March 22
1930

RADIO WORLD

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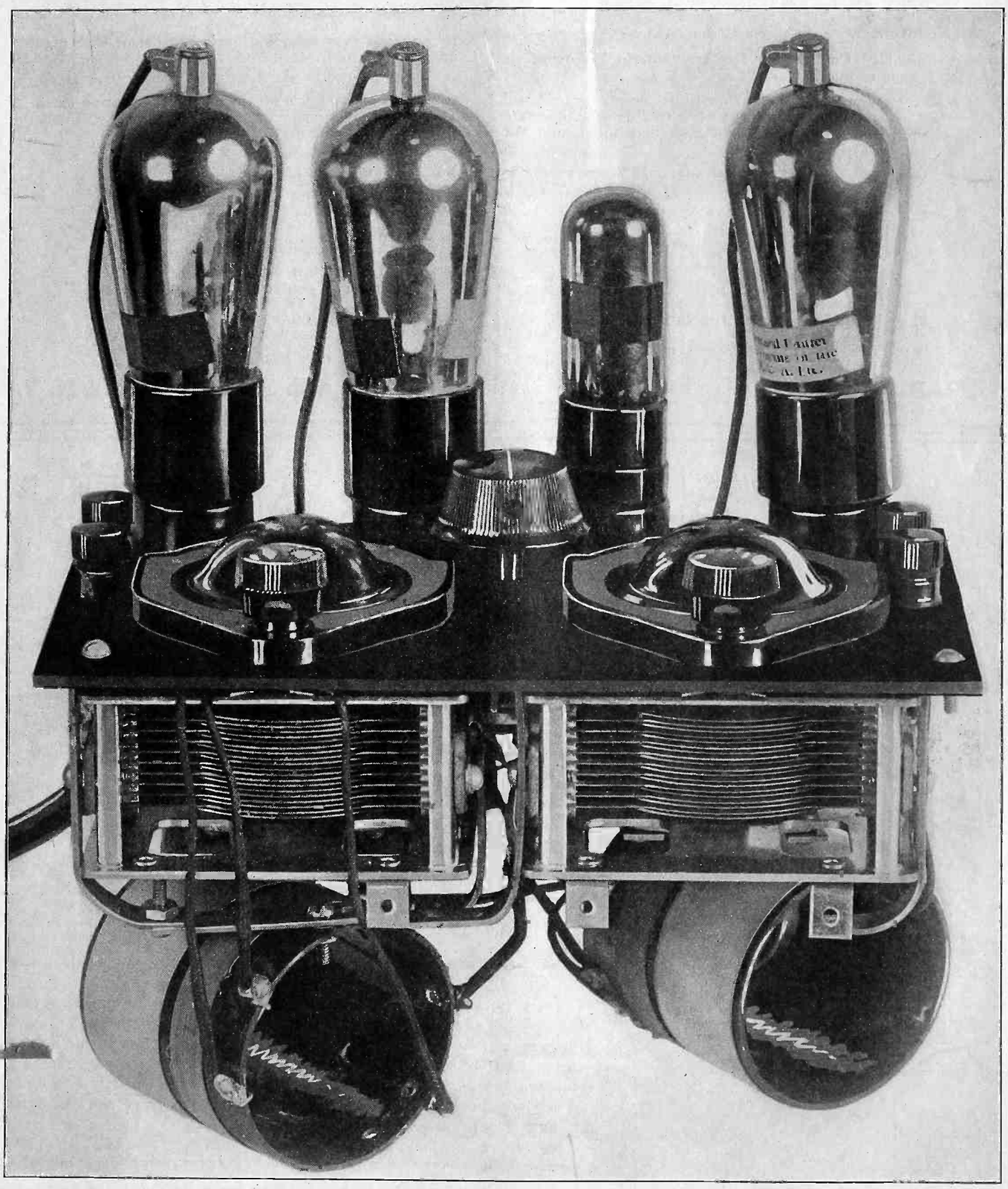
417th Consecutive Issue—EIGHTH YEAR



A compact battery-operated receiver, panel 8⅜ x 5½ inches, to work a speaker. See page 3.

Eighth Anniversary Number

of RADIO WORLD *Issue of March 29th, (Next Week)*

THE first national radio weekly, and for the last several years the only one, RADIO WORLD will be eight years old soon, and will publish an especially attractive and interesting number in celebration of the event. Contributors, editors and national advertisers, because of the special significance of this issue, and the extra-large distribution it will enjoy, have selected this issue as one worthy of their very best. The result will be something of predominating value to reader and advertiser alike.

One of the principal technical articles will deal with short-wave adapters for all types of AC and battery-operated sets, for one to three tubes, including some new ones of remarkable performance. There will be ten circuit diagrams on this article alone.

"Shielded Coil Design for Screen Grid Receivers" is the topic of another article.

"Answers to Questions That Can't Be Answered" will deal with familiar questions that defy a definite, accurate answer, but which are asked time and again, and the interesting reasons for their unanswerability are set forth.

"A Four Tube Receiver You Can Put in Your Pocket" will be set forth constructionally, as a complete answer to the demand for compactness.

"Audio Coupling Methods" will be another of the technical articles, of which there will be a fascinating profusion.

Besides, there will be the weekly debate, this one entitled, "Resolved, That Commercial Receivers Are Superior to Home-Built Receivers."

There will be pages of up-to-the-minute radio news from all over the world, plenty of illustrations, a lively assortment of letters from readers in Forum, and much else to absorb your attention, including list of U. S. and Canadian stations by frequencies.

Readers—Be sure to get the Eighth Anniversary Issue.

Advertisers—Capitalize on the extra "edge" at no **extra** cost to you. Advertising forms for the March 29th issue close at noon, Wednesday, March 19th.

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Rectification theory and practice in all the applied branches, grid bias methods and effects, push-pull principles, power detection, reproduction of recordings and methods of measurements and testing are set forth. And besides there is a chapter on the subject of motorboating, with which one of the authors is probably better familiar than any other textbook author. Then, too, there is a chapter on tubes, with essential curves and a full list of tables of tube data. Every tube that will be used in an audio amplifier —therefore virtually all tubes—is clearly diagnosed, classified and tabulated! These data on tubes should be at every radio engineer's hand.

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RADIO WORLD

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Technical Accuracy Second to None
EIGHTH YEAR

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A Compact Battery Set

Four Tubes, Three of Them Screen Grid, Work Speaker Well

By Thomas March

I HAVE constructed a variety of radio circuits with a variety of results. I well remember the very first set I made, using a single WD11 dry cell tube and a 22½-volt B battery with results that seemed truly marvellous.

I used to tune in Texas, Cuba, Alaska, Montreal, and WGY (then hard to get). WHN was out in Queens County, New York City, and it used to be faint and wobbly.

It is a far cry to the comparative performance of the sets of long ago, but the most essential improvements in parts that are used to make up a simple set of today have been the tubes, coils and the audio coupling. So we can utilize a small standard circuit in a modern design and compact assembly and produce some results and excellent quality.

A standard design is shown in Fig. 1. Care in assembly and wiring will produce excellent results from this inexpensive circuit.

As the front cover illustration shows, it is best to arrange the tuning coils at an angle, as this allows working the set at its most sensitive point without undue tendency to spill over on DX work.

Order of Tube Arrangement

Facing the front of the panel the tube order is, left to right, first RF stage, first audio stage, second audio (output), detector. There are two resistance-coupled stages. Three screen grid tubes are used ahead of a 199 output. This set will operate on a dynamic speaker on local reception, using a small indoor antenna, and will also bring in fairly loud DX with the same antenna and speaker, but for real DX reception on the speaker an outdoor antenna of about 100 feet, including lead in, is better.

The set is sufficiently sensitive with the usual range of B supply voltages, as designated in Fig. 1, but I brought in DX stations with very good volume by raising the screen-grid voltage from 50 to 70 volts, the other voltages acting remaining as shown.

Good selectivity in this circuit is due to several things: short grid and plate wires, sharp resonance characteristic of the coils and the relative positions of the coils in respect to the condensers that tune them, and to each other.

The tendency of most circuits to bring in high frequency stations so very much better than the low frequency ones is partly circumvented in this circuit by arranging the tuning condenser so that as the frequency response is lowered, the rotor plate area couples more of the magnetic field of the tuning inductance and thus creates a stabilizing effect which acts continuously as you vary the frequency.

Sensitivity Control by Rheostat

I have stated that the sensitivity of the set can be increased to bring in DX stations on an indoor antenna. The rheostat takes care of this when screen grid RF voltage is raised to 50 or more. Check up on all other voltage values.

It will be found that the grid bias of 4½ volts may be varied, usually upward, with different tubes, but this variation in any case won't be great.

A series condenser in the water pipe ground circuit, whether

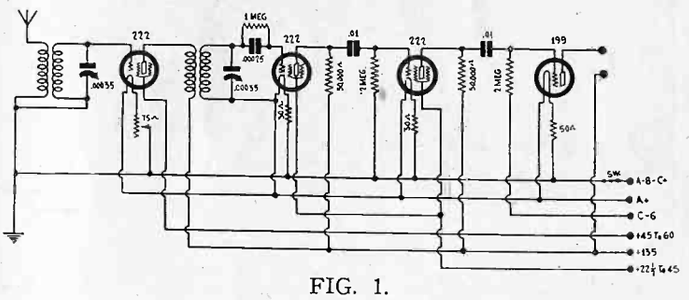


FIG. 1.

a B-eliminator is used or B batteries, is sometimes helpful, according to location and receiving conditions prevailing. About .01 mfd. should be the minimum.

Of course the outdoor antenna with its usually much longer span horizontally is admittedly better, but need not be more than 100 feet in length. The horizontal antenna is directional. If you want a non-directional antenna use a vertical wire.

The values of coupling resistor and the grid leak resistor have been determined by experiment and should not be changed.

Coil Data

Of special interest to the builder of this receiver are certain constructional items. These include the coils, whose unusual mounting is partly responsible for the success of the circuit. Below are given some dimensions and assembly data which will be helpful.

Two coil forms are of bakelite, 2½ inches O. D. x 2½ inches long x 1/16 wall. Primary (narrow winding) and secondary, No. 24 single silk covered wire.

Begin primary winding 9/16 inch from end of bakelite tubing

(*Concluded on next page*)

LIST OF PARTS

Two SGS-3 screen grid tuning coils.
Two .00035 mfd. tuning condensers.
Two .01 mfd. fixed condensers.
One .00025 mfd. grid condenser with resistor clips.
One 1 megohm grid leak.
Two 50,000-ohm coupling resistors with mountings.
Two 2-megohm grid leaks with mountings.
Two 30-ohm filament resistors.
One 50-ohm filament resistor.
One 75-ohm volume control rheostat, with filament switch built in.
Three UX (four-prong) sockets.
Two tuning dials.
Four binding posts (Ant., Grid., Speaker +, Speaker —).
One 5½ x 8⅜ inches front panel.
One sub-panel.
One six-lead terminal cable.

Battery Compact Wiring

Effective Receiver Built in Cabinet Only 5½ x 8⅜"

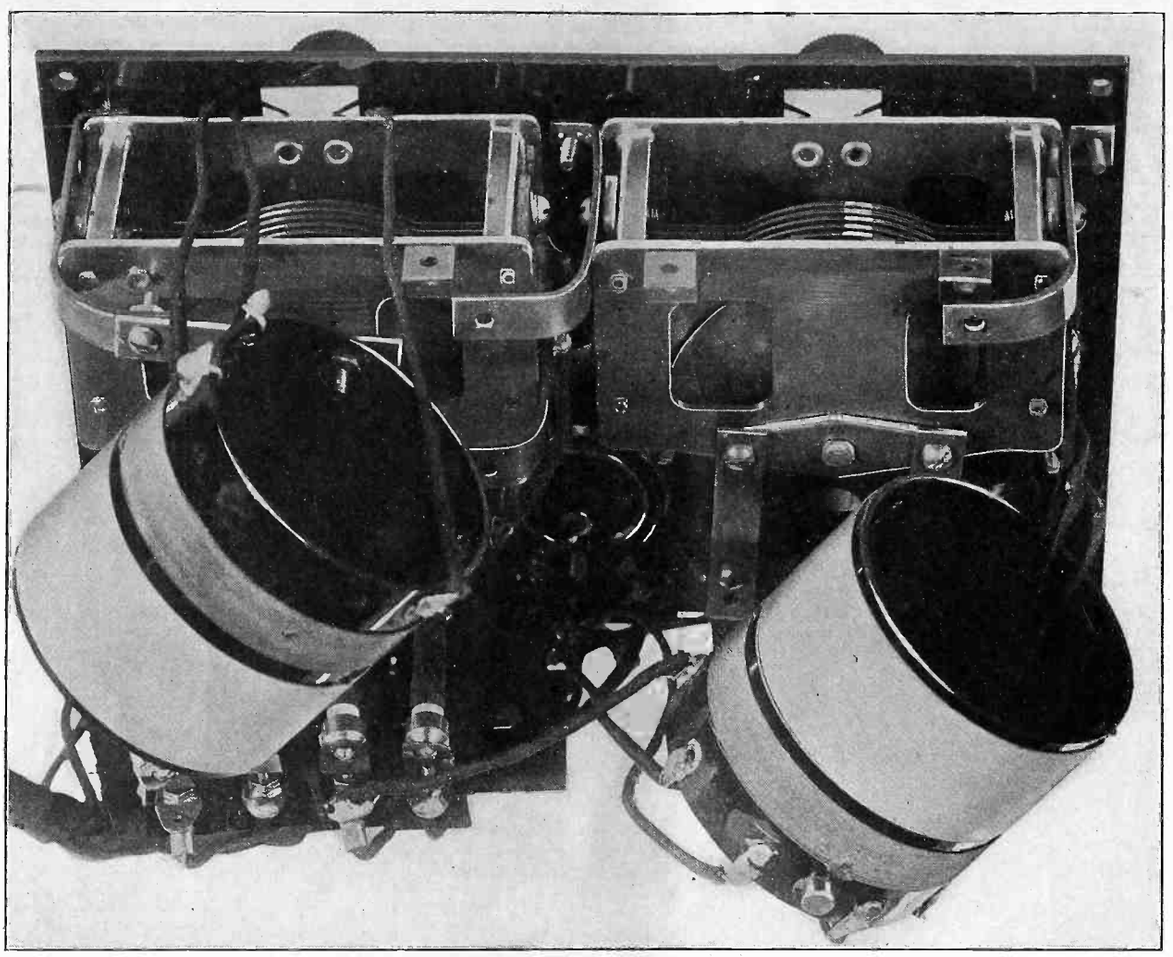


FIG. 2
SMALL BATTERY - OPERATED RECEIVER THAT GIVES GOOD RESULTS ON LOCALS AND TUNES IN SOME DISTANCE AS WELL. THREE 222 TUBES AND AN OUTPUT TUBE ARE USED.

and wind 25 turns. Then lead the connecting wires to the opposite end of the bakelite tube. Then begin the secondary winding about 3/16 inch from the primary winding, being careful to wind the secondary coil in the same direction as you wound the primary. Then wind on 60 turns and bring out two leads to the same end of the form as before. Now, having made the two coils, the next step is to mount the two .00035 mfd. tuning condensers. These may be mounted as shown, or they may be turned at right angles so that the backs of each condenser face right and left. The filament rheostat and switch, a combined instrument, may then be mounted nearer the tuning condenser knobs, which will make the arrangement of controls look much better.

Then make up a subpanel mounting of the four resistor clip supports, on one side, and the three fixed filament resistors on the other. Everything will have to be mounted up close, but a small panel 3½ inches by 2⅜ inches will be found ample and it can be attached by a small right angle bracket right behind the antenna tuning coil as shown in photo.

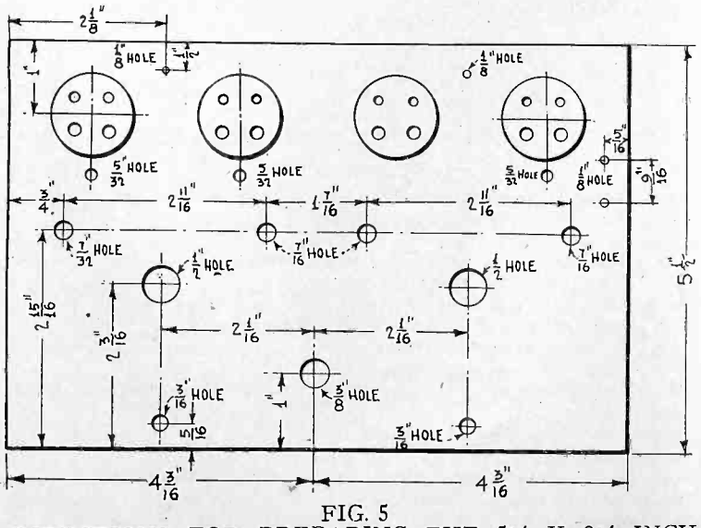


FIG. 5
DIRECTIONS FOR PREPARING THE 5½ X 8⅜ INCH PANEL TO ACCOMMODATE THE PARTS MOUNTED THEREON.

Connections Outlined

When the parts have been mounted, begin wiring by connecting one side of all the filament resistors together—then go from here to one side of the switch, attach the A— filament lead on cable (yellow, black tracer), attach the (black) B— lead of battery cable to common resistor connection, then run one lead each to each of the four tubes and then connect the other sides of each filament to a common return which goes to the (yellow) A+.

Now run from antenna post to primary lead on coil nearest antenna post (left hand, Fig. 1) and connect to primary lead nearest secondary coil. Run a lead from opposite end of this primary to A— on common lead on filament resistors.

Next run lead from the stator of the first tuning condenser to the bottom end of the right hand coil in (Fig. 2) and continue to the cap of the first RF tube. Connect the rotor plates of the first tuning condenser (Fig. 2) on the right hand to A—. Then repeat the above, except that the top of the second RF coil in Fig. 2 goes to a .00025 grid condenser and thence on to the cap of the detector tube. The second tuning condenser connects to the junction of the coil and the grid condenser and leak. The other end of the secondary of the coil goes to the second tuning condenser rotor and to A+.

Where Cable Leads Go

Then connect all screen grids together and connect them to the battery cable wire (maroon, black tracer). The red lead in the cable goes to 135 volts on the B supply and also to all the plate returns on the receiver, that is, to the speaker return, the lower ends of the two 50,000-ohm coupling resistors and to the B plus end of the primary of the second tuning transformer.

The grid return of the output tube goes to a point on the grid battery 6 volts negative. Use the green lead with the yellow tracer for this connection. The grid return of the detector tube goes to A plus and the remaining two grid returns to A minus.

It will be noted in the circuit diagram that a lower screen grid voltage is recommended for the detector and the first audio tube than for the radio frequency amplifier. The reason for this is that comparatively high resistance loads are in the plate circuits of these tubes, whereas in the radio frequency tube the DC resistance is negligible. When the load resistance is high the effective plate voltage is low and this requires that the screen voltage be low for best operation. However, there is nothing against trying higher values.

How Sets Work on Trains

Good Reception Obtained With TRF in AC Designs

THE Canadian National Railways was the first railroad system in the world to adopt radio as part of its regular services of transportation. Experiments in this regard may be said to date back to 1902, when Sir Ernest Rutherford, then a professor at McGill University, Montreal, carried out successfully the transmission of wireless signals to a moving train on the Grand Trunk lines between Montreal and Toronto, now part of the Canadian National System.

In the early Summer of 1923 radio on the Canadian National Railways really came into being. A party of influential citizens from New York and vicinity were on their way across Canada on a special train, and it was decided as a novelty to broadcast them a message of welcome to the Dominion as their train left Montreal.

First Effort a Success

The observation car of their train was equipped with a receiving set. From a broadcasting station in Montreal an address was delivered into the microphone. The success of the experiment was far beyond anticipations and in that moment the radio services of the Canadian National Railways was born.

A special branch was organized as the Radio Department and development proceeded along two related plans, one for the equipment of trains, the other for the organization and establishment of broadcasting stations.

The first broadcast of the Canadian National Railways Radio Department was sent out from Montreal on New Year's Eve, 1923.

The next step was the erection of a broadcasting station at Ottawa and then came the establishment of other links in the system. One by one stations were added in Winnipeg, Regina, Saskatoon, Calgary, Toronto, Edmonton, Moncton, Vancouver and other points, completing a chain of stations which stretch across the Dominion of Canada.

Other Railroads Follow Suit

Due to the success attained by the Canadian National, other railways have installed radio receiving sets on their trains.

From the experiences met with it appears to be definitely established that radio reception on trains is greatly appreciated by the traveling public. Some dining cars have also been equipped with outlets with loudspeakers. The company now has under construction Pullman cars which will be wired for radio headsets to be used in each compartment and programs to these cars will be supplied by the radio sets installed in the observation and lounge cars to which the radio circuit will be connected. In all, 75 cars on the Canadian National System are wired for radio reception and of these 54 are actually equipped. The installation of the new train lining system will permit of the reception of radio in two cars on the one train from the one radio-phonograph set.

Good Reception

Reception on trains has been consistently good. In some localities, as for instance in the Rocky Mountains, local difficulties are met. For trains operating through such areas the Canadian National is now installing a combination radio-phonograph set so that radio programs may be supplemented by recorded talks and entertainment.

Some fading is experienced when trains are operating through rock cuts, but proper handling of the set by an experienced operator helps to offset this.

Tuned radio frequency sets are operated on alternating current. The power is obtained by means of a motor-generator, dynamotor or rotary-converter. A converter has been developed which supplies the alternating current for the radio receiver and dynamic loudspeaker. The unit is especially designed for the severe demands of railroad services while at the same time the electrical efficiency has not been neglected.

It is desirable to have as little drain on the car-lighting batteries as possible and at the same time to obtain from the radio receiver sufficient signal level for the normal operation of the loudspeaker and headphones.

Aerials are erected on the top of the cars in which the sets are operated.

Coils Too Close to Shield, Suffer Intense Loss

The writer is constructing some RF tuning transformers that will combine operatively with a .00035 mfd. tuning condenser to give a flat top resonance curve.

In some receivers built of bought parts the writer has noticed a tendency of various combinations to give sharp resonance, also the other extreme which causes some overlapping of signals. Complete isolation of coupled circuits is attainable only where all the various constants and effects tending to produce poor audio quality are recognized and treated accordingly.

The shielding of tunable RF units is one item of importance.

Shielding, as the word implies, means protection. In this case it means protection of the tunable unit from being affected by stray fields, whatever be their source. Now, shielding to be effective can and should be so designed so as to fulfill its purpose without involving strong "eddy current" losses within itself, of such magnitude to affect seriously the mutual inductance between two coupled circuits.

Shielding that is too close to the coil we intend to "shield" will result in a serious impairment of the function of the coil, i. e., will rob the tunable circuit as a whole of RF energy spent in the shield structure in the form of heat, thus serving no especially useful purpose. Now, the spacing between a coil and shield is sure to affect not only the inductive relations existing at the time of operation but also the capacitance to ground and is therefore a condenser in parallel with the tuning condenser. This effect, however, is usually not large enough to defeat wave band coverage.

—Herbert E. Hayden.

Baffle Atones for Approximate Matching

An output dynamic speaker transformer may be substituted for a regular output mid-tap transformer, care being taken that the speaker transformer matches the speaker voice coil impedance to the plate impedance. This match is not difficult to ascertain or obtain commercially. The ratios used are anywhere from 20-to-1 to 25-to-1, and even if the match may be not very exact the usual cabinet baffle mounting will atone for any slight acoustic deficiencies which otherwise would be present.

The load current of the 245 should provide sufficient power for operating the magnetizing coil (the pot) of the dynamic. There is no one standard rating for this, but if you have a 1,000-ohm magnetizing coil, for instance, you should try to arrange the voltage division so that the pot winding in this case gets at least 4.9 watts or, better, 8.1 watts if possible. The builder can determine the power available for this case by measurements, using either a substitute load or the magnetizing coil in question.

These measurements are an infallible guide.

A list of stations by frequency, in United States and Canada, corrected to the last minute, will be published next week in the Eighth Anniversary Number. For other data in this issue see announcement on page 2.

The Hi-Q 30 for

Same Fundamental Circuit is Main

By Lewis

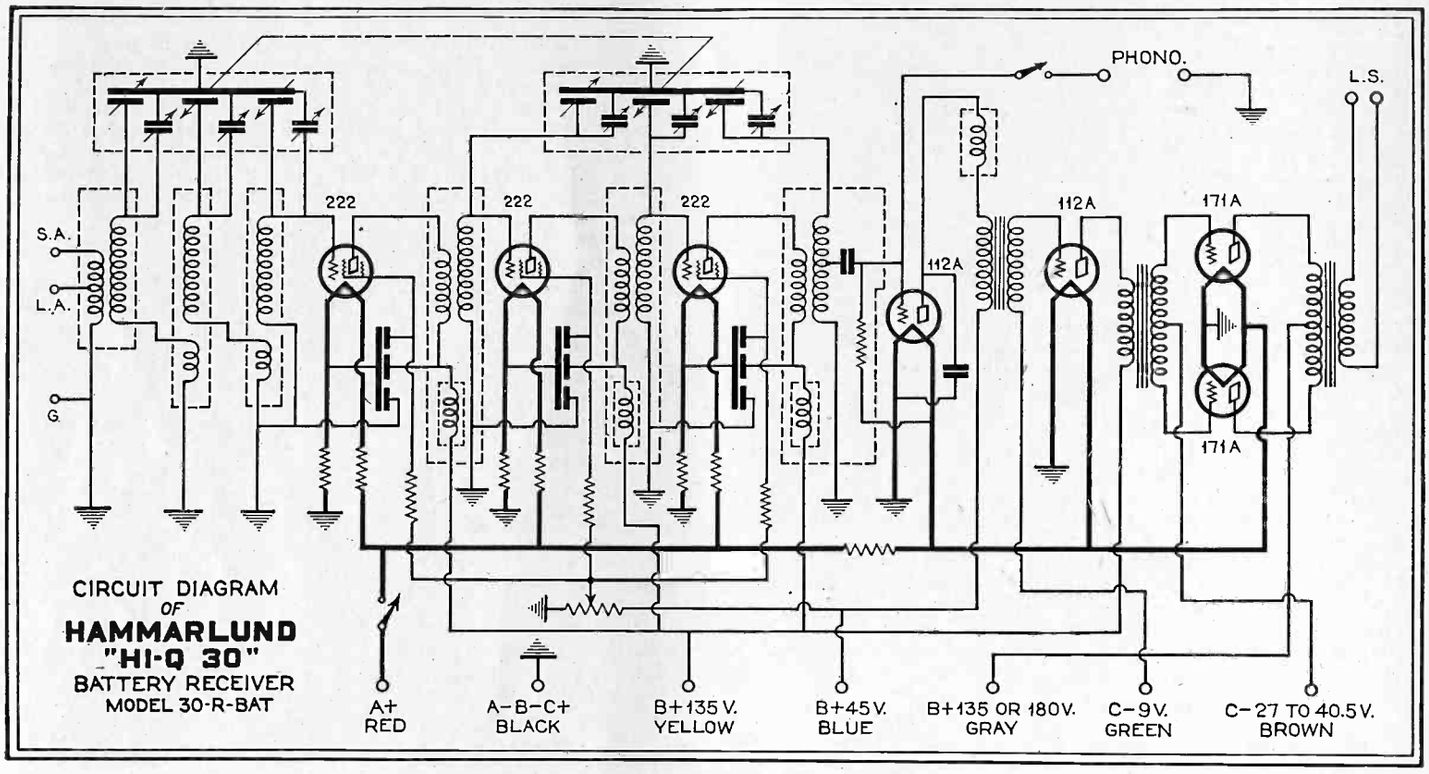


FIG. 1

IN A RECENT survey conducted throughout this country by the Hammarlund Manufacturing Company to ascertain the popularity of battery receivers it was found that 40 percent. of those solicited preferred battery-operated receivers for various reasons. Most of these were in locations where there was either no electric supply or where the supply was direct current.

The survey clearly brought out the importance of producing battery-operated receivers comparable with the best modern alternating-current receivers in points of selectivity, sensitivity, undistorted volume, and entertainment value. The HiQ-30 for battery operation is the Hammarlund answer to this demand.

Band Pass Pre-Selector

This receiver is shown diagrammatically in Fig. 1.

Connected with the antenna and the control grid of the first radio frequency tube, a band filter pre-selects the signal and thus presents a pure radio frequency signal, absolutely devoid of any background or interfering signal, to the first screen grid tube. The resultant signal, ten kilocycles wide, is fed into a high-gain three-stage screen grid radio frequency amplifier, a combination affording tremendous amplification, yet with extreme selectivity and flawless reproduction.

The condensers which tune the coils in the band filter and the coils in the radio frequency unit are all controlled by a single knob. Great care has been taken in the design of the tuning inductances. The windings are made on threaded Bakelite forms, the coils are matched with an accuracy better than 1/20%.

There are two triple-gang, .0005 mfd. tuning condensers, one being used in the band filter unit and the other in the radio frequency unit. These also are matched with an accuracy better than ¼%. This matching is important for both selectivity and sensitivity.

Since the distributed capacities of the six tuned circuits differ widely, a supplementary adjustable capacity is connected across each main tuning condenser. These supplementary capacities are adjusted so as to bring the minimum or inherent capacities to exactly the same value. Thereafter, since the inductance and the individual tuning condenser sections are matched, the six circuits track throughout the entire tuning range.

The radio frequency transformers have high inductance primaries closely coupled to space-wound secondaries, thus insuring a high load impedances in the plate circuits of the screen grid radio frequency amplifier tubes and also a high radio frequency gain over the whole broadcast band. Although the amplification of these radio frequency transformers increases rapidly with the frequency, no steps were taken to prevent this condition, since it is a simple matter to control the amplification at any wavelength by properly adjusting the volume control.

The tremendous amplification, which results in a sensitivity well under 1½ microvolts per meter, makes complete shielding absolutely necessary, and accordingly this phase of the HiQ-30 design has received especially careful attention. The filter coils and radio frequency transformers are shielded by individual copper cans, completely encircling the coils. Each triple-gang tuning condenser is also shielded in an aluminum can. In the

LIST OF PARTS

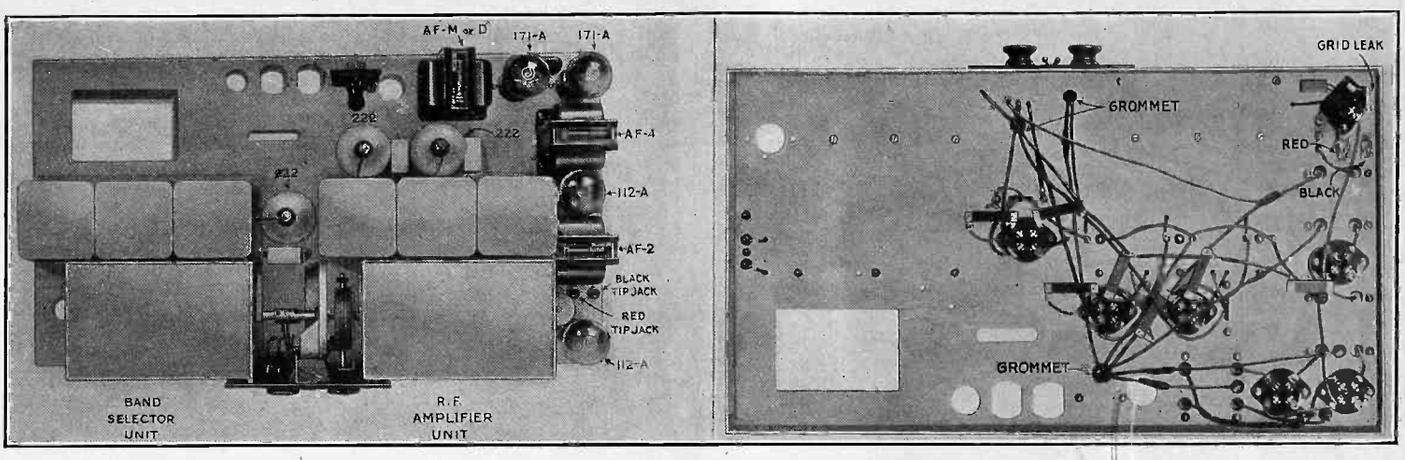
One Hammarlund HiQ-30 Foundation Unit, QFU-30.
One Hammarlund Three Stage Band Filter Unit, BS-3.
One Hammarlund Three Stage Screen Grid Radio Frequency Amplifier Unit, RF-3.
One Hammarlund Knob Control Drum Dial, SD.
One Hammarlund Shielded Polarized Radio Frequency Choke, SPC.
One Hammarlund First Stage Audio Transformer, AF-2.
One Hammarlund Push Pull Input Audio Transformer, AF-4.
One Hammarlund Push Pull Output Audio Transformer, AF-M or AF-D (See Text).
Three Hammarlund Screen Grid Tube Shields, TS.
***Three Aerovok Triple ByPass Condensers, BP-3.**
One Pair Yaxley Insulated Phono Tip Jacks, No. 422.
One Yaxley Speaker Twin Tip Jack, No. 401-S.
One Yaxley Cord Connector and Cable, No. 669.
Two Yaxley Pup Plugs, No. 415.
Six Yaxley 10-ohm Fixed Resistors, No. 810.
***One Yaxley .8-ohm Fixed Resistance, No. 8008.**
***Three Electrad 5,000-ohm Flexible Filter Resistors, No. 3.**
***One Electrad 25,000-ohm Royalty Volume Control Potentiometer, special taper.**
***Four Eby Four Prong Tube Sockets, marked 112A, No. 6-11.**
***Three Eby Four Prong Tube Sockets, marked 222, No. 6-11.**
***One Eby Triple Binding Post Strip.**
***One Hart & Hegeman Phono-Toggle Switch, No. 20510.**
***One Hart & Hegeman Line-Toggle Switch, No. 20510.**
***One Sangamo "Illini" .001 mfd. Mica Fixed Condenser.**

*Specially designed for the HiQ-30 Battery Model. Not stocked by radio distributors and available only on special order.

Battery Operation

ained That Proved So Successful on AC

Winner



FIGS. 2 AND 3
TOP VIEW OF THE BATTERY MODEL AT LEFT, AND BOTTOM VIEW AT RIGHT.

case of the second triple condenser, which tunes the radio frequency transformers, the shielding is carried on still further, partitions being placed in this can to isolate each condenser section from the others.

The screen grid tubes are enclosed in specially designed two-piece aluminum shields, which are removable to facilitate changing or inspecting tubes. The radio frequency chokes used as isolating impedances are mounted in the copper shields housing the radio frequency transformers, but are shielded from them by their own aluminum cases. The radio frequency choke coil used in the plate circuit of the detector is also shielded, since any feedback of radio frequency energy from this point to the input of the receiver would be undesirable.

Special Grid-Leak Condenser Used

The grid leak condenser detector system is used in the receiver, but with several important modifications. As will be noticed in the circuit diagram, the lead to the grid condenser and leak is tapped off the secondary of the third radio frequency transformer at a point roughly two-thirds from the filmament end. By this method, the damping effect on the tuned circuit caused by the low input resistance of the detector tube is reduced by more than half, thereby materially improving the selectivity of the circuit. At the same time greater voltages are built up in the circuit by reason of the reduced damping, which means that the voltage actually impressed on the grid of the detector tube is **not** reduced. Another important advantage of the tap is the reduction of the effective input capacity of the detector. While the input capacity of the tube is not actually reduced, its effect on the tuned circuit is reduced by over fifty percent. This permits the use of an equalizing condenser across this circuit as well as across each of the others, and hence more accurate balancing.

Push-Pull Audio Used

The total amount of audio amplification is comparatively low, even though two stages are used. This enables the use of low ratio audio frequency transformers with larger primaries, insuring good low-note reproduction. The low overall audio frequency amplification makes audio regeneration virtually impossible, and it also reduces microphonic troubles to a minimum. However, the audio gain is sufficient to insure maximum input to the push-pull power tubes long before the detector tube is overloaded. The first stage transformer has a ratio of 1½ to 1 and the push-pull input has a ratio of 2 to 1.

The two 171A or 112A tubes (the 112A tubes being used where economy in battery consumption is necessary) in the output are connected in push-pull. This output stage provides a reserve of power sufficient to supply almost any degree of volume desired, and in addition insures tones with a distinct richness even at low volume levels. Two different output transformers are available, depending on the operating conditions to be met. One of these transformers, known as the AF-M, is designed to match the output impedance of the tubes to the magnetic type of speaker, also to dynamic speakers with built-in input transformers. The other, known as the AF-D, is designed to match the tube impedance directly to the moving coil of a dynamic speaker having an input impedance of the order of 10 ohms.

To control the filaments of the screen grid tubes, 10-ohm fixed resistances are used. And to bias these tubes, additional 10-ohm resistances are used in the opposite filament leg, that is, the minus leg.

The filaments of the detector and audio tubes are controlled by an .8-ohm fixed resistance.

In series with the screen grid of each tube, a 5,000-ohm flexible, fixed resistance is connected, three in all, all three in turn being connected to the arm of a 25,000-ohm potentiometer. These resistors in conjunction with the .5 mfd. bypass condensers isolate each screen grid.

Wiring the Set

When wiring, it is suggested that a colored pencil be used to mark out each wire on the diagram when that wire has been connected. Where wires are joined together, or where other bare surfaces occur, a liberal use of insulating tape is recommended. Ordinary adhesive tape will do if electrician's tape is not available.

The .001 mfd. bypass condenser is supported by its terminals. One terminal is soldered to the double lug on the socket mounting screw, and the other terminal is soldered to the nearest terminal of the shielded choke. The terminals of the condenser should be bent to make the above connections. The grid leak, which should be removed from its position in the radio frequency can, is also supported by its terminal wires. It is connected between the G post and the plus A post on the socket.

After the wiring is complete each connection should be carefully checked to assure proper operation. A wrong connection may easily make the difference between perfect results and poor results, or may even cause considerable damage to the parts.

A series of voltage tests can be made later, using a high resistance, direct-current voltmeter of the double scale type.

The covers of the variable condenser shields should now be removed, and the rotor plates of both condensers so turned that they are fully meshed. Then one of the coupling sections should be slid over on the short shaft in such a position as to engage about 1/16 inch of the long shaft. The set screw in this half of the coupling should then be tightened securely. The other half of the coupling can then be placed so as to engage the first half, leaving about 1/32 inch between the end of the tongue and the bottom of the grove. The set screw in this half may now be tightened.

Now turn the dial knob to the right until the stop is reached and tighten the set screws in the drum drive. Insert the dial light in its socket if this has not been done previously.

The indicator drum should now be centered with the escutcheon aperture and rotated until the 100 mark is exactly even with the indicating points and its set screw tightened.

Attachment of Cable Plug

The screws can now be placed in their respective sockets, the shields being placed over the screen grid tubes and the connectors placed over their control grid caps. The cable plug

(*Continued on page* 14)

The Hi-Q 30 for

Same Fundamental Circuit is Main

By Lewis

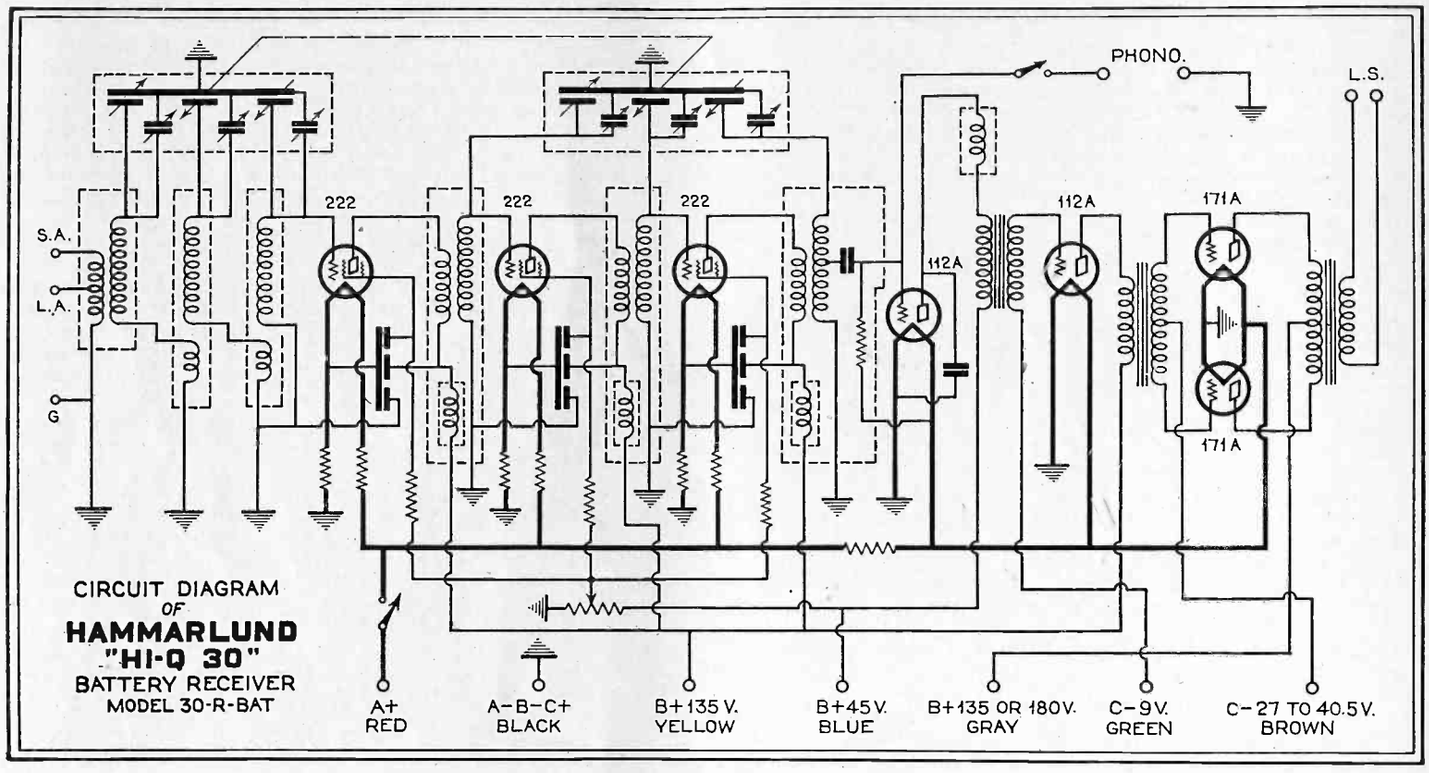


FIG. 1

IN A RECENT survey conducted throughout this country by the Hammarlund Manufacturing Company to ascertain the popularity of battery receivers it was found that 40 percent. of those solicited preferred battery-operated receivers for various reasons. Most of these were in locations where there was either no electric supply or where the supply was direct current.

The survey clearly brought out the importance of producing battery-operated receivers comparable with the best modern alternating-current receivers in points of selectivity, sensitivity, undistorted volume, and entertainment value. The HiQ-30 for battery operation is the Hammarlund answer to this demand.

Band Pass Pre-Selector

This receiver is shown diagrammatically in Fig. 1.

Connected with the antenna and the control grid of the first radio frequency tube, a band filter pre-selects the signal and thus presents a pure radio frequency signal, absolutely devoid of any background or interfering signal, to the first screen grid tube. The resultant signal, ten kilocycles wide, is fed into a high-gain three-stage screen grid radio frequency amplifier, a combination affording tremendous amplification, yet with extreme selectivity and flawless reproduction.

The condensers which tune the coils in the band filter and the coils in the radio frequency unit are all controlled by a single knob. Great care has been taken in the design of the tuning inductances. The windings are made on threaded Bakelite forms, the coils are matched with an accuracy better than 1/20%.

There are two triple-gang, .0005 mfd. tuning condensers, one being used in the band filter unit and the other in the radio frequency unit. These also are matched with an accuracy better than ¼%. This matching is important for both selectivity and sensitivity.

Since the distributed capacities of the six tuned circuits differ widely, a supplementary adjustable capacity is connected across each main tuning condenser. These supplementary capacities are adjusted so as to bring the minimum or inherent capacities to exactly the same value. Thereafter, since the inductance and the individual tuning condenser sections are matched, the six circuits track throughout the entire tuning range.

The radio frequency transformers have high inductance primaries closely coupled to space-wound secondaries, thus insuring a high load impedances in the plate circuits of the screen grid radio frequency amplifier tubes and also a high radio frequency gain over the whole broadcast band. Although the amplification of these radio frequency transformers increases rapidly with the frequency, no steps were taken to prevent this condition, since it is a simple matter to control the amplification at any wavelength by properly adjusting the volume control.

The tremendous amplification, which results in a sensitivity well under 1½ microvolts per meter, makes complete shielding absolutely necessary, and accordingly this phase of the HiQ-30 design has received especially careful attention. The filter coils and radio frequency transformers are shielded by individual copper cans, completely encircling the coils. Each triple-gang tuning condenser is also shielded in an aluminum can. In the

LIST OF PARTS

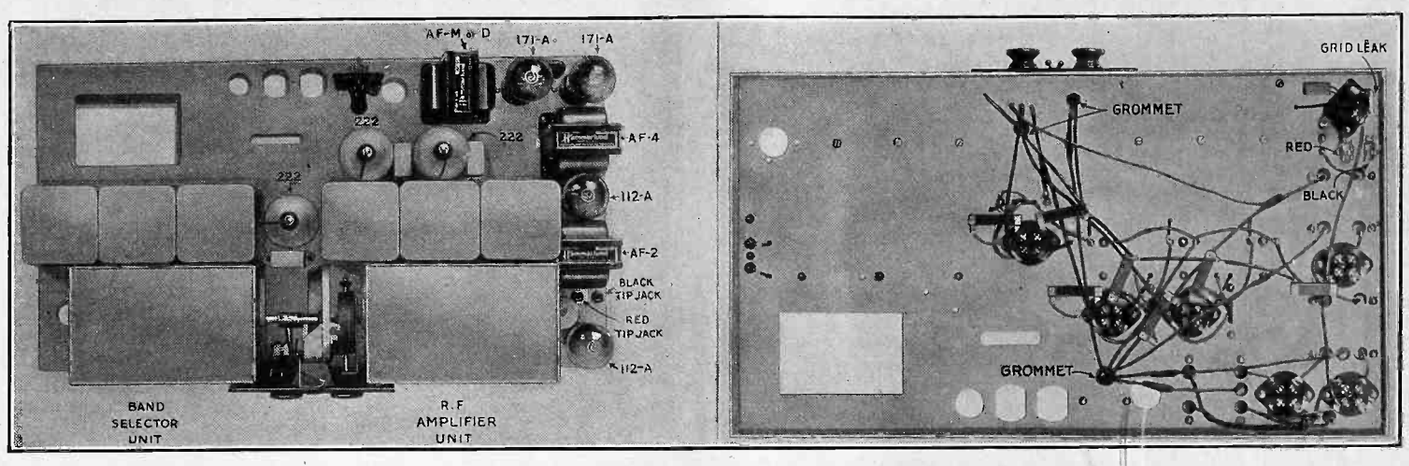
One Hammarlund HiQ-30 Foundation Unit, QFU-30.
One Hammarlund Three Stage Band Filter Unit, BS-3.
One Hammarlund Three Stage Screen Grid Radio Frequency Amplifier Unit, RF-3.
One Hammarlund Knob Control Drum Dial, SD.
One Hammarlund Shielded Polarized Radio Frequency Choke, SPC.
One Hammarlund First Stage Audio Transformer, AF-2.
One Hammarlund Push Pull Input Audio Transformer, AF-4.
One Hammarlund Push Pull Output Audio Transformer, AF-M or AF-D (See Text).
Three Hammarlund Screen Grid Tube Shields, TS.
***Three Aerovok Triple ByPass Condensers, BP-3.**
One Pair Yaxley Insulated Phono Tip Jacks, No. 422.
One Yaxley Speaker Twin Tip Jack, No. 401-S.
One Yaxley Cord Connector and Cable, No. 669.
Two Yaxley Pup Plugs, No. 415.
Six Yaxley 10-ohm Fixed Resistors, No. 810.
***One Yaxley .8-ohm Fixed Resistance, No. 8008.**
***Three Electrad 5,000-ohm Flexible Filter Resistors, No. 3.**
***One Electrad 25,000-ohm Royalty Volume Control Potentiometer, special taper.**
***Four Eby Four Prong Tube Sockets, marked 112A, No. 6-11.**
***Three Eby Four Prong Tube Sockets, marked 222, No. 6-11.**
***One Eby Triple Binding Post Strip.**
***One Hart & Hegeman Phono-Toggle Switch, No. 20510.**
***One Hart & Hegeman Line-Toggle Switch, No. 20510.**
***One Sangamo "Illini" .001 mfd. Mica Fixed Condenser.**

*Specially designed for the HiQ-30 Battery Model. Not stocked by radio distributors and available only on special order.

Battery Operation

ined That Proved So Successful on AC

Winner



FIGS. 2 AND 3
TOP VIEW OF THE BATTERY MODEL AT LEFT, AND BOTTOM VIEW AT RIGHT.

case of the second triple condenser, which tunes the radio frequency transformers, the shielding is carried on still further, partitions being placed in this can to isolate each condenser section from the others.

The screen grid tubes are enclosed in specially designed two-piece aluminum shields, which are removable to facilitate changing or inspecting tubes. The radio frequency chokes used as isolating impedances are mounted in the copper shields housing the radio frequency transformers, but are shielded from them by their own aluminum cases. The radio frequency choke coil used in the plate circuit of the detector is also shielded, since any feedback of radio frequency energy from this point to the input of the receiver would be undesirable.

Special Grid-Leak Condenser Used

The grid leak condenser detector system is used in the receiver, but with several important modifications. As will be noticed in the circuit diagram, the lead to the grid condenser and leak is tapped off the secondary of the third radio frequency transformer at a point roughly two-thirds from the filmament end. By this method, the damping effect on the tuned circuit caused by the low input resistance of the detector tube is reduced by more than half, thereby materially improving the selectivity of the circuit. At the same time greater voltages are built up in the circuit by reason of the reduced damping, which means that the voltage actually impressed on the grid of the detector tube is **not** reduced. Another important advantage of the tap is the reduction of the effective input capacity of the detector. While the input capacity of the tube is not actually reduced, its effect on the tuned circuit is reduced by over fifty percent. This permits the use of an equalizing condenser across this circuit as well as across each of the others, and hence more accurate balancing.

Push-Pull Audio Used

The total amount of audio amplification is comparatively low, even though two stages are used. This enables the use of low ratio audio frequency transformers with larger primaries, insuring good low-note reproduction. The low overall audio frequency amplification makes audio regeneration virtually impossible, and it also reduces microphonic troubles to a minimum. However, the audio gain is sufficient to insure maximum input to the push-pull power tubes long before the detector tube is overloaded. The first stage transformer has a ratio of 1½ to 1 and the push-pull input has a ratio of 2 to 1.

The two 171A or 112A tubes (the 112A tubes being used where economy in battery consumption is necessary) in the output are connected in push-pull. This output stage provides a reserve of power sufficient to supply almost any degree of volume desired, and in addition insures tones with a distinct richness even at low volume levels. Two different output transformers are available, depending on the operating conditions to be met. One of these transformers, known as the AF-M, is designed to match the output impedance of the tubes to the magnetic type of speaker, also to dynamic speakers with built-in input transformers. The other, known as the AF-D, is designed to match the tube impedance directly to the moving coil of a dynamic speaker having an input impedance of the order of 10 ohms.

To control the filaments of the screen grid tubes, 10-ohm fixed resistances are used. And to bias these tubes, additional 10-ohm resistances are used in the opposite filament leg, that is, the minus leg.

The filaments of the detector and audio tubes are controlled by an .8-ohm fixed resistance.

In series with the screen grid of each tube, a 5,000-ohm flexible, fixed resistance is connected, three in all, all three in turn being connected to the arm of a 25,000-ohm potentiometer. These resistors in conjunction with the .5 mfd. bypass condensers isolate each screen grid.

Wiring the Set

When wiring, it is suggested that a colored pencil be used to mark out each wire on the diagram when that wire has been connected. Where wires are joined together, or where other bare surfaces occur, a liberal use of insulating tape is recommended. Ordinary adhesive tape will do if electrician's tape is not available.

The .001 mfd. bypass condenser is supported by its terminals. One terminal is soldered to the double lug on the socket mounting screw, and the other terminal is soldered to the nearest terminal of the shielded choke. The terminals of the condenser should be bent to make the above connections. The grid leak, which should be removed from its position in the radio frequency can, is also supported by its terminal wires. It is connected between the G post and the plus A post on the socket.

After the wiring is complete each connection should be carefully checked to assure proper operation. A wrong connection may easily make the difference between perfect results and poor results, or may even cause considerable damage to the parts.

A series of voltage tests can be made later, using a high resistance, direct-current voltmeter of the double scale type.

The covers of the variable condenser shields should now be removed, and the rotor plates of both condensers so turned that they are fully meshed. Then one of the coupling sections should be slid over on the short shaft in such a position as to engage about 1/16 inch of the long shaft. The set screw in this half of the coupling should then be tightened securely. The other half of the coupling can then be placed so as to engage the first half, leaving about 1/32 inch between the end of the tongue and the bottom of the grove. The set screw in this half may now be tightened.

Now turn the dial knob to the right until the stop is reached and tighten the set screws in the drum drive. Insert the dial light in its socket if this has not been done previously.

The indicator drum should now be centered with the escutcheon aperture and rotated until the 100 mark is exactly even with the indicating points and its set screw tightened.

Attachment of Cable Plug

The screws can now be placed in their respective sockets, the shields being placed over the screen grid tubes and the connectors placed over their control grid caps. The cable plug

(*Continued on page* 14)

Methods of Trimming

Alternate Adjustments of Condensers and Inductances for

By Leon L.

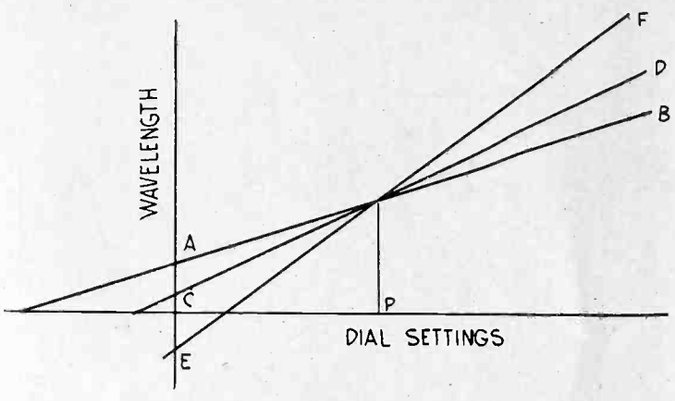


FIG. 1

THESE CURVES SHOW THE RELATIONSHIPS BETWEEN DIAL SETTINGS AND WAVELENGTH OF TUNED CIRCUITS IN A GANG BEFORE INDUCTANCES AND CAPACITIES HAVE BEEN EQUALIZED.

THE operation of several tuned circuits in a gang always presents a troublesome problem. There are so many conditions that must be satisfied before such operation is successful that very few circuits have as yet been completely satisfactory. To be sure, many carefully designed circuits, both factory made and home constructed, do give satisfaction, but these are not always as selective as they should be, considering the number of tuned circuits involved. They may be all right at one point on the tuning dial but fail at other points.

The first condition that must be satisfied is equality of the rate of change of the capacities of all the condensers in the gang. This does not mean that all the condensers must be equal, although if they are equal the condition is more likely to be satisfied. Equality of rate of change of the capacities does not alone depend on the construction of the condensers but also on the distributed capacities in the circuits. However, the distributed, or zero setting capacities, can always be equalized so that this condition really depends on the construction. High grade condensers, rigidly constructed, made of plates of equal thickness and spacing usually are sufficiently alike to satisfy the condition. If condensers of different types are used it is practically impossible to satisfy the condition. The corresponding plates of the condensers should have been cut with the same tools, out of the same stock, and in fixtures made with the same tools.

Not only is this a requirement but the assembly of the condenser gang should be such that every rotatable set of plates should be mounted in the same manner with respect to other conductors such as shields, frames and coils. It is clear that this condition is difficult to satisfy, not only for the condenser alone but especially for the condenser mounted in the receiver.

Means for Adjustment

Assuming that all the condensers in a gang are equal with respect to rate of change of capacity when the gang is mounted in the receiver, not counting the effect of distributed capacity, we have several means of effecting equality of the tuned circuits throughout the tuning range. To simplify our problem we shall assume that the condenser sections also have equal maximum capacities, requiring equal inductances.

Suppose coils are designed for the given capacities. When these coils are wound as nearly the same as possible it may be that the effective inductances will be different. If they are, ganged tuning will not be successful because a different rate of change of capacity would be needed to each tuned circuit. Hence one of the conditions is that the inductances be made equal in fact as well as appearance.

There are many things which may contribute to make the coils different. For example, one form may have a slightly different shape from the others. The wire of one, though nominally the same, may be different because it was not drawn through the same die, or if through the same die, not through it at the same stage of wear. Again the insulation thickness may vary, or the tightness with which the wire is wound on the form, or the closeness of the turns. These are relatively unimportant because they can be compensated for without difficulty.

Reaction Effects

More troublesome are the effects of various reactions. For example, shields around or near a coil will change its effective inductance, and this change will depend on frequency. The change is usually a decrease in the inductance because of the bucking effect of induced eddy currents in the shielding. The remedy for any inequality from this effect, obviously, is to mount every coil in the same manner with respect to shielding. And since different metals will react differently it is important that every shield should be of the same type and thickness of metal.

Still another reaction effect is that of the primary on the secondary. The mutual inductance between the primary and the secondary will change the effective inductance in the secondary and hence the required capacity to tune the secondary to a given frequency. This demands not only that the primaries be equal but that they be placed in the same manner with respect to the secondaries. Not only that, but it demands, as a rule, that the primaries be preceded by the same type of tube similarly operated. This effect also depends on the frequency and therefore it is somewhat troublesome.

The first thing to do about the coils is to make them as nearly equal as practical manufacturing permits and put them in as nearly equal settings in the circuit as practicable. This having been done, the coils should be adjusted so that the effective inductances of all are the same. For coarse adjustment the number of turns may be varied. For finer adjustment a tiny variometer may be put into each coil and that variometer turned until all the inductances are exactly the same. This part of the adjustment is somewhat complicated and the results may not warrant it. In place of a variometer the turns near one end of the tuned winding may be pulled apart or pushed together to effect small changes in the inductance.

How to Adjust

It is not easy to tell when the inductances are equal because there is no simple way of measuring them in the circuit. The coils could be compared outside the receiver with a standard but there is no assurance that the effective inductance will be the same when the coil is put into the circuit, for reasons pointed out above. An exact method of determining whether or not coils are equal will be described below. While it is not expected that this method will be applied it points to certain tests which may be made simply. The results of these tests show whether turns should be removed from a coil, or added to it.

We have already assumed that the tuning condensers were of equal value and had the same rate of capacity change throughout their range before they were put into the circuit. But the rate of change is affected by the various distributed capacities in the circuit, such as the capacity of the grid circuit of the tube, the capacity of the secondary, the capacity between the two windings, and other stray capacities. All these may be considered as one fixed capacity usually called the zero setting capacity of the circuit. It determines the highest frequency to which the circuit may be tuned, or the lowest wavelength.

Most condensers mounted in gangs are provided with small trimmer condensers. The object of these condensers is to equalize the zero setting capacities of the various tuned circuits. If the normal zero setting capacity in a given circuit is smaller than those in the others, more of the trimming capacity is used in that circuit, and conversely, if the normal zero setting capacity in a circuit is higher than those in the other circuits, less of the trimmer capacity is used.

Just as it was difficult to tell when the inductances in the circuit were equal, so it is difficult to tell when the zero setting capacities are equal, and for the same reason.

Difficulty of Trimming

The difficulty of "trimming" a circuit arises from the fact that both the inductances and the rates of capacity change may be different. Suppose the trimming condensers are adjusted at the high frequency end of the dial until a given station comes in with greatest volume, which can nearly always be done. Then when the condensers are turned so that the tuned circuits will resonate with lower frequencies they will pull apart because neither the inductances nor the capacity rates of change are equal. The result is that the circuit will not be selective lower frequency end of the scale. Neither will it be sensitive. It is quite possible that a given station will come at two different settings. That happens frequently.

Suppose the trimmer condensers are adjusted at the 550 kc end of the dial. This can nearly always be done just as well as at the other end. But this does not help because just as soon as the dial is turned toward the high frequency end the tuned circuits pull apart. The set again loses its selectivity and sensitivity. Now the low wave stations may come in at two or more points on the dial, or they may come in with practically the same intensity over a large portion of the dial.

Frequently it is recommended that the trimmers be adjusted at the middle of the tuning scale. Some improvement in the

Gang-operated Receivers

Successive Approximation Lead Quickly to Results

Adelman

circuit can be effected in this manner because any detuning effect that may result on turning the dial is cut in half as compared with the detuning effects resulting from either of the other two adjustments. But no matter where the trimmers are adjusted there will only be one point at which the set works as it should, and that is the point of adjustment.

Now if the inductances are the same in all the circuits, and also the zero setting capacities, this difficulty will not be experienced, assuming as we have done that the condensers by themselves are alike. For practical purposes they safely can be assumed to be the same provided that they are of the same make and type.

Cut and Try Method

One way of adjusting both the zero setting capacities and the effective inductances is by successive approximation. This is rather tedious but it involves less work than the exact method to be described.

The first step is to set the control at the short wave limit and then adjust the trimmer condensers until the lowest wave station that can be tuned in comes in with greatest strength. It may in some instances be necessary to provide a local signal to work with. When the trimming has been done at the low end by means of the small condensers turn to the other end of the tuning range and repeat the trimming, but this time leave the condensers alone and work on the coils. Try to tune every circuit to the highest wave station until it comes in loudest and do this tuning by adjusting the turns on the coils, or with the small variometer if one is installed, or by separating the turns, depending on the amount the inductance has to be changed.

When all the tuned circuits have been adjusted in this manner go back to the short wave end of the dial, the same point that was used the first time. It will be found that the station does not come in at exactly the same place, nor as strongly. It is now necessary to readjust the trimmer condensers. But this time it will not require as great a change as the first time because the first step in equalizing the zero setting capacities and the inductances has been taken. When the trimmers have been adjusted the second time at the low wave end of the dial return to the high wave end and readjust the coils again. Only a small change should be required this time.

This process of alternately adjusting the zero setting capacities and the inductances at opposite ends of the dial is the method of successive approximation. Theoretically it should never be possible to make an exact adjustment in this manner but practically it should be possible in two or three steps.

Exact Method of Adjustment

The exact method of adjustment depends on the taking of curves on each tuned circuit. The wavelength is plotted against dial settings for every tuned circuit, or the wavelength squared is plotted against dial settings. The method which gives the more nearly straight lines should be selected.

Suppose three such curves have been taken on three different tuned circuits. Let these curves be as represented in Fig. 1. The vertical wavelength line represents the zero position on the dial and the horizontal line represents the zero of wavelength, or the zero of wavelength squared.

The three lines in Fig. 1 represent the plots of three different tuned circuits which have been adjusted to equality at the dial setting marked P. At this point the lines intersect indicating that all the tuned circuits resonate to the same frequency. For different dial settings the lines are far apart.

The slope of these lines is proportional to the inductance. Thus the steepest line EF is for the circuit which has the highest inductance. The line AB which has the smallest slope represents the circuit which has the smallest inductance.

The intersections of the lines with the wavelength axis indicates the lowest wavelengths to which the circuits may be tuned. The intersection A is the highest. It may be higher than the 200-meter limit. The intersection E is below the horizontal axis which really means that such a line will not be obtained.

The intersections of the lines with the horizontal axis to the left of the zero setting line give a measure of the zero setting capacities in the circuit. The farther to the left the intersection the higher the zero setting capacity. These intersections can be obtained only by extending the lines, and they will not be obtained experimentally.

Interpreting the Lines

The first object of any adjustment, using this method, should be to make the curves, or lines, parallel. That is, to make the inductances the same. To begin with, there should be enough wire on the coils to permit the inductance adjustment to be made

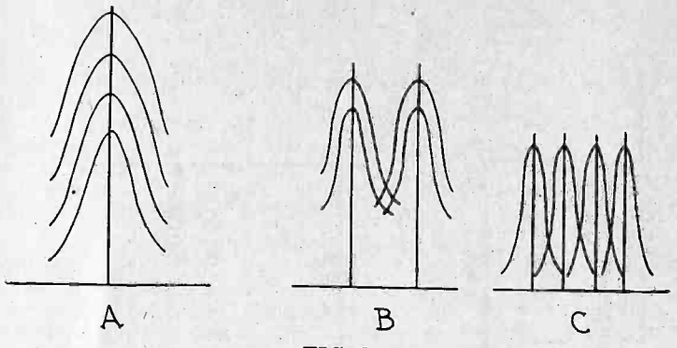


FIG. 2

THESE CURVES SHOW THREE DIFFERENT DEGREES OF ADJUSTMENT OF FOUR TUNED CIRCUITS. A REPRESENTS EXACT ADJUSTMENT, B SHOWS DOUBLE TUNING, AND C BROAD TUNING.

by removing turns. If all the inductances are large enough two of the coils can be adjusted to be equal to that which has the lowest inductance.

When the coils have been adjusted to equality the trimmer condensers should be adjusted. The line which is highest up the graph will have too much capacity and the corresponding trimmer should be reduced. The lowest curve may be all right as it is or it may be that the capacity of the corresponding trimmer may have to be increased. The adjustment of all the trimmers should be made so that the lines cut the wavelength axis at the same point. If they do, and if at the same time they are parallel, they will coincide throughout and the adjustment of the tuned circuits will be correct at every setting.

In applying this method it is not necessary to take many observation points. Perhaps three for each curve will be sufficient, one at each end of the scale and another in the middle. A clear understanding of the meaning of the slope of a curve and of the intercept on the wavelength axis is necessary to apply the method.

It is admitted that this exact method of adjusting the tuned circuits involves a great deal of work, and accurate quantitative work at that. Not many will apply it for that reason. But the principle underlying it is important for it shows what is being done when the successive approximation method is used. In the cut and try method the lines, whether drawn or not, are brought to parallelism in successive steps. Likewise the intercepts on the wavelength axis are brought to equality by the trimmers in successive steps. These steps are taken alternately. The lines are brought together in the same manner as three baseball players are brought together when a man is caught between third base and home.

Effect of Poor Adjustment

The effect of various degrees of adjustment are shown in the graphs in Fig. 2. A represents exact synchonism of four tuned circuits. The peaks fall at the same dial setting and consequently the four tuning curves are drawn with a single line as the axis of symmetry. All the tuned circuits contribute to the selectivity. There is only one point on the dial where the particular station comes in.

In B two circuits are tuned to one frequency, the two others to another frequency. In this case the selectivity will be poor and the given frequency will be tuned in at two settings of the tuning control. Interference of a serious nature may be the result because the lower peak of one station may be same as the higher peak of a station operating on another channel. The two stations may not come in with the same intensity but the signals of one may be heard in the background all the time. This is a frequent and annoying type of interference.

In C is a still more serious situation. All the tuned circuits resonate at different frequencies. Therefore the receiver will not be selective nor will its sensitivity be great. In this drawing the peaks of the four tuned circuits happen to be equally spaced. In such a case there will be one pronounced peak, the resultant of all the individual peaks, but the sharpness of this peak will not be comparable to that of a peak resulting from four peaks that are coincident.

Any four-circuit receiver may have all the characteristics shown in Fig. 2. A would be the characteristic where the trimmer condensers have been adjusted and the others would be at points on the dial remote from the trimming point. If the inductances, the zero setting capacities, and the rates of capacity change are the same in all the circuits, A would be the characteristic throughout the tuning range.

A Pre-Selector Filter

Improves Selectivity of Existing Receiver by Band Pass Method

By Adam Damon

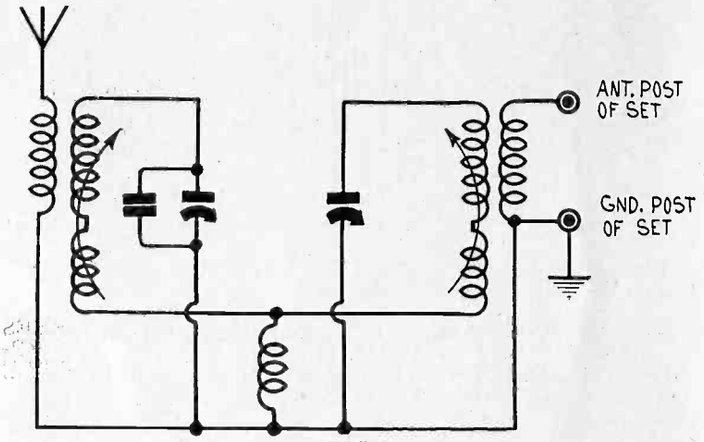


FIG. 1
A BAND PASS FILTER FOR USE AS A PRE-TUNER WITH ANY BROADCAST RECEIVER. TO IMPROVE SELECTIVITY CONSIDERABLY, WITHOUT IMPAIRMENT OF QUALITY.

THE abundance these days of electric sets is likely to lead us to think that we have circuits that are different than those that were offered a few years back.

Then, as now, a great deal of interest was manifested in methods that would enable us to construct a tuned radio frequency circuit that would bring in distant broadcasters and through powerful local stations.

Let us suppose that we have an arrangement whereby we can connect our antenna and ground wires to any one of three RF tuned stages preceding a detector and associated amplifier circuit, and further assume that the RF stages amplify RF only. Also assume that our detector is very sensitive. Then beginning with the RF stage nearest the detector we tune in a given station, but along with the station's carrier come fragments of other signals picked up en route by the original carrier, and weakly overlapping carriers of other stations, all of which combines to make the circuit seem not very selective, in terms of the background noise level, as compared to the desired signal. An untuned input to the detector will be assumed.

Effect on Stray Noises

Now we shift to the next stage, leaving the original adjustments on the other circuits, and proceed to tune the added RF stage. We now find that stray noises have been greatly reduced. The overlapping weak signals we heard at the beginning have disappeared, and the relative acoustical level between the desired signal and the background noise has improved, so we try to improve on this state of affairs by shifting our antenna and ground to the next RF stage. Here we find on tuning the third RF stage to the desired signal that we have increased the desired signal level and also have slightly increased the background noise level, too. So we tune to sharpest resonance and though we improve our desired signal level relative to what it was before, we have not succeeded in effecting as great a change in relative acoustical level between our desired signal and the background noise as we formerly did. This is due to having increased the sensitivity of our responsive circuit out of proportion to its "selective" capability.

Geometric Tuning

Cascade RF amplifiers tune in "geometric order," that is, if we have three tuned circuits that are identical and each has a selectivity "factor" of 1, and the first stage then can be regarded as a kind of "gate," one unit of width in opening, and it allows a unit quantity of signal to pass through, the next "gate" in line allows in one-half of what passed through gate No. 1, and finally gate No. 3 allows one-half of what passes through gate No. 2 to reach the detector.

This action is illustrated in Fig. 2. The incident waves are shown and the "gates" through which they pass.

Lines "Grow" Shorter

It will be seen that the length of the lines in the "gates" are successively shorter as they pass along. This roughly corresponds to the filtering effect of TRF circuits, because this type of filter circuit is operative principally due to progressive absorption of non-resonant frequencies.

The addition of RF stages, we have seen, resulted in our getting a certain compromise energy level between background noise level and desired signal level, and on including a third stage of RF we increased both levels.

Now we know that if we can interpose another "gate" of the correct width, or, electrically speaking, another filter circuit of correct constants for the type of RF tuned amplifier involved, we can expect still further to improve the relative constant level between the desired signal and the background noise, thereby improving the selectivity.

Where Strength Suffers Badly

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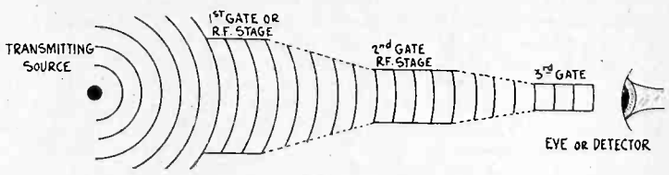
A type of additional filter that overcomes some of the major disadvantages of tricky coil arrangements and in some cases even shielding, is the tuned band pass filter. If a reasonable amount of care is exercised in the assembly and wiring, and in adjustment of tuning condensers and trimmers, a filter can be made which will be of decided help to the DX fan who might otherwise spend a lot of time and extra money attempting the

(*Continued on next page*)

GATE ACTION IN TUNING



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One 7x18-inch bakelite panel.

A SIMPLE BAND-PASS FILTER

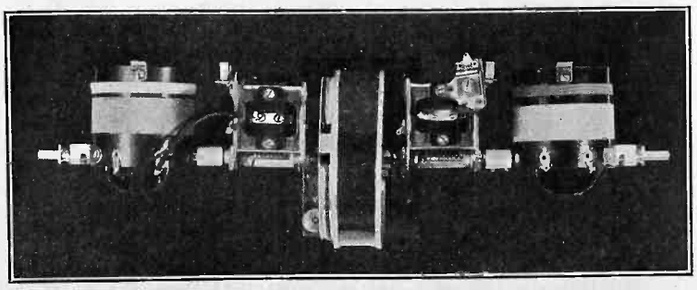

FIG. 3
REAR VIEW OF COMPLETED ASSEMBLY.

Quality Built Into 250's

At Any Volume Push-Pull High-Power Output is Called Best

By F. C. Davis

LET there be a little more light on quality production. There are no half measures possible if one wants the very best quality of radio music, and 245 tubes are a half measure.

Established radio practice is to select an output power tube according to the volume of sound which will be demanded, the theory being that a single 112A will give quality equal to two 250's in push-pull, provided the 112A is not overloaded. And 245s in push-pull are declared to furnish the utmost in quality for the home, because the stage can deliver far more sound than is ever required in a home. The only trouble with this theory is that it is not at all based on fact.

Push-Pull All the Way Through

The fact is that two 250 tubes in push-pull will furnish music of better quality at **any** volume than any other tubes made. Yet this fact has been published only once that I know of, and this in a recent issue of "Radio News." If any radio engineer denies it, it is only because his head is given more to mathematics and set economies than his ears are to musical perception.

Likewise, a set using two 250s in push-pull will furnish better quality if this stage is preceded by another stage of push-pull, using either 226s or 227s, than it will if preceded by a single tube of any type.

Also, a set using two stages of push-pull, the last 250, will furnish better quality if the detector is of the grid-bias type rather than of the grid-leak-condenser type, and a 224 detector will furnish better quality than a 227 if the hook-up is designed for it.

Likewise, screen-grid tubes in the radio stages (or pentodes if they are available) will furnish better quality than 226s, 227s, 201As, 112As, or what have you.

A dynamic speaker certainly will furnish better quality music than a magnetic cone type, and no small baffleboard will do for it, even if all these specified tubes and push-pull stages are utilized.

But regardless of the fact that 224s in the radio stages, a power detector, and two stages of push-pull, the last 250 are used, it is sheer folly to build such a set for the utmost quality unless the set can bring in the stations in which the most important programs originate.

Blames Attenuation by Wires

The reason for this is that little quality comes over the telephone wires which connect the nation-wide hookups. The best set in the world can't make anything but high-pitched tinny sounds when tuned to a station relaying a program from New York over hundreds or thousands of miles of land wire.

An easy way to prove this is to listen to the difference. Some Sunday night tune in the Studebaker Champions from WEAF or your nearest outlet station, then pull in the Chicago station in the studio of which the program originates. Although the Chicago program may be passing through 700 miles more of ether, it will be of better quality (if receiving conditions are clear) than that receivable from WEAF.

This is certainly true when the nearest powerful station to any one listener is equipped with inferior broadcasting apparatus.

Real Estate Note

Those who want the utmost in quality, therefore, should equip themselves with tuner and amplifier using 224s or pentodes in the RF stages, a power detector, preferably of the 224 type, two stages of push-pull, the last being 250, the best dynamic speaker possible to buy, operating preferably from a 6 to 12-volt DC source for minimum hum and maximum quietness, and for best results this speaker should be set into the wall of the room.

Lastly, having equipped himself with this quality apparatus, its owner should move to a position close to New York City and stay there.

The Mystery of Speakerless Speech

IT OFTEN happens that music and speech are heard from a radio receiver even when the loudspeaker is not connected. This phenomenon troubles many of those who have observed it in their receivers. Is it a defect in the receiver that should, if possible, be corrected, and if so, how can it be corrected?

The general cause of the noise, for noise it is, even if speech can be understood, can be stated at once. There is something loose in the receiver which vibrates when the receiver is in operation and acts the same way as the diaphragm in the receiver. The specific cause may not be so easily located, that is, the specific part which is loose.

Two Sources of Trouble

There are two forces which may cause the trouble, namely, electric and magnetic. Of these two, magnetic forces are the more common. Frequently the loose part is the case of an audio transformer, or the case of a power transformer located within the leakage field of an audio transformer. The magnetic lines of force from the transformer act on the transformer case and set it in vibration. Sometimes the vibrating member is a lamina in the transformer core, usually in the audio transformer. The vibrations are strongest when the loose member is iron or other magnetic material.

Electric Forces

But lose iron members are not alone subject to vibration. When any loose metal is subjected to strong electric, alternating or varying, forces the metal vibrates. This is the more severe the higher the varying voltage. In this case the loose member acts as the diaphragm in a condenser type speaker. It is clear that a loose sheet of iron may be subject to both magnetic and electric forces.

The hum that is often heard from a B supply unit is due to the same cause. In this instance it is usually the case of the power transformer that is loose and vibrates because of the leakage flux from the transformer itself.

Now that the cause of speech and music from the receiver without a speaker is understood the remedy is obvious. Prevent vibrations in the loose member. This can be done by clamping it or sometimes simply by damping it with rubber or similar substances. Usually the noise can be stopped by pressing the finger against the vibration member.

Data on Coils for the Pre-Selector Filter

(*Concluded from preceding page*)

often difficult task of making his set selective enough by endless adjustments to coils, tuning condenser and wiring locations.

Helps Where Help Is Needed

It must be realized that unless the receiver be broad to begin with, that is, it does not get rid of crosstalk or similar interference, that any filter circuit, though it may perform as it should, will absorb some of the received RF energy that passes through it, and with this fact understood it can be determined whether the relative change between the desired and undesired signal level, introduced by the use of the filter, is going to be worth while.

What Coils Are Used

The pre-selector diagrammed is one intended for use with existing receivers, so that the antenna and ground wires are moved over to the pre-tuner's binding posts, and the output of the pre-selector is delivered to the antenna and ground posts of the receiver. These posts are not interchangeable, so observe the correct connections.

The coils used are Bernard tuners, which were assembled with condensers attached by a coupling link. An 80 mfd. equalizer makes single control of the pre-selector practical. Full wave band coverage is assured, and high step-up ratio at lower radio frequencies, with lower step-up at higher frequencies. This has a levelling effect on the RF amplification, so that high frequencies do not shout at you and low frequencies merely whisper. The rising characteristic of TRF is partly circumvented. The antenna coil has a small winding, the primary, and a combination of two windings constituting the secondary. The combination is in series and consists of a fixed outside winding and a moving coil actuated by the condenser shaft. The other coil consists of a tuned combination primary, duplicating the previous coil's secondary, and a large pickup coil which the antenna-ground winding of the receiver used virtually short, as is intended, so the energy transfer to the receiver will be large.

A Pre-Selector Filter

Improves Selectivity of Existing Receiver by Band Pass Method

By Adam Damon

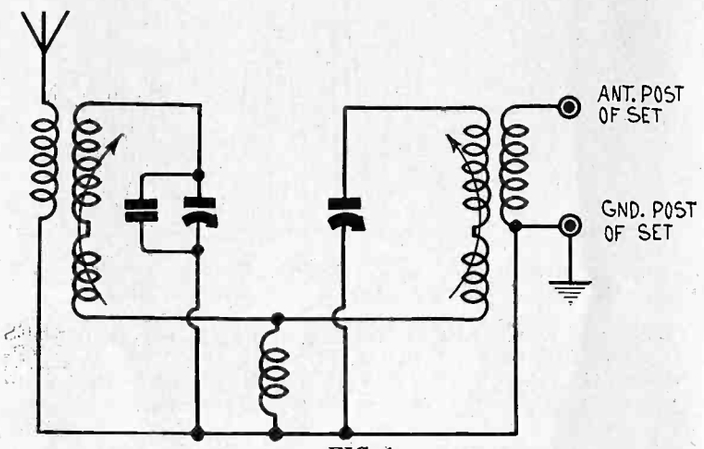

FIG. 1
A BAND PASS FILTER FOR USE AS A PRE-TUNER WITH ANY BROADCAST RECEIVER. TO IMPROVE SELECTIVITY CONSIDERABLY, WITHOUT IMPAIRMENT OF QUALITY.

THE abundance these days of electric sets is likely to lead us to think that we have circuits that are different than those that were offered a few years back.

Then, as now, a great deal of interest was manifested in methods that would enable us to construct a tuned radio frequency circuit that would bring in distant broadcasters and through powerful local stations.

Let us suppose that we have an arrangement whereby we can connect our antenna and ground wires to any one of three RF tuned stages preceding a detector and associated amplifier circuit, and further assume that the RF stages amplify RF only. Also assume that our detector is very sensitive. Then beginning with the RF stage nearest the detector we tune in a given station, but along with the station's carrier come fragments of other signals picked up en route by the original carrier, and weakly overlapping carriers of other stations, all of which combines to make the circuit seem not very selective, in terms of the background noise level, as compared to the desired signal. An untuned input to the detector will be assumed.

Effect on Stray Noises

Now we shift to the next stage, leaving the original adjustments on the other circuits, and proceed to tune the added RF

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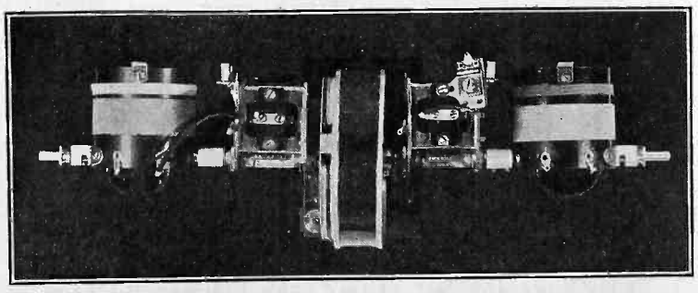

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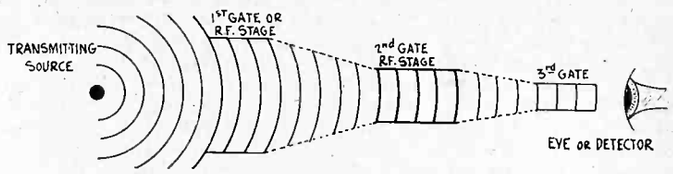

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stage. We now find that stray noises have been greatly reduced. The overlapping weak signals we heard at the beginning have disappeared, and the relative acoustical level between the desired signal and the background noise has improved, so we try to improve on this state of affairs by shifting our antenna and ground to the next RF stage. Here we find on tuning the third RF stage to the desired signal that we have increased the desired signal level and also have slightly increased the background noise level, too. So we tune to sharpest resonance and though we improve our desired signal level relative to what it was before, we have not succeeded in effecting as great a change in relative acoustical level between our desired signal and the background noise as we formerly did. This is due to having increased the sensitivity of our responsive circuit out of proportion to its "selective" capability.

Geometric Tuning

Cascade RF amplifiers tune in "geometric order," that is, if we have three tuned circuits that are identical and each has a selectivity "factor" of 1, and the first stage then can be regarded as a kind of "gate," one unit of width in opening, and it allows a unit quantity of signal to pass through, the next "gate" in line allows in one-half of what passed through gate No. 1, and finally gate No. 3 allows one-half of what passes through gate No. 2 to reach the detector.

This action is illustrated in Fig. 2. The incident waves are shown and the "gates" through which they pass.

Lines "Grow" Shorter

It will be seen that the length of the lines in the "gates" are successively shorter as they pass along. This roughly corresponds to the filtering effect of TRF circuits, because this type of filter circuit is operative principally due to progressive absorption of non-resonant frequencies.

The addition of RF stages, we have seen, resulted in our getting a certain compromise energy level between background noise level and desired signal level, and on including a third stage of RF we increased both levels.

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Data on Coils for the Pre-Selector Filter

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A Comparative Test

Truer Highs as Well as Much Better

By John C.

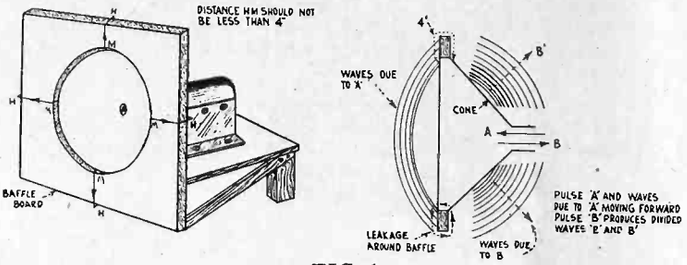


FIG. 1

THE SHORTEST DISTANCE AROUND THE BAFFLE FROM FRONT TO REAR OF THE CUTOUT SHOULD BE NOT LESS THAN 4 INCHES. THIS IS REPRESENTED BY HM AT LEFT.

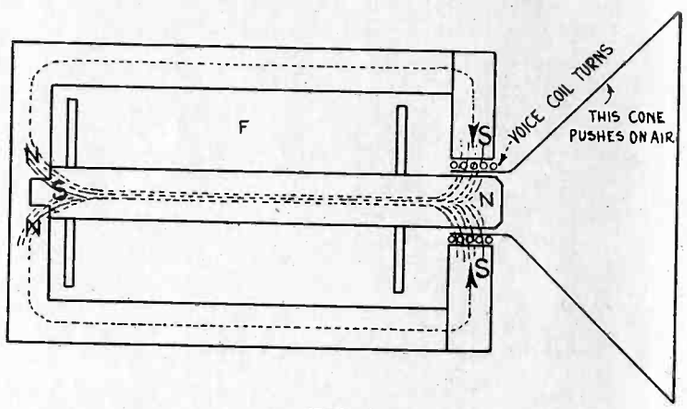


FIG. 2

THE DISPOSITION OF THE COILS AND FLUXES IN A "POT" AND SHOWS VOICE COIL TURNS BEING "CUT" BY THE POT FLUX—THE CONE MOTION DEPENDING ON THE DIRECTION OF CURRENT FLOW IN THE VOICE-COIL.

IF WE have a look at the various ways in which a dynamic speaker may be adapted to operate, we will find a diversity of interesting design characteristics.

Now let us begin with the simplest case, that of the person who has a good battery-operated set and is using a magnetic speaker. Let us assume that he is satisfied with the volume but wants better quality. Just what is better quality, anyway? Is it a lack of some audio frequencies or is it an excess of unwanted frequencies?

Is quality something which the laboratory can get by merely working the slide rule, on one hand, or deliberately modifying the impedance of the operating transformer primary on the other?

Now, every student of physics learns during the early steps he takes in the study of acoustics that quality is the result of overtones, not only the sound that is emitted when a sounding body is struck, but all the associated and simultaneous sounds that are emitted. Some of these bear relation to the original sound produced but many of the others and particularly the weaker pulses set up by the original pulse may not be simply related, so that quality is neither an excess of something or a deficiency of something. It is due to a given natural state of acoustical response, and natural damping. So returning to our case under discussion we find that we must try to improve our quality by making the overtones emitted by our speaker more pleasing. It is a fact that certain combinations of sounds that are pleasing we call harmonious and they bear a certain simple relation to one another. Sounds that are discords, that fray our nerves, are not proportionately related and do not bear a harmonious relationship, harmoniously or acoustically, so, after all, there is something tangible to quality.

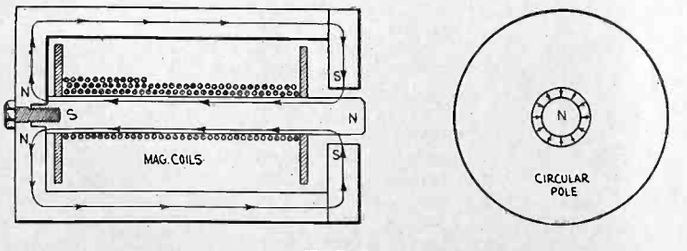


FIG. 3

THE "POT." THIS SHOWS THE ARRANGEMENT OF MAGNETIZING COIL TURNS, AND DIRECTION OF FLUX THROUGH POT WALLS AND AIR GAP.

Acoustical Improvement

And so if our speaker has relatively poor quality we set about improving it acoustically. The unit is presumed to be all right. We study its output with a source of variable frequency alternating voltage. For comparison's sake the actual voltage drop across the unit is kept constant and we start off with a high note, say 3,000 cycles, and take observations as we decrease our testing frequency.

Now as we go down the scale the overtones will decrease, too, generally speaking, but not until we have reached the lowest part of our useful audio range do we begin taking close stock of what we've recorded.

We have found that our speaker was relatively 50% better on the highs (between 1,500 cycles and 3,000 cycles) compared to the lows (40 to 80 cycles). We find a reason for poor audio quality, because the speaker lacks the ability to radiate well on the low end. The associated overtones are therefore missing. So we place the speaker in a baffle that is so constructed that the volume of air enclosed behind the baffle is about 3 times as great as the volume of air in front of the cone. The object is to load the rear surface of the cone in some ratio to the load on the front. Three-to-1 is a good ratio for reasons that will be discussed later on.

Better Response on Lows

Now on repeating the test we find that the low response of our speaker is considerably better and consequently there will be more overtones and resultant better quality, which is confirmed by a trial on the radio set.

Now that we know that to obtain better quality we have to get more overtones effective, the next logical question is that of volume, in other words, acoustic pressure. We increased the output power applied to our magnetic unit but found that it began blasting, an effect that is most unpleasant to listen to, and due to the relatively large motion of the unit driving the armature at a low frequency, compared to its motion on the higher frequencies. Therefore we have reached a practical limit for this case and must adopt some other method of handling the additional electrical audio frequencies which we want converted into sound.

So now we have to call for a device whose sounding body is capable of executing large excursions, far larger than any possible combination of levers, armatures and springs, no matter how they are arranged, and this fundamental requirement is met by the dynamic or moving coil type of speaker, mounted in a baffle.

We will proceed to adapt a dynamic to our battery set and we will obtain a step-down transformer of ratio to match the motional impedance of the voice-coil to the audio amplifier tube with which it is used.

Voltage Input

We will have to make some assumptions to be subject to correction and final verification later on in regard to the conditions which affect the voice coil. There are the size of the coil and the field intensity or flux. An input wattage of about 8 watts DC is required in most dynamic "pots" or field coils to maintain the field or flux in which the voice coil operates at or near a suitable value, so let us chose this input wattage to the pot for the present.

This means that our "pot"-coil input must be 8 watts and on a 6-volt circuit the current will be 1.34 amperes. The resistance of the winding will be 4.6 ohms. We need in the neighborhood of 1,500 ampere turns, and if we use No. 17 enamelled wire for our winding we will have sufficient turns to provide the flux.

# of Dynamic Results

ows, as Compared with Magnetic

Villiams

The actual relationships of the above and means of determining the best economical designs will be taken up later.

Our 1,500 ampere turns and 1.34 amperes mean that we can predict the size and shape of our "pot," provided we make some further assumption for the present. Let us decide to make a solenoid an inch or so longer than its diameter. Since 3 inches or so inside diameter is a standard article we can use this for our "pot" internal diameter.

Now, the next issue is, what diameter voice-coil? The principal item of immediate interest here is what sized "pot" core will carry the flux that we desire in the airgap where the voice coil operates. There is lots of room for argument here and one answer is that we have to know the magnetic permeability of the substance that we are going to use as core material. It happens that a core material is available which makes possible the utilization of a relatively smaller-core diameter on account of its high flux carrying power or permeability.

We will choose Swedish iron, which is about 98% pure, and the core diameter will be 1 inch because this will mean cutting away only a small portion of the center of the cone, and it is desirable to cut away as little as possible.

Width of Air Gap

The air gap in which the voice coil operates is formed by placing a circular pole concentrically around the central core or pole, as it will now be called, and the outer periphery of the circular outer pole fits to the outer periphery of the "pot." The air gap in which the voice coil is made to operate is usually 0.250 inch to 0.258 inch, and we will make our voice coil so that it clears the central pole by 0.005 inch all around and be wound with about 80 turns of No. 33 enamelled wire. The resistance of the winding is 6 ohms, approximately. Its resistance may differ slightly without introducing any serious effects.

The voice coil is now attached to a cone, and a supporting centering spring of bakelite is also include in the assembly. Our cone is mounted and placed in a cone supporting housing, a member that acts as a partial support for the "pot."

Now the voice coil operating transformer is the most important item for consideration for three reasons: (1), because it is the connecting medium between the speaker and the set; (2), because its design can be altered to give pre-determined acoustical effects, and (3), because its frequency range is controllable, and hence it affects the speaker performance directly.

Related in importance to the voice coil transformer is the cone, consisting of the assembly of the cone supporting leather, and the voice coil spring and voice coil. The cone we are assuming is not radically different from the original magnetic speaker cone we started with.

Transformer Impedance

Now we're back to the tranformer again. If the load impedance of the primary is made 4,000 ohms, which it will be found is a suitable volume for use with a 171A tube, the ratio of winding will be 1-20, assuming that the voice coil motional impedance is 10 ohms.

The transformer is assumed to have a flat response curve, as most good designs have, therefore if we operate our voice coil with the above transformer we have a speaker set up that is sufficiently correct to make a comparison.

Now if we set up our sound pressure recording apparatus again, this time the electrical arrangements will be somewhat more complicated due to testing two speakers, and our desire is to know about many more constants, for we can now make comparisons.

Let us aim both speakers, suitably mounted in simliar baffles, at the sound pressure recording apparatus at such a distance that the direct wave from the speaker will be the principal effective sound. Then we arrange a switch to apply the variable AC testing voltage to either speaker and arange also to measure the power input to each speaker. We are ready to begin the test.

Keeping the input voltage constant across either speaker input terminals, we start with the high note again and go down the scale gradually. We find not so very much difference between the sound pressures of the two speakers on the high, but the dynamic cone sounds clearer. As we go down we find a very gradually increasing sound pressure for the dynamic and also a gradual increase of overtones. As we pass the lower end of the middle register we find the dynamic decidedly better until we

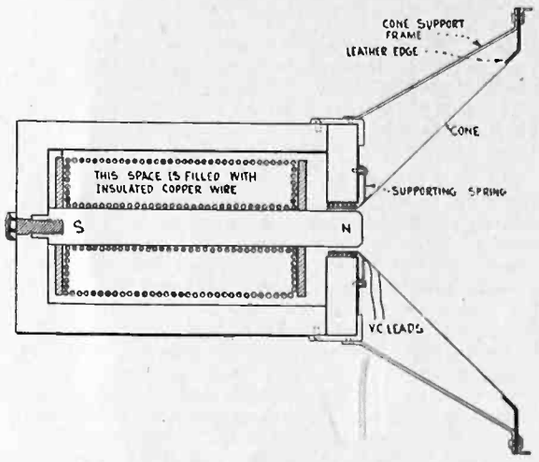


FIG. 4
THIS SHOWS LOCATION OF VOICE COIL TURNS IN AIR GAP, AND CONE SUSPENSION METHOD.

reach the lower end in the bass, when the dynamic is decidedly superior. The magnetic is developing a rattling sound and upon increasing the input voltage a little the magnetic speaker rattles.

Put to Reproduction Test

So now we put both speakers on the air, and our ear should confirm what the sound-pressure device indicates.

Now of course the time is ripe for questions, and in they come. How can I raise the pitch of my speaker? How can I get more depth, or roundness, or how can I use two 250s in push-pull with 700 volts on the plate? Can I operate my speaker by the plate supply to my set? Can a speaker be operated with a 171A tube or with a 201A? All these and many other questions are justified, and can be answered correctly provided all the facts pertinent to the question are included.

Frequency of Hum

A question very frequently asked in connection with speakers, especially with those that are dry-rectifier operated, is: "How can I kill that hum?" The answer is that the hum can only be reduced to a point where it is relatively ineffective acoustically, and not objectionable. And right here the value of a voltage for an annoyingly loud hum will be of interest, primarily because of its relatively low value to other voltages employed in the operation of the speaker. This troublesome hum voltage is of the order of 20 millivolts.

Some of our most effective hum elimination circuits reduce this value to around 2 millivolts, but it is a very troublesome feature of the AC operated design, hence the high inductance type of magnetizing coil winding is most widely used now. But even in this model the field supply current must be partly filtered.

[*Hum elimination problems will be discussed in the next article for all types of "pots" commonly used, and there will be mention of the relation of this to rectifier output characteristics.—Editor.*]

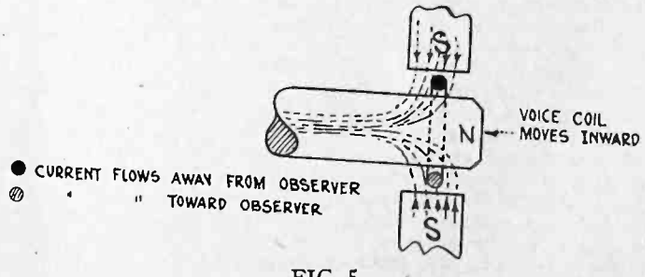
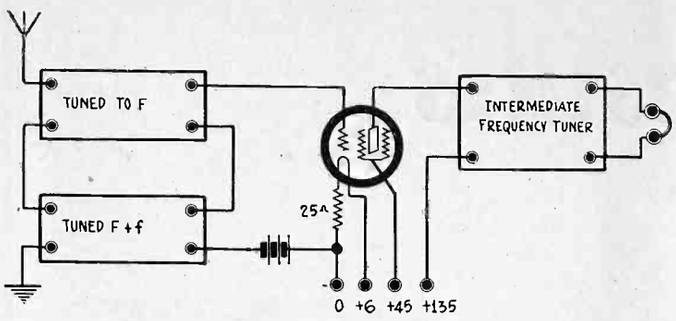


FIG. 5
THIS SHOWS HOW THE VOICE-COIL DEVELOPS MECHANICAL FORCE, UNDER THE CONDITIONS SHOWN THE VOICE COIL IS MOVING INWARD BECAUSE THE ADJACENT CONDUCTOR FLUXES ARE OPPOSITE.



THIS SHOWS THE METHOD OF COUPLING TWO TUNERS IN SERIES TO IMPRESS TWO SIGNALS OF DIFFERENT FREQUENCIES AT THE SAME TIME FOR PRODUCING AN INTERMEDIATE FREQUENCY.

Intermed

How to Wind Them and

By Knollys

IN THE article "Trend in Design of Super-heterodynes" which appeared in the March 15 issue we emphasized the advantages of a 500 kc intermediate frequency. The main advantage was said to be that there would be no repeats of stations in the broadcast band provided that the oscillator was designed so that signals could be received on the upper frequency setting alone.

It is well, also, to call attention to a disadvantage of the 500 kc frequency, one which was not mentioned in the article. It is well known that many code stations operate on this frequency and that many of these still use spark equipment. Since the intermediate frequency amplifier is tuned to the same frequency as that used by these code stations it is likely that there will be much interference, both in intensity and in frequency of occurrence. Indeed, there is a possibility that interference will be continuous.

This trouble would rule out the 500 kc frequency definitely if there were no way of overcoming the difficulty. Fortunately there are many ways in which the interference can be avoided.

Shield Intermediate Amplifier

The code signals will not get through the modulator and the oscillator in the same manner as the signals desired do. They can only get through because the intermediate frequency amplifier picks up the signals directly. Therefore it is a simple matter to avoid the interference by shielding the intermediate frequency amplifier. This shielding should not be confined to the coils alone, but should extend to leads to the filament and B supplies. Or better, the receiver as a whole should be shielded. This shielding does not impose any conditions that are not satisfied by most broadcast receivers of the modern type.

Copious use of by-pass condensers will help greatly to prevent leads from acting as antennas. Likewise choke coils are useful to eliminate the intereference, if it should occur. The AC circuit published in the cited article is well provided with both chokes and condensers, and the DC circuit does not require so many.

Moreover, while the intermedite frequency is nominally 500 kc, it is not necessary to use exactly that. There is no objection against using a frequency ten or twenty kilocycles above or below that, although it is not advisable to deviate as much as 50 kc in either direction. By this is not meant that other intermediate frequencies are not suitable for a Super-heterodyne. They are, but if the deviation is greater than ten or twenty kilocycles, the special advantages of the 500 kc frequency cited in the article are sacrificed to some extent.

If the intermediate frequency does differ about 10 kilocycles from 500 kc there will be little trouble from code interference even if the intermediate frequency amplifier is not shielded.

Coils for Amplifier

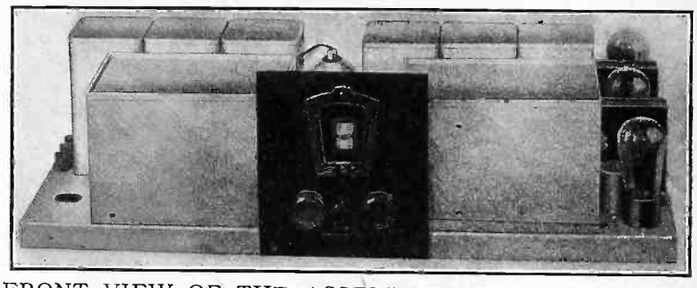
Many radio enthusiasts will have coils designed for .0005 mfd. condensers and many others will have coils for .00035 mfd. condensers. The larger of these condensers are standard and can be obtained without any trouble. The smaller, however, are not usually available in fixed capacities. Fixed condensers of this capacity can be made up by connecting .00025 and .0001 units in parallel. If this is not desired and the coils available are for .00035 mfd. turns and can be removed from the secondaries of the coils until the inductance in each is right for .0005 mfd.

Some experimenters may wish to wind their own coils, which they can do with a little patience. A suitable coil form for a .0005 mfd. condenser is a cylinder of 1.25-inch diameter, and a suitable wire is No. 28 enameled copper. With this combination the number of turns to give 500 kc peaking should be 100. This will make a winding about 1.36 inches long.

If it is desired to use a .00025 mfd. condenser for tuning, the coil diameter should be larger, say 1.5 inches. The wire may be the same. The number of turns now should be 134, which makes a winding about 1.8 inches long.

Since there will be a certain amount of distributed capacity in either case, some of which will be in the coil and some in the tube, the peak will be a little lower than 500 kc. If the receiver works satisfactorily with respect to tuning after all the tuned circuits have been adjusted to resonate at the same frequency, there is no reason for changing the intermediate frequency. However, if it is too low it only requires the removal of a few

Wiring Directions



FRONT VIEW OF THE ASSEMBLED HI-Q DC MODEL RECEIVER WITH THE CONTAINING CABINET REMOVED

should now be attached to the connector and the black wire attached to the minus terminal of the storage battery.

Connection of Voltmeter

The plus post of a voltmeter of the low scale type should now be connected to the plus terminal of the storage battery and the red wire of the cable to the minus post of the voltmeter. When the set switch is "off," no reading should be obtained. When "on," the meter should indicate 6 volts. With the switch turned "off," disconnect the red wire from the meter. Then touch each of the remaining cable wires to the minus post of the meter. No readings should be obtained. If such is the case pull out the cable plug and connect the cable wires to the batteries. If only 135 volts of B battery are available, the grey cable lead is connected to the plus 135 and the brown to the minus 27. If 112A tubes are used in the push-pull stage the grey wire is connected to the plus 135 and the brown wire to the minus 9.

Now connect the cable, the loud speaker, and the antenna and ground wires. The "on' and "off" switch can now be turned on and if all the connections have been made correctly, the filaments of all the tubes should light. If a tube fails to light, a careful check of the connections to its socket will reveal the trouble.

Assuming that all the tubes light properly, advance the volume control to the half or three-quarters points and rotate the tuning dial slowly until a station is heard. Then as the signal increases reduce the volume control and readjust the tuning dial until the best tuning adjustment is obtained.

Final Equalizing Adjustment

Although all possible matching adjustments have been made at the factory, the final adjustment of the six equalizers can only be made after the receiver is in actual operation. One of these equalizers is connected across each section of the two triple-gang condensers. In adjusting them a wooden or other insulated screw driver is convenient.

Preliminary synchronizing can now be done by adjusting each equalizing condenser for loudest signal. It is extremely important that the volume be kept at a low point during these adjustments, as otherwise a false setting may be made.

When this adjustment has been completed, the receiver will be found to track well, but a final adjustment, made by tuning in a weak station at around five or ten on the dial, and carefully resetting each equalizer for loudest signal, will make the tracking still better. During the adjustment keep the volume as low as practical. Theoretically, adjustment of the equalizers can best be done at the lowest wavelength, that is, at 200 meters, which should be received with the dial at 5 degrees, but practically it is sometimes preferable to adjust at a higher setting.

Any Length Antenna May Be Used

Due to the use of the three-stage input filter in the HiQ-30, the length of the antenna does not have a very marked effect on the selectivity of the receiver. There are two antenna

iate Coils

djust for 500 kc or Less

Satterwhite

turns from each tuned winding to bring it up. The adjustment should be made by removing one turn at a time from each coil.

If the coils are to be used after screen grid tubes, either of the DC or AC types, the number of turns on the primaries may be half the number on the corresponding secondaries. That is, the coils for the .0005 mfd. condensers would have 50-turn primaries and the coils for the .00025 mfd. condensers would have 67-turn primaries.

It is important that the primary and secondary turns be closely coupled, yet it is equally important that the capacity between the windings be as low as practicable. In order to get the closest coupling possible with specified turns, the primary on any coils should be placed in the center of the secondary, either inside or outside. In order to make the capacity between the two windings small there should be a space between them. But the greater the space the looser will the coupling be, and thus it is necessary to compromise. For example, the secondary may be wound on the form first. This may then be covered with several layers of paraffined paper or empire cloth, upon which the primary may be wound.

The primary winding may well be wound with finer wire than the secondary, although if the wire is not available No. 28 may be used. The finer wire has the advantage of making the capacity between the two windings slightly less. Another way of reducing the effect of a given capacity is to wind the primary near the low potential end of the secondary. Unfortunately, this loosens the inductive coupling between the two windings and thus tends to reduce the amplification, but at the same time it will improve the selectivity.

Adjustment of Tuned Circuits.

Commercial condensers specified ratings vary among themselves a great deal. This fact must be taken into account when the tuned circuits are adjusted. It cannot be assumed that because the coils are made exactly alike and because the condensers have the same ratings the tuned circuits will be resonant at the same frequency. In general they will be peaked at quite different frequencies. This, of course, will make the selectivity as well as the amplification poor. It is necessary to tune the intermediate frequency selector just as carefully as a radio frequency tuner. But since the intermediate frequency is always the same it is only necessary to make the adjustment once.

The tuning may be effected in one or two ways. First, a trimmer condenser may be connected in parallel with each fixed condenser and the tuning effected with the trimmer. The capacity of each trimmer should be at least as great as the maximum deviation of the fixed condenser from the rated value, or from the average value of the condensers used. Only as much of the trimmer condenser capacity should be used as is necessary, because the capacity thus added will lower the intermediate frequency.

The second method of tuning the circuits is to adjust the turns on the secondaries. This is really the simplest and most economical since it does not require any extra parts. However, it is not possible to make the adjustment as accurately in this way as with condensers. When the coil form is small and the number of turns is large more accurate adjustment is possible than when a large form is used. This is one reason the coils suggested are for 1.25-inch diameter.

Sometimes the capacity of the fixed condensers can be varied by small amounts by putting screws through the holes and tightening with a nut. By exerting pressure the tin foil and the mica insulators can be forced closer together, thus increasing the capacity, and similarly by loosening the screw the existing pressure will be reduced, which will lower the capacity. Some condensers, however, are so rigidly made that this variation is not possible. Other condensers are so made that they would have to be put between clamps in order to vary the capacity in this manner.

When adjusting by the turns method do not cut the wire when a turn has been removed. It may be necessary to put it back on again. Simply remove the wire and straighten it out.

Two-Method Adjustment.

It is, of course, possible to use both the turns method and the trimmer methods of adjusting the tuned circuits. If this is done the turns should be adjusted for approximate tuning and the trimmer condensers for final, precise tuning. In this case the trimmer may be of the wafer type since only a small capacity range is required.

While adjusting the intermediate frequency selector a signal should be tuned in with the radio frequency tuners and no part of the high frequency circuits should be altered. It is especially important that the oscillator be not touched in any way, because if the oscillator control be changed the beat frequency between the signal carrier and the local oscillation will change by a large percentage, necessitating large changes in the intermediate frequency selector.

Those who care to go to the trouble of making two tuners which may be adjusted to two broadcast stations operating 500 kc apart can get a constant source of intermediate frequency. It is only necessary to couple these tuners to the same detector tube. The output will contain the 500 kc frequency which may be used for adjusting the circuits. However, it is not in every place where two such stations can be received. In New York WGBS and WLWL are operating on 600 and 1,100 kc, respectively, and the beat between them would be 500 kc. The accuracy of the beat frequency would depend on the accuracy of the two beating frequencies. Since they are not allowed to deviate more than 500 cycles the greatest possible deviation is 1,000 cycles. The highest error would then be .2 of one per cent.

for the Hi-Q

binding posts, one for a long and one for a short antenna. In general, a long antenna may be considered as one having an overall length, including the lead-in, of 75 feet or more. Such an antenna normally should be connected to the middle of the three binding posts. A short outside or indoor antenna will in general give best results if connected to the post marked "short antenna." However, the most efficient connection can best be determined by experiment under actual operating conditions. When testing for best results, it will generally be necessary slightly to readjust the first equalizer when shifting the antenna from one post to the other. When the best connection for a particular set and location has been obtained, the first equalizer can finally be adjusted, preferably at a low dial setting, after which no further change should be necessary.

Ordinarily best reception is had when the receiver is accurately tuned to the incoming signal and the volume control setting reduced to the lowest point for the desired amount of sound from the loud speaker. In no case should the receiver be detuned to reduce the volume, as when this is done the quality of the output from the reproducer is quite materially affected. As stated previously, the volume control and the tuning dial should be alternately adjusted until the proper loudness is obtained with the lowest setting of the volume control.

Checking Up on the Voltages

As an aid to checking up the accuracy of wiring and making sure that the voltages at various points in the circuit are correct, the following table of voltages is given. A high resistance direct current voltmeter, one having a resistance of 1,000 ohms per volt, is needed for these tests. Connect the negative terminal of this voltmeter to the chassis, turn on the set and adjust the volume control to about half on. Attach a piece of wire to the positive terminal of the voltmeter. When the free end of this wire is touched to the following points, the voltmeter should read as indicated below:

P terminal of socket 1, 2, 3 and 5	135 volts
P terminal of socket 4	45 volts
P terminal of socket 6 and 7	135-180 volts
G terminal of socket 1, 2 and 3	10 volts
F terminal of socket 1, 2 and 3	1.3 volts

The voltage between the F terminals of sockets 1, 2 and 3 should be 3.0 to 3.3 volts, while the voltage between the F terminals of sockets 4, 5, 6 and 7 should be 5 volts.

Byrd's Voice Echoes In Short-Wave Talk

The phenomenon of a double transmission was recently demonstrated in connection with the two-way radio phone talk between Schenectady, N. Y., and Dunedin, New Zealand, when Admiral Byrd spoke.

Many listeners here with sufficient luck and acute hearing were able distinctly to hear words apparently spoken twice.

At times the voices from Dunedin seemed to have an echo or shadow which came from the loud speaker a fraction of a second after the "main signal".

Naturally the echo was of lower intensity than the main signal which it followed closely. For instance, if the person speaking at Dunedin spoke a short word, and sufficient time elapsed before the next word was spoken, the listener at Schenectady would hear the repetition easily.

One explanation of the above was that as radio waves travel in all directions from a transmitting antenna, the ground wave took the most direct path to Schenectady from Dunedin, while the sky wave by a longer path arrived at Schenectady as the echo.

Resolved, That Sideb

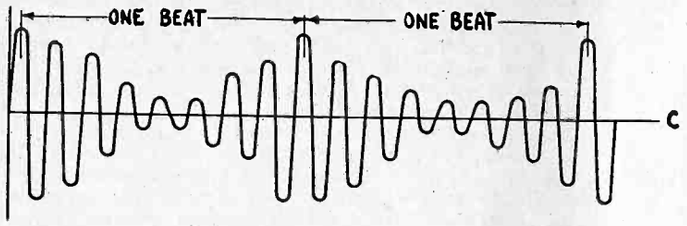


FIG. 1
A COMPLEX WAVE RESULTING FROM THE MIXING OF A WAVE OF HIGH FREQUENCY AND ONE OF LOW FREQUENCY. THE AMPLITUDE OF THE RESULTING WAVE VARIES.

AFFIRMATIVE

By Thomas Callfort

WHEN two alternating currents of different frequencies are mixed there results a complex alternating current the amplitude of which varies in a definite matter. If the frequency of one is much greater than that of the other, and if the lower frequency current has a smaller amplitude than the other, the complex current may be regarded as a current having the higher frequency and an amplitude which varies in accordance with the lower frequency.

It can be shown by simple mathematical juggling that this complex current is mathematically equivalent to three currents, one having the frequency of the original current of higher frequency, another having a frequency of the sum of the frequencies of the two originals, and the third a frequency equal to the differences between the two original frequencies.

A certain definite relationship exists among these three currents. The sum and difference frequencies are called side frequencies to the higher of the original frequencies, which is called the carrier. When either side frequency may assume any value within a certain band of frequencies, that band is called a sideband.

For example, when a radio frequency current of 1,000,000 cycles is modulated by musical frequencies, one sideband may range from 1,000,030 to 1,010,000 cycles and the other from 999,970 to 990,000 cycles.

Are Side Frequencies Real?

There now rages a controversy as to the reality of side frequencies. Some say that they represent real currents, others that they are only mathematical conveniences.

Sir John A. Fleming, England's best-known man of radio, and a mathematian of note, recently stated in effect that side frequencies are nothing but mathematical fictions, non-existent in reality, and that they are in fact only mathematical toys with which radio engineers find it convenient to play. Sir John's recognized standing as a radio authority and mathematician commands attention to his assertion. That he himself has found it convenient to toy with the side frequencies in the past in no way detracts from the importance of his pronouncement. It is one thing to use side frequencies when it is convenient and proper thing to do, and another thing to believe in their reality.

Many radio fans have taken side frequencies and sidebands very seriously and have worried a great deal about the quality impairment supposed to result if the tuners in a radio receiver are so selective as to suppress the higher side frequencies. But this is not all. One fan recently wrote:

"All this ballyhoo about cutting sidebands is the bunk. I have a receiver as selective as anybody's, and, believe me, I get real quality from distant stations."

If side frequencies are real, high quality should not be consistent with high selectivity, for the selector would suppress all except the lowest audio frequencies. Distant reception with such a receiver should be characterized by a predominance of low notes. But it is a fact that even with highly selective Superheterodynes it is possible to receive excellent music and speech. Indeed, it is possible clearly to hear the sibilant consonants in speech which are supposed to be suppressed by a highly selective circuit.

Demonstration of Reality

A few years ago at a meeting of the New York Electrical Society a well-known American engineer closely associated with the establishment of broadcasting attempted to demonstrate the reality of side frequencies.

"They are real," he said, "and not merely mathematical stractions."

He then proceeded to show the concreteness of the side f quencies by producing audible heterodynes between them. T demonstration apparently was conclusive. In reality the gineer demonstrated nothing except that vacuum tubes distor fact so well known that it needed no demonstration.

The fact that acoustic beats can be heard as separate to is often pointed to as evidence of the existence of side f quencies. What can be more conclusive than a demonstrat which affects the senses of perception? An experiment of t kind does not prove that side frequencies exist when two sou are produced separately. It merely proves that the ear is imperfect mechanism and that it has the same distorting prop ties as a vacuum tube. It has not yet been proved by perf instruments, where two sounds of different frequencies co-ex that the air pressure varies according to the sum and differe frequencies. It has, however, been proved mathematically t if the air itself is distorting, the side frequencies do exist, but t proof is based on exactly the same mathematical reasoning the proof of the existence of side frequencies in the ether. distorting ether has not been admitted by anybody. If the et is not distorting there is not even a mathematical excuse for t assertion that side frequencies exist.

Nature of Reality

The nature of a real ether wave composed of two waves different frequency is a wave of varying