.

Radio-Craft FREE BOOKLET SERVICE

READERS' BUREAU

On this page are listed manufacturers' catalogs and booklets, chosen because they are of interest to readers of RADIO-CRAFT. You can obtain copies FREE by using the coupon below.

5. CLAROSTAT CONTROL HANDBOOK. A large 32-page book containing detailed specifications of volume controls, attenuators, constant-impedance controls, phonograph pickup faders, tone controls, line ballasts, rheostats, potentiometers and fixed resistors of various kinds, together with valuable circuit-design data. Contains many diagrams and charts, and a guide of replacement volume and tone controls for many commercial receivers. *Clarostat Manufacturing Company, Inc.*

6. MEASURING RESISTANCE BY THE DEFLECTION METHOD. The conventional method for the measurement of resistance involves the use of the Wheatstone bridge, a costly piece of apparatus. However. there are other methods which provide a fair degree of accuracy, enough for all practical purposes. The least expensive is the deflection method, which makes use of popularly priced milliammeters and fixed resistors. This bulletin describes the method completely, and should be very useful to Service Men and experimenters with limited meter equipment. *Shallcross Manufacturing Company.*

11. SUPREME INSTRUMENTS. Contains lengthy descriptions of the Supreme service instruments, including the AAA1 Diagnometer, which is five instruments in one, the model 90 analyzer, the model 40 tube tester and the models 60 and 70 oscillators. Interesting to the Service Man because it tells how his work is facilitated by ingeniously-designed test equipment that indicates the condition of an entire set in a few minutes. New test apparatus to take care of the new tubes is also described. *Supreme Instrument Corporation.*

19. A BAPTISM OF FIRE. Centralab fixed resistors are made by forcing a carefully calibrated resistance material through a plastic ceramic material, and then baking both under terrific heat. This booklet describes the manufacturing process in detail, and lists the advantages claimed for fixed resistors of this type. It is interestingly written and illustrated, and makes good reading. *Central Radio Laboratories, Inc.*

21. READRITE RADIO INSTRUMENTS. This sixteen-page pamphlet contains some valuable hints on the testing of electrolytic condensers, as well as descriptions of the full line of popular-priced Readrite instruments. Worth having. *Readrite Meter Works.*

76. THE COAST-TO-COAST "BROADCAST." The "Broadcast" is the Spring-Summer 1933 edition of a 100-page mail order catalog that is a veritable encyclopedia. Its listings are very varied, and run from soldering lugs to complete 100-watt public address amplifiers. Every article is well illustrated and described for the benefit of radio dealers and Service Men, for whom the volume is specifically intended. *Coast-to-Coast Radio Corporation.*

94. ELECTRAD PRODUCTS. The newest and latest catalog of Electrad products contains twelve pages and lists many types of fixed and variable resistors and five different kinds of amplifiers for public address purposes. The popular Truvolt resistors have been improved by the addition of insulating shields and heat radiating covers, and a number of new sizes have been added to the line. The catalog also contains some valuable data on the application of resistors to radio receivers, transmitters, amplifiers and sound systems, and suggestions on how to compute the value of resistors. A handy and useful catalog. *Electrad, Inc.*

96. TOBE FILTERIZER AND CONDENSERS. The Tobe Deutschmann company is now catering to the Service Man with an extensive line of filter, by-pass and line condensers and radio noise eliminators. Their latest catalog, describing the complete line, has just come off the press. A full page is given to the new "Filterizer" noise eliminating antenna system, an item of particular interest to Service Men because of the money-making opportunities it offers. *Tobe Deutschmann Corporation.*

97. ARCO TUBE BULLETIN. A descriptive folder giving full technical characteristics on the complete line of Arco radio receiving and transmitting tubes, photo-electric cells, television lamps, hot and cold cathode tubes, cathode ray tubes, rectifiers and charger bulbs. This can be posted for easy reference. *Arco Tube Company.*

98. HOW TO USE NOISE REDUCING ANTENNA SYSTEM ON BROADCAST WAVES AND SHORT WAVES is the title of the latest booklet on this important subject. In addition to covering the theory, the *practical application* of the various noise-reducing systems available for broadcast and short wave use, is described also. *Lynch Mfg. Co.*

102. AMERICA'S OLDEST RADIO SCHOOL. This attractive 16-page catalog describes the various course of instruction available at the RCA Institutes, New York. Training is given in the following subjects: radio broadcasting, radio operating, radio servicing, and sound and public address work. *RCA Institutes, Inc.*

103. MILES PUBLIC ADDRESS SYSTEMS. A concise 8-page catalog listing microphones, loud speakers, power units, amplifiers, transformers and incidental accessories. *Miles Reproducer Co., Inc.*

104. WESTON STANDARDIZED SERVICE UNITS. This folder describes a complete series of standardized service units, consisting of an analyzer, tube checker, oscillator, volt-ohmmeter and capacity meter. The units are of uniform size and may be combined in single cases of various sizes, depending on the requirements of the Service Man. *Weston Electrical Instrument Corp.*

RADIO-CRAFT 5-104
Readers Bureau
96-98 Park Place, New York, N. Y.

Please send me *free of charge* the following booklets indicated by numbers in the published list above:

No. ....

....

Name ....

Address ....

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

(Please check the following)
I am
(1) ☐ Service Man (2) ☐ Experimenter
(3) ☐ Dealer (4) ☐ Jobber
(5) ☐ Radio Engineer
(6) ☐ Licensed Amateur
(7) ☐ Professional or Amateur Set Builder

This coupon will not be honored unless you check off your classification above.

"Operating Conditions for Successful Demonstration of Radio Reproduction"

The size and construction of the room, the furnishings of the room and the number of persons present in the room affect the quality of reproduction of any radio receiver. The selection of the type of program material for demonstrating various operating capabilities of the receiver also is of great importance.

1—Effect of a Bare Room on Tone Quality:

If the store demonstration room is bare of home furnishings, so as to present hard floors, walls and ceilings, there will be an excessive amount of sound reflection, resulting in a "hollow" or "live" effect which will interfere with clear, natural reproduction.

2—Beneficial Effects of Home Furnishings on Tone Quality:

For best results, the demonstration room should be about the size and have furnishings similar to that of a "home" room in which the receiver is ultimately to be used. A heavy rug, window drapes, a davenport and one or more upholstered chairs with soft cushions will give average "home" acoustics and a "comfortable" listening condition.

3—Effect of Audience on Tone Quality:

The size of the listening audience also affects the quality of reproduction, the larger the audience the greater the absorption of high pitched (treble) tones and the "duller" the reproduction. Thus, for a small room demonstration, only a few people should be present in order that "home" acoustic conditions will be provided.

4—Effect of Receiver Location on Tone Quality:

The most favorable location for a console type radio receiver for best reproduction is diagonally across one corner of the room. There are three reasons for this location as follows:

(a) Reinforces the bass tones, as the two sides of the room act as extensions to the sides of the radio cabinet and thus add to the baffling system of the loud speaker.

(b) Provides for greater intensity of sound in the room as the angle of sound radiation is only one-half (90 degrees) of that resulting when the radio cabinet is located against a side wall (180 degrees of radiation.)

(c) Absence of "booming" tones due to large opening (venting) at rear and top of cabinet.

When a radio cabinet must be located flat against a side wall, it should be placed at least 4 inches from the wall to avoid "booming" tones.

5—Effect of Location of Listener on Tone Quality:

The location of the listener, with respect to the radio receiver is important, if the full reproducing capabilities are to be determined. Due to the fact that treble (high pitched) tones are more directional than bass tones, it is necessary that the listener be directly in front of the cabinet, seated and between 6 to 12 feet away, otherwise the actual balance of low and high tones possible under best conditions of reproduction for a particular receiver will not be known. In actual home use, these directional treble tones are reflected from walls, ceilings and other hard surfaces in the room, so as to reach the listener's ears along with the bass tones, regardless of the location of the listener with respect to the receiver.

The best location of the loud speaker in the radio cabinet is below the radio chassis, so that the center of the "beam" effect of the high pitched tones will be focused below the listener's ears at all times.

6—Correct Volume of Reproduction for Best Tone Quality:

It is a safe rule that reproduced sounds, whether speech or music, should never be louder than the original sounds picked up by the broadcast station microphone. For example, the reproducing of a speaker's voice at higher sound levels (volumes) than the sound level at the microphone will give a "giant" voice which is not natural. However, if the person before the microphone is talking loudly or is shouting, then a loud reproduction of this voice by the receiver will be natural. Also, if we should reproduce a musical instrument, such as a violin, at higher levels (volumes) than a violin can play, this loud reproduction will not sound like a violin or any other instrument now in use. Thus, for demonstrating the high volume possibilities of a

• Index to Advertisers •

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

receiver, use dance orchestras, bands and other program material that is being played at high volumes before the microphone.

7—Type of Program for Demonstrating Bass Response:

When demonstrating bass response particularly at low volumes (low sound levels), it is best to select a dance orchestra playing selections in which the *bass tones are continuously reoccurring.* Then, as the volume control is turned down, the amount of bass response can be easily judged as compared to higher pitched tones.

When listening to lower sound levels, the listener should be at the same distance from the radio set as would be the case in a home when listening under low volume conditions. At very low volumes, the listener should be fairly close to the receiver.

In receivers having "constant fidelity," or means for reinforcing of the bass and treble tones as the volume control is turned down, a natural balance of all tones are reproduced, whereas receivers not having this operating feature, the bass tones (complete bass instruments in some cases) will entirely drop out of the reproduction at the lower volume levels.

WHY STROMBERG-CARLSON STICKS TO CLASS A

It has long been recognized in the sound system industry that the only type of audio amplifying system that can be considered distortionless is known as class A. Other reproducing systems, such as class B and pentode types, inherently have a kind of distortion which can be heard in the reproduction of speech and certain kinds of music, producing harshness, raspiness or "sour notes." Sometimes these distortions are smothered by cutting down the treble response, as most of this noticeable discord is in the region of the high pitched tones. This drastic treatment, however, makes the reproduction dull, lifeless and tiring to the listeners.

Up to the present time, the main reason for using output systems other than class A, was that higher powers were possible in the customary design of radio receiver. Now, this limitation has been removed from the class A system by Stromberg-Carlson engineers who have had designed for them a new Super Triode, multifilamentary cathode type of tube, which combined with new design of class A audio circuit apparatus and a new loudspeaker of high power capabilities, gives an undistorted audio output of six times the power of the class A systems employed in previous Stromberg-Carlson receivers.

The real reason for this great increase in undistorted power output is to provide ample reserve power to allow for many improvements in audio quality, including: Higher undistorted volumes to allow for truthful reproduction to the loud passages in music, without the usual noticeable restraint. Also, percussion sounds, such as drum beats and the like come through with lifelike feeling. Another use for this reserve power is the electrical equalizing of the useful audio-frequency range of the radio set, so as to give bass and treble tones their correct prominence at all volume levels. These audio improvements apply also to the reproduction of phonograph records, bringing out tone qualities that have heretofore been hidden in the recordings.

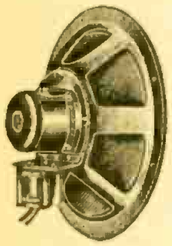
This revolutionary advance in radio set sound reproduction is available in four new console type Stromberg-Carlson receivers, known as Models 48, 49, 50 and 51. The No. 51 model is an automatic phonograph combination which handles automatically standard 10 inch and 12 inch records either size or mixed, or the long playing ($33\frac{1}{3}$ r. p. m.) 10 inch records automatically, or long playing 12 inch records singly.

See the September issue of Radio-Craft for additional details of direct-coupled amplifiers.

SURPLUS RADIO PRODUCTS

ORDER DIRECT FROM THIS ADVERTISEMENT — WE DO NOT ISSUE ANY CATALOG

We have on hand



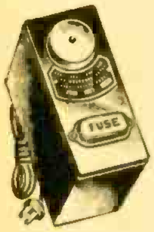
779 UTAH DYNAMIC SPEAKERS

(10" Diameter)

SPECIFICATIONS: Field 1,750 ohms; for single '47 tube; equipped with hum-bucking coils and bakelite connection strips.

PRICE as long as supply lasts $2.29 Each

Sale of 337 King-Silvertone POWER PACKS



A replacement unit for the popular King and Silvertone sets. Consists of Power Transformer and Choke for Silvertone 1928 and 1929 Models, and for King Models H and J. Measure 6½ x 5½ x 2¾". Wt., 5 lbs. Supplies 4—226, 1—227, 2—71A and 1—280. Specifications: 1½ V. at 4½ amps.; 2½ V. at 1¾ amps.; 5 V. at ½ amp.; 5 V. at 2 amps.; 600 V. C.T. at 60 mils.

PRICE as long as supply lasts $1.73 Each

REMIT BY CHECK OR MONEY ORDER FOR FULL AMOUNT OF EACH ITEM—SHIPPED EXPRESS COLLECT, NO C. O. D. ORDER ACCEPTED—MONEY REFUNDED IF NOT SATISFIED.

Wellworth Trading Company RC-833
148 East Superior St., Chicago, Ill.

Enclosed you will find my remittance of $............ for which please send me:

( ) Utah 10" Dynamic Speaker, $2.29 each
( ) King-Silvertone Power Pack, $1.73 each

Name ....

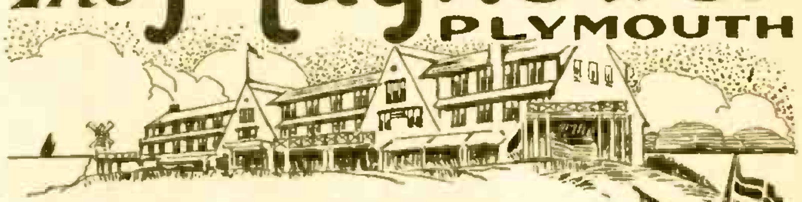
Address ....

City .... State ....

Hotel Directory of the Radio Trade

The Hotels on this page are patronized by the Radio Trade. Make them your headquarters.

The Mayflower PLYMOUTH



On the Ocean at Manomet Point
One of New England's Finest Resort Hotels

Surprisingly Inexpensive

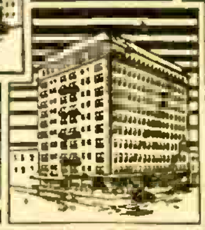
Special Vacation Tour 9-days $60.00 up including transportation, Hotel accommodations, sight seeing, etc.
Smooth Sandy Beach . . . Surf Bathing . . .
Warm Sea Water . . . Swimming Pool . . .
Tennis Courts . . . Golf Course . . . On Hotel Grounds

UNDER SAME MANAGEMENT
MAYFLOWER HOTEL
HYANNIS
CAPE COD'S NEWEST HOTEL
CHARLES A. DOOLEY, MGR.

CAPE COD in MASSACHUSETTS

In ST. LOUIS

THE AMERICAN HOTEL
275 ROOMS WITH BATH
$2.00 up



THE ANNEX
226 ROOMS WITH BATH
$1.50 Up

The AMERICAN HOTEL
MARKET AT SEVENTH

The AMERICAN ANNEX
MARKET AT SIXTH

Our Food has made our Reputation
COFFEE SHOP OPEN UNTIL MIDNIGHT

The Hotel Royal

The HOMELIKE Hotel of Philadelphia

at Broad St. & Girard Ave.
Philadelphia, Pa.

Combines every convenience and home comfort and—commends itself to people of refinement.

WITHIN 5 MINUTES OF CITY HALL

Rates as low as

$1.50	$2.00	$2.50—	Single
2.50	3.00	& up—	Double

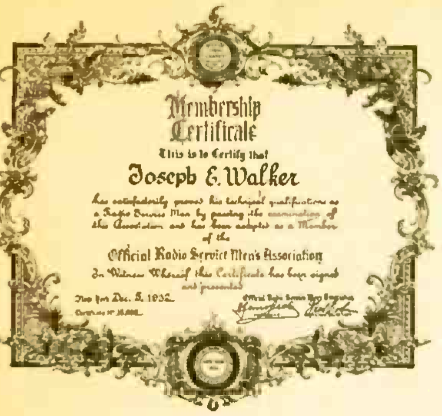
We make it our business to please

Ask for Mr. Smith, Mgr.

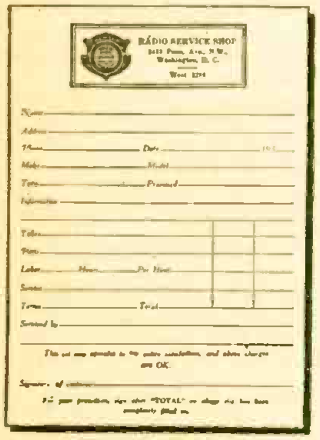
LEARN *Electric* REFRIGERATION SERVICING

Get a copy of the OFFICIAL REFRIGERATION SERVICE MANUAL today. Complete details about this Manual will be found on page 120 of this issue.

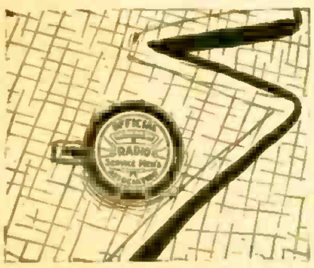
Service Men's Essentials for All Members of the ORSMA



No. 14—50c each
(Plus 10c for Postage)



No. 3—60c per pad of 50
$3.00 per ten pads, each of 50



No. 5—50c each

SERVICE MEN'S ESSENTIALS

THE OFFICIAL RADIO SERVICE MEN'S ASSOCIATION has made arrangements to supply a number of "Service Men's essentials" for the use of its members and associate members. Only members and associate members can buy these items; they are not sold to others.

These essentials are priced at cost, plus a small additional fee which is the only source of income that the Association has. No one obtains any profit or benefit, except the Association itself. Whatever profit accrues, is reinvested for the furtherance and enlargement of the Association.

By using the letterheads, billheads, etc., you present the business-like appearance to your customers, so essential to successful servicing. In addition, the Association has made arrangements with most of the prominent manufacturers to allow special discounts to members, providing ORSMA letterheads are used when ordering.

No. 1 ORSMA LETTERHEADS

These letterheads, shown on the right, are furnished with your name, address and telephone number, printed on excellent paper. They are sold in lots of 100 or multiples thereof, with a distinct saving for single orders of 1,000 or more. You would have to pay many times more if you ordered small lots from your local printer. Per 100, 60c; per 1000, $3.00.

No. 2 ORSMA ENVELOPES

These are furnished to match the letterheads, printed with your name and address and seal of the Association. They go hand-in-hand with the letterheads and are usually ordered in the same quantity. Per 100, 60c; per 1000, $3.00.

No. 3 ORSMA SERVICE RECORD CARDS

They serve a double purpose; whenever you complete a job you fill out the report-bill and hand it to the customer; this is the "psychological moment" to collect. By the use of carbon paper a permanent record is kept which is a valuable asset to your business. They are furnished with your name, address and telephone number. Per pad of 50, 60c; per 10 pads, each of 50, $3.00.

No. 4 ORSMA INSPECTION LABELS

The label is to be filled in with the proper dates, and pasted inside the set or cabinet where the customer will see it. It is a continuous reminder to him that, when service is needed, he can call you again. The advantage is apparent. Per 100, 50c; per 1000, $3.00.

No. 5 ORSMA LAPEL BUTTON

At the suggestion of many members a handsome lapel button bearing the name and emblem of the Association has been designed. It signifies to your fellow members that you belong to the same Association;—and in addition it gives your customers a better appreciation of the professional nature of your work. 50c each.

No. 6 ORSMA BUSINESS CARDS

These are furnished on a fine grade of paper in two colors with a blotter back. Thus they present an added incentive to your customers to keep them in a prominent place, where they will do the most good. They are printed with your name, address, and telephone and bear the official seal of the Association. Per 100, 75c; per 1000, $4.00.

No. 7 ORSMA EMBOSSED STICKERS

Ideal for use in sealing packages, envelopes, etc., or for use on post cards. They give your letters or cards a professional aspect. They are sold in lots of 100 or more. Per 100, 85c; per 1000, $6.00.

No. 8 ORSMA RUBBER STAMP

A handy addition to any member's equipment. The first line of the stamp bears your name and the second reads — *Member Official Radio Service Men's Ass'n.* This stamp has many uses in the everyday life of a Service Man. 40c each.

Nos. 9 & 10 ORSMA EMBLEM CUTS

These cuts for printing, advertising, etc., are furnished in two styles and sizes. They may be used for newspaper or telephone-book advertisements or for printing of any kind. Large size, 1¼x1¼ in., 75c each; small size, ¾x¾ in., 60c each.

No. 11 ORSMA MEMBERSHIP SIGN

A set of three of these signs, printed on heavy cards, and having holes punched in order to hang in your office or store, and are sold to members and associate members. They are large enough so that they are quite prominent and the two tone effect makes a very attractive appearance. Set of three, 50c.

No. 12 ORSMA ADVERTISING DISPLAY SIGN

A two color sign printed in large letters with your name, address and telephone, with the seal of the Association. This sign is sold in quantities of 25 or more and is ideal for hanging in stores, offices, etc., for advertising purposes. Set of 25 cards, $3.00.

No. 13 RADIO SERVICE MEN'S ASSORTMENT PACKAGE

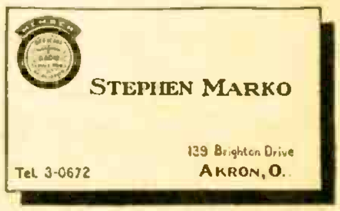
This includes one gold filled lapel button, 100 letterheads, 100 envelopes, 50 service record cards, and 100 labels printed with your name and address as described above. The whole assortment costs only—$3.00—a worth-while saving. Complete, $3.00.

No. 14 ORSMA MEMBER CERTIFICATE

A handsome diploma-like certificate engraved on stiff vellum-bond. The certificate is personally signed by the President and Executive Secretary and the corporation stamp of the Association is impressed on a red seal attached to it. Your name, certificate number and date of registration are lettered by hand and the Certificate is mailed in a cardboard tube to insure safe delivery. Each 50c, plus 10c for postage.

No. 1—60c per 100
$3.00 per 1000

No. 2—60c per 100
$3.00 per 1000



No. 6—75c per 100
$4.00 per 1000

No. 4—50c per 100
$3.00 per 1000

Mail This Coupon Today!

Application for Membership in ORSMA

Executive Secretary, ORSMA
98 Park Place, New York, N. Y.

Kindly send an application blank for

☐ Full Membership
☐ Associate Membership

Name ....

Street or Box ....

City .... State ....

"D"

OFFICIAL RADIO SERVICE MEN'S ASSOCIATION "D"
98RC Park Place, New York, N. Y.

Please send me the following RADIO SERVICE MEN'S ESSENTIALS which I have selected from this advertisement. My remittance for $.......... is enclosed. *Send remittance in form of check or money order. Register letter if it contains cash, currency or unused U. S. Postage Stamps.*

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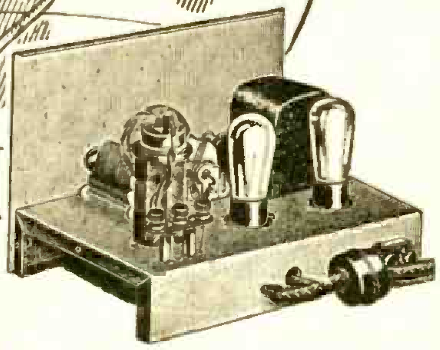
Name .... ORSMA No. ....

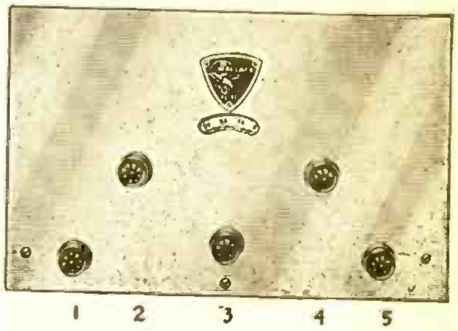
Address .... City and State ....

POWERTONE

WALLACE

Short Wave Receiver





Control No. 1—"On" and "Off" Switch.
Control No. 2—Band Spread Switch.
Control No. 3—Tuning Dial.
Control No. 4—Antenna Tuning Condenser.
Control No. 5—Regeneration Control.

Features That Make This Receiver Outstanding:

- *Designed to tune the aerial circuit to the exact frequency of the sending station.
- *Properly laid out—placement of parts are arranged so that best reception is obtained.
- *Smooth operation—provides smooth vernier tuning over the entire short wave band. 20-200 meters.
- *Provides either band spread or continuous coverage at will.
- *Hammarlund Isolantite sockets—prevents losses.
- *Hammarlund Isolantite insulated regeneration and tuning condensers.
- *Ribbon wound ribbed Bruno Coils.
- *Rigidly mounted on sheet metal base chassis, with metal panel eliminating hand and body capacity.
- *Hammarlund Vernier Tuning Dial.
- *Highest Quality Audio Transformer. Flat response curve.

These features have never before been found in any single receiver.

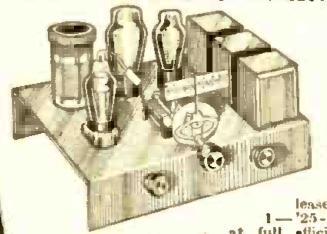
Price of POWERTONE WALLACE complete kit of parts, with blueprint, including a choice of any one of four coils........ **$14.70**
No. 1 Coil, 20-32 meters; No. 2 Coil, 40-60 meters; No. 3 Coil, 75-150 meters; No. 4 Coil, 150-200 meters.

Price of wiring receiver completely tested........ **$3.23**

Price of set of matched Sylvania Tubes (2-230)....... **$1.25**

Price of coils, each........ **$1.18**

POWERTONE UNIVERSAL AC & DC Short Wave Receiver



Described in Radio World, May 13th, 1933.

A brand new number. For the first time you can have a short wave receiver that operates on either AC or DC. Employs all recently released tubes. 1—'78, 1—'43 1—'25-Z5. Tubes operate at full efficiency due to special voltage rectification circuit used. Laboratory tests have resulted in reception from all parts of the globe. Absolutely humless in operation.

Complete kit of parts with blueprint, 4 coils........ **$7.95**
Wired, with 4 coils—$2.00 extra.
Set of R.C.A. licensed tubes........ **$3.25**

ONE of our OUTSTANDING VALUES
Stromberg-Carlson Magnetic Pick-Up Outfit

The original Stromberg-Carlson Pick-up Outfit at this new rock-bottom price. Our price includes Stromberg-Carlson Input Transformer, Stromberg-Carlson Magnetic Pick-Up with built-in volume control, phonograph plug and 20 ft. special insulated extension cord. OUTFIT COMPLETE—NOTHING ELSE TO BUY!
Price........ **$5.50**

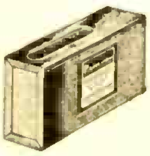
180 Watt Converter

Operates on 110 volts D.C. and has an output of 110 volts, 60 cycle A.C. at 180 watts. Sturdy and efficient, can be used on electrical appliances not drawing more than 180 watts in power. Completely protective construction thus prevents any injuries from shock, due to unprotected mechanism. Dimensions—6½ inches by 7½ inches by 10½ inches.
Price........ **$17.95**

BRUNO Condenser Microphone Head Kit

Frequency Range 30 to 7500 Cycles. Complete kit of parts to assemble a condenser microphone head. Same type of microphone used in broadcasting studios, public address systems, and by amateurs. Kit includes a detailed diagram for accurate assembling. All parts fully machined including back plate. Has diaphragm adjustment
Price........ **$3.00**

MAJESTIC Replacement Condenser Blocks Model 70 Series



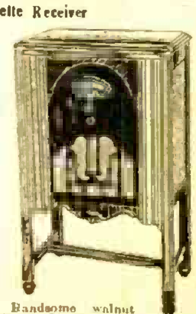
Every block is an exact reproduction of the original Majestic part. We guarantee that this block is equal to or better than the original Majestic Specifications. This is our pledge that these blocks will stand up. All brand new. Shipping wt., 5 lbs.
Price........ **$0.95**

R. C. A. VICTOR Hand Mike

Used with Victor R.E.-57 and R.C.A. 86 Home Recording Combinations.

A single button microphone fine for home recording and amateur broadcasting. 100 ohm button. Operates from a 1¼ v. dry cell and draws 10 mils. Gun metal finished equipped with 5 ft. cord.
Price........ **$1.25**

TEMPLE Bell
6-Tube Consolette Receiver



The Greatest Radio Value of the Year

A full sized consolette receiver at the price of an A.C.—D. C. midget. Produces remarkable tone quality with ample sensitivity for all requirements. Employs a highly developed T. R. F. Circuit using latest type tubes — 2—'58, 1—'57 1—'56, 1—2A5 and 1—'80. Delivers 6 watts of undistorted output. Handsome walnut two-toned cabinet—exquisitely moulded. Measures 35¼" high, 21" wide and 10¼" deep. Only the finest quality parts are used throughout the entire construction. A matched electro dynamic speaker mounted on a special built-in baffle handles the full output with realistic tone.
Price.....$12.95
Complete set of R. C. A. licensed tubes..... $1.95
Cabinet only...... 3.95

All offers are F. O. B. New York, and subject to prior sale. Terms: A deposit of 20% is required with every order. Balance may be paid on delivery. Or, deduct 2% if full amount is sent with order.

GRENPARK COMPANY
245 Greenwich St. Dept. RC New York, N. Y.

RTC's Big August SPECIALS

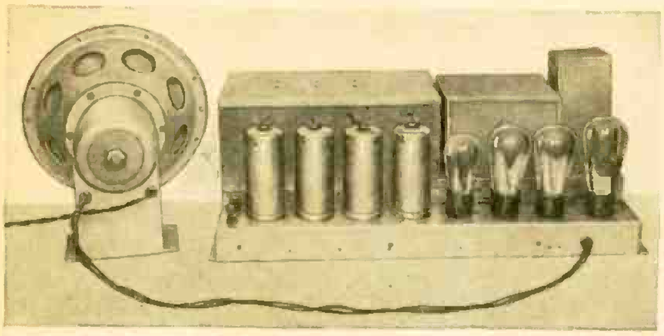
Every month we list on this page a few STAR ★ items which are not listed in our catalog. These are all specials of which the quantities on hand are not sufficient to catalog them. *Once sold out, no more can be had.* ORDER NOW—TODAY.

No One in Radio Undersells Us!

STOP SHOPPING—the lowest prices are right on this page. *No one undersells us.* We meet any price on any new merchandise. Order direct from this page and save money. 100% satisfaction on every transaction. Take advantage today of these special offers.

★"PEERLESS" 7-TUBE SCREEN-GRID T.R.F. RADIO RECEIVER

Complete with Full Dynamic Speaker



Back View

The selectivity and sensitivity of this 7-tube receiver due to its **three tuned stages** are just as sharp as those of an expensive 11-tube Superheterodyne receiver. The construction of this receiver is best described as "standard." Its circuit is none other than the "good old standby" TRF type which is the most reliable. It incorporates two stages of tuned R.F. amplification using type '24 Screen-grid tubes; the power detector is a '24; a single stage of AF voltage amplification utilizing the type '27 tube, feeds a 247 super-power pentode, the full wave rectifier is an '80. All provisions are made for supplying field power for the 9 inch genuine Magnavox, fully shielded full dynamic speaker. Both cone and spider of this excellent reproducer are made of Burtex to improve the high note response (brilliance) without impairing the low note production.

Tuning is extremely simple, the tuned circuits being controlled by a single central knob; a vernier drum-type illuminated tuning dial is employed. The second knob controls the on-off switch and the third, the one on the right, volume control. Coils, tuning-condenser-gang, filter condenser bank, output choke and by-pass condenser bank are all individually shielded. The chassis itself is made of non-magnetic aluminum.

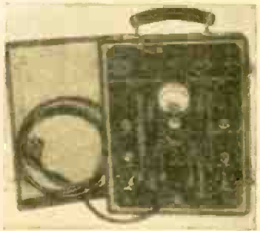
The use of three tuned circuits, employing screen-grid tubes and high gain R.F. transformers, together with careful wiring, and by-passing, result in high sensitivity. Tone quality, too, is extraordinarily fine. Despite the mass of new tubes recently thrown upon the market, it is generally conceded that for average home use a single 247 pentode supplies **adequate power with the least distortion.**

Why build a set when a complete receiver, wired and ready to use, and complete with speaker, can be bought at this phenomenally low price? Here is an excellent opportunity for wide-awake service men to "clean up." Remember that the supply is limited. Hence, "first come, first served." Overall size 21" x 8" x 8½" (set only). Ship. wt. 45 lbs.

List Price $75.00
NO. SP-2000 Peerless 7-Tube TRF Receiver
YOUR PRICE with speaker but less tubes **$10.86**
LIMITED SUPPLY—ORDER TODAY—TOMORROW MAY BE TOO LATE

BUILD THE "NEW DEPENDABLE" TUBE TESTER

Sold Either Wired or in Kit Form



Here indeed is your opportunity to build one of the finest tube checkers ever designed—an instrument which is MODERN in every sense of the word. Will test all the latest type tubes, including those with 7 AND 8 PRONGS—DIRECTLY—without the use of a single adapter!

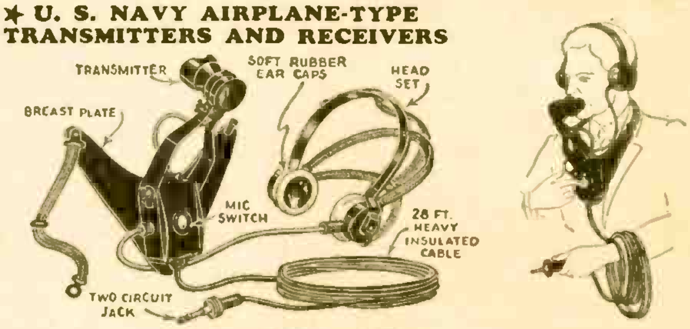
The "NEW DEPENDABLE," despite its high degree of accuracy, is extremely simple to operate. Both plates of the 80—82—83 and other rectifier tubes are readily tested without the use of a "second plate" button.

The instrument employs a high-grade, D'ARSONVAL TYPE, MOVING-COIL METER, insuring thereby extreme accuracy. This instrument will check more than 120 different tubes and even those which have not as yet been placed on the market. The tube tester is amply guarded against tube "shorts," which condition is indicated by the flashing of a small pilot light. All component parts are mounted on a beautifully etched panel and the entire instrument placed in a sturdily constructed, leatherette-covered, carrying case. For operation on 105-125 volts, 50/60 cycles, A.C. This instrument is available either in kit form or completely wired and tested, ready to use. Shipping weight 9 lbs.

NO. 303 "New Dependable" Tube Tester, completely wired and tested.
YOUR PRICE.......... **$16.50**

NO. 303A "New Dependable" Tube Tester in kit form.
YOUR PRICE.......... **$13.50**

★ U. S. NAVY AIRPLANE-TYPE TRANSMITTERS AND RECEIVERS



Only 300 at This Unheard-of Price

This microphone and head set outfit was built especially for the U. S. Navy Aviation Corps for plane-to-plane and plane-to-ground communication. Constructed under rigid governmental supervision.

The outfit consists of a low-impedance carbon transmitter securely fastened to a metal breastplate and a set of heavy-duty low-impedance earphones provided with soft rubber cushions. A specially constructed switch on the back of the breastplate, controls the microphone circuit. Twenty-eight feet of heavy conductor cable, terminating in a special brass plug, is furnished complete with this outfit. Two of these outfits make an efficient communication system over long distances.

The U. S. Government probably paid more than $30.00 for each of these outfits. Yet, a fortunate purchase permits us to sell them to you at $1.96, COMPLETE, as shown in the illustration above. There is no question but what considerable use can be found for these delicate, yet sturdily constructed instruments. Ship. wt. of entire outfit, 7 lbs. List Price $40.00. **No. B7216** U. S. Navy Airplane-Type transmitter and Receiver
YOUR PRICE.......... **$1.96**

FREE RADIO AND SHORT WAVE TREATISE

Avail yourself now of the opportunity to receive the FREE 1933 Edition of our Radio and Short Wave Treatise — **116 solid pages of useful information, radio items, diagrams and illustrations.** Positively the greatest book in print—**NOT JUST ANOTHER CATALOG.** Contains a large editorial section with valuable information not found anywhere else. Special consideration has been given to the radio beginner in this issue. Among the new technical information listed are the following:

HERE IS A PARTIAL LIST OF CONTENTS

Fundamental Principles of Radio—Ohm's Law—Discussion of New Tubes—Constructing a "Triple-Twin" Amplifier—All about Superheterodynes—Eliminating Man-Made Static—Constructing a Two-Tube Short-Wave "Globe-Trotter" Receiver—$3.00 Prize Suggestions—Radio Kinks, etc., etc.

Over 100 New Hook-Ups, Etc. 1000 Illustrations.

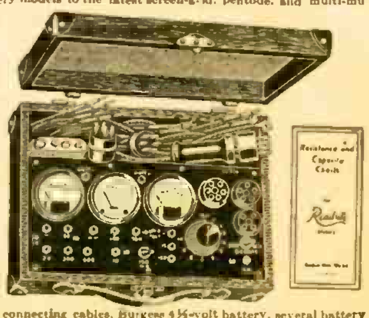
WRITE TODAY. Enclose 4 cents for postage. Treatise sent by return mail.

NEW READRITE MODEL 710 ANALYZER

TESTS LATEST TYPE 6 AND 7 PRONG TUBES

NINE METER SCALES AVAILABLE

This new Readrite precision instrument embodies features which have always been desired in any instrument built for service work: (1) low cost; (2) simplicity of design; (3) accuracy of measurements; (4) ruggedness of the complete unit. It is needless to add that the kit is capable of testing anything from old battery models to the latest screen-grid, pentode, and multi-mu receivers.



The "Model 710" is an **extremely compact device.** The outside dimensions of the carrying case are only 10¾ by 7⅝ by 3⅜ inches. The analyzer contains a D.C. voltmeter, an A.C. voltmeter and a milliammeter. The D.C. voltmeter has four ranges: 0 to 10; 0 to 60; 0 to 300 and 0 to 600 volts. The A.C. voltmeter has three ranges: 0 to 10; 0 to 140; and 0 to 700 volts. The milliammeter has two ranges; one for 15 mill. reading and the other for 150 mill. **This variety of ranges makes it possible to test every conceivable radio circuit;** high voltage secondaries of power transformers, current drain of all radio tubes, including the high power 250 and 210 tubes, etc.

CONVENIENT SELECTOR SWITCH — The instrument is equipped with a ten position bi-polar selector switch; by means of which readings may be obtained of "C" volts, "C" volts reversed, "K" volts, "K" volts reversed, plate voltage, screen-grid voltage, etc. A 4½-volt battery is supplied with the analyzer, to provide "C" bias for grid tests, continuity tests, etc.

TESTS PENTODES—"MULTI-MUS" '57's and '58's—'80 RECTIFIERS, Etc.—There are four sockets on the panel of the analyzer to take care of the four, five, six and seven prong tubes. There is a "grid-test" push-button. Pin jacks are available for the individual use of all meters, externally, in every range. There is a screen-grid pin jack, and there are two pin jacks for connecting the external battery. Both plates of the '80-type rectifier may be tested by use of a special adapter furnished. Charts are provided for measuring resistances and capacities. The Analyzer is furnished complete with test leads, connecting cables, Burgess 4½-volt battery, several battery leads, UY to UX adapter, '80 rectifier adapter and resistance and capacity charts. Shipping weight, 8 lbs.

Model 710 Analyzer. List Price, $25,
YOUR PRICE.......... **$14.72**

WE ARE A WHOLESALE HOUSE AND CAN NOT ACCEPT ORDERS FOR LESS THAN $3.00.
If C.O.D. shipment is desired, please remit 20% remittance, which must accompany all orders.
If full cash accompanies order, deduct 2% discount. Send money order—certified check—U. S. stamps.

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Should you wish goods shipped by parcel post, be sure to include sufficient extra remittance for same. Any excess will be refunded.

Radio Trading Company 102 Park Place New York, N. Y.

ANNOUNCING THE 1934 OFFICIAL RADIO SERVICE MANUAL

This new manual has been in actual preparation for several months. The vast amount of important data, which we have received from manufacturers who are assisting us in the compilation of the book, leads us to believe that the 1934 Manual will be more valuable than any previous editions.

THE necessity of GERNSBACK Manuals in the radio field has been shown by the fact that the total sales of the first three OFFICIAL RADIO SERVICE MANUALS, including the new CONSOLIDATED EDITION, now exceed 80,000 copies. Radio Service Men and others engaged in various branches of radio know the importance of such books, and how they must depend upon them for reliable information. Whether for public-address work, tube information or a circuit diagram, the material needed is certain to be found in one of the OFFICIAL RADIO SERVICE MANUALS. The GERNSBACK Manuals have been constantly used in reference work by leading radio set manufacturers, mail-order houses, jobbers, dealers and, most extensively, by Service Men, for whom these books are invaluable.

In the planning of the 1934 OFFICIAL RADIO SERVICE MANUAL many things have been taken into consideration. First, how we could reduce our own costs, and in turn pass these savings on to our readers. Second, what information not contained in previous editions of the Manuals must be incorporated in the 1934 edition and would be of utmost importance to its users. Third, what advance information we could print that would be useful in the future.

After careful analysis we found that the total cost of producing the 1934 Manual would be considerably less than in former years, and that at this time we could reduce the price of the book to our readers. The Fourth Edition of the OFFICIAL RADIO SERVICE MANUAL will sell this year for $3.50. The book will be published like the 1933 Manual—the volume will be sent to you complete. As usual, we urge that all our readers place their order early so that they will get a copy of the first printing. Usually, at the last minute a tremendous number of orders come to us and quite often orders are held up while the book is going through a second printing.

Anticipating such information as may serve future radio needs, we are holding many pages of the Manual open until the very last minute. Any timely "dope" which we then receive will be included before going to press.

In preparing this new edition many of the outstanding problems of the Service Men have been considered—methods of servicing, the new equipment constantly needed to cope with new tubes and sets, and the other fields of radio, such as public-address systems, short waves, auto radio and others.

The illustrations in the 1934 Manual will be more explicit than before; inasmuch as the diagrams will not be limited to the schematic circuit, but other illustrations will show the parts layout, positions of trimmers, neutralizers, etc. There will be hundreds of new circuits included, and not one from any previous edition of the manuals will be repeated. *This we unconditionally guarantee.*

The number of pages in the new Manual will exceed 400, with hundreds of illustrations, including diagrams, charts, photos, picture layouts, etc. The size of the Manual will be the same as that of the former volumes—9x12 inches, with a flexible, loose-leaf binder.

As in previous years, the 1934 Manual will also include a FREE QUESTION AND ANSWER SERVICE. In each book will be found 25 coupons, which entitle you to free consultation on any radio service topics. These coupons give you a complete mail service—questions on servicing and operating on any set or circuit are answered promptly and accurately by the editors. Remember that, at the regular rate of 25c per question which is usually charged by radio magazines, this service alone is worth $6.00. And for the Manual, we charge only $3.50.

It is quite evident that the 1934 Edition of the OFFICIAL RADIO SERVICE MANUAL will be a decided improvement over previous volumes, and will even surpass the high standard of the former Manuals.

Contents of the 1934 Manual in Brief

- Diagrams and service notes, more complete than ever before in any MANUAL. Not merely the schematic hook-ups will be found, but also chassis drawings showing parts layouts, positions of trimmers, neutralizers, etc.
- Voltage readings for practically all sets, as an aid in checking tubes and wiring.
- All values of intermediate-frequency transformers used in superheterodynes, with the manufacturers' own suggestions as to correct balancing.
- Detailed trouble-shooting suggestions and procedure as outlined by the manufacturers' own engineers—in other words, authentic "dope" right from headquarters.
- Values of all parts indicated directly on all diagrams. WE WILL POSITIVELY NOT INCLUDE DIAGRAMS FOR WHICH PARTS VALUES CANNOT BE OBTAINED.
- A special section for reference to A.C.-D.C. cigarbox midgets.
- A special section for reference to automobile radio.
- A special section for reference to public-address amplifiers.
- A special section for reference to short-wave receivers.
- A special section for reference to remote-control systems.
- A complete compilation of radio tube data, covering both the old and the many new types.
- A special section devoted to test equipment, analyzers, etc., with full diagrams and other valuable information.
- A complete list of American broadcast stations with their frequencies in kilocycles; extremely useful in calibrating and checking test oscillators and in calibrating receivers.
- Free Question and Answer Service, the same as in our last two Manuals.
- No theory; only service information in quickly accessible form.
- Absolutely no duplication of any diagrams; nothing that appeared in any of the previous Manuals will appear in the 1934 MANUAL. This we unconditionally guarantee.
- A handy, easily-consulted master index making it easy for you to find almost anything pertaining to your service problem instantly. This index will include all the diagrams published in all the previous GERNSBACK Manuals, as well as the 1934 diagrams. A big convenience and time saver!

ORDER YOUR COPIES NOW

It is important to every Radio Service Man and Dealer that he receive his copy of the 1934 OFFICIAL RADIO SERVICE MANUAL as soon as it is published. The new book will prove itself to be invaluable as those volumes of previous years. The book as usual comes to you postpaid and free of additional charges.

No need to delay sending us your order—the 1934 MANUAL, like its predecessors, is a necessity in your business. We strongly advise you to order your copy today, and then you will be certain to get one from the first printing of the book. The 1934 Manual will be ready in about eight weeks.

Mail the coupon today.

RC-8

GERNSBACK PUBLICATIONS, Inc.
96-98 Park Place, New York, N. Y.

Gentlemen: Enclosed you will find my remittance of $3.50 for which you are to send me One Copy of the 1934 OFFICIAL RADIO SERVICE MANUAL as soon as it comes off the press. [Send remittance by check or money order; or register letter if it contains cash, currency or unused U. S. Postage stamps.]

Name...

Address...

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

An Open Letter to Intelligent Folks—

This is Not a High Pressure Sales Advertisement
Rather It Is a True Statement of Facts

The feeble attempts of man do not surmount the powers and forces of the infinite. Therefore, to be honest with you, we cannot, and do not, guarantee DX reception regardless of weather conditions, storms, sun spots, magnetic disturbances and man-made noises.

Others may guarantee this to you, but it is simply a gross insult to your intelligence, and the mere guarantee does not make it a truth or a fact.

We do, however, state that the new Lincoln 1934 (SW-34) hereinafter known as the Lincoln DeLuxe Receiver of the century *will equal the distance-getting performance, under the same conditions, in the same location, at the same time.* This we are willing to and do guarantee.

We claim and guarantee only that this Receiver will equal the performance of any receiver. It is, however, our honest belief that the new Lincoln DeLuxe Receiver of the century will out-perform *any* Receiver. We do not offer a thousand dollars to be given to charity in proof of this statement, but we are willing, for you at all times, to make comparative tests against any other make of Receiver, and are content for you to be the judge. In fact, we have such confidence in our receiver that we encourage you to test it in the seclusion of your own home on our liberal *10 day free trial.* We want you to take advantage of this offer. Surely if we are willing to put this receiver in your home, absolutely free for 10 days, you should, in all fairness, take this opportunity to convince yourself of Lincoln superiority.

It is our firm conviction that while the DX getting propensities of a Receiver should be everything that present day tubes and circuit design make possible; yet, it is a strange paradox that the R.F. design of receivers has advanced away beyond and at the expense of the A.F. or audio frequency section. The paradox becomes more apparent when you stop to consider that your entire enjoyment depends upon the fidelity of reproduction. As remarked by an expert: "Almost any short-wave receiver will bring in European stations today—But How?" The last two words are the answer—*But How*—

With this in mind, Lincoln set out last year to design a Receiver from a tonal standpoint which would embody that something which has always been lacking in radio broadcast rendition—that something in music is comparable to perspective in a picture. The perspective is the natural result of viewing an object with your two eyes. It is depth—the third dimension.

Perspective in music, or let us say the bin-aural effect is the result of listening to sound with two ears. It has remained for Lincoln to create in this new Lincoln DeLuxe Receiver of the century that for which you have always hungered but never realized exactly what was lacking. In this new Lincoln DeLuxe Receiver of the century, Lincoln employs two distinct audio channels, split at the detector tube, each channel is tapered filtered at a thousand cycles. This enables you, the listener, to adjust with micrometer precision the intensity and volume level individually of the high and low register above, and below a thousand cycles. A thousand cycles is chosen as the axis of this adjustment because of the peculiar frequency characteristic of the ear curve. This bin-aural dual-channel would not have been possible of accomplishment had it not been for a startling new development in output tube design.

From a fidelity and over-load standpoint, it was clearly realized that at least four to five undistorted watts of pure triode quality must be secured for each channel. Type 250 tubes were tried, but discarded because of the low amplification factor. A high plate voltage requires expensive transformers and condensers, as well as their high list price, would have made the cost to you prohibitive. Also, its low amplification factor would necessitate additional stages, thus causing distortion.

It was our desire to furnish this Receiver to you with all of these wonderful improvements at a low price. The high list price of the 250 tube would have made this impossible. The 245 tubes were, naturally, discarded because of their low power output. Such various trick circuits as an "A" prime, Class "B" were not even considered because they had been disproved and found to be lacking in essential qualities during the last year's use in practically all of the cheaper radio sets.

Here, again Lincoln has shown their leadership by the selection of an output tube so new that no other manufacturers have as yet incorporated it, but of such wonderful characteristics that eventually they will all follow Lincoln's leadership and adopt it.

This new tube is known as the 2B6. It is a super triode with wattage output comparable to a 250, but requiring only 280 volts plate supply as compared to 530 volts for the 250. The 4-5 watts output of this tube are secured with an input voltage of only 25 RMS volts, whereas a 250 requires 84 volts. This tremendous power sensitivity with triode quality was the only thing which made it possible for Lincoln to give to you this startlingly new bin-aural or musical perspective effect at a low price.

Each one of these 2B6 super triodes operates into its individual speaker, thus the low channel speaker reproduces frequencies from 16 cycles to a thousand, while the high channel speaker reproduces frequencies from a thousand to five thousand. Two absolutely individual controls give you the most delicate graduations of tone possible whereby you may compensate for high or low deficiencies of your ear, the absorption factor of your home, plus a sound perspective never before possible.

Many marvelous and mysterious tonal effects may be achieved by the placement of the two speakers. The large Jensen Ortho-Dynamic "A" is used to reproduce the base, while the Jensen D-16 speaker, of special cone construction is used for the reproduction of the highs.

Your own individual taste and experimental ability will be given ample opportunity to create astounding musical effects secured by the placing of these two speakers in connection with this Lincoln bin-aural dual-channel Receiver.

For your convenience in comparing the 2B6 audio system of the Lincoln DeLuxe Receiver of the century with any other, you will find complete tube specifications of the new Arcturus 2B6 super triode on the inside of the front cover. These are printed in convenient form so this sheet may be torn out and put in your note book. We call to your particular attention the harmonic distortion curve versus output, which is the reason for the marvelous crystal bell-like quality obtained with this new Receiver.

Space does not permit of our presenting to you the many other engineering achievements embodied in this Lincoln DeLuxe Receiver of the century. The entire story of the Lincoln DeLuxe Receiver of the century, showing complete circuits and outlining many new up-to-date design features such as the new air tuned special high gain intermediate transformers, and electron coupled oscillator will all be fully explained. Simply send us six cents in stamps to cover the cost of mailing, that you may be assured of first-class mail delivery, and the complete details of the Lincoln DeLuxe Receiver of the century, with the new bin-aural dual-channel 2B6 amplifier will be sent to you.

LINCOLN RADIO CORPORATION
Dept. R. C.-8—335 S. Wood St., Chicago, Ill.

LINCOLN RADIO CORPORATION
Dept. R.C.-8—335 S. Wood St., Chicago
Enclosed six cents for which please send information on your Lincoln DeLuxe Receiver.

Name ....
Street ....
City ....
State ....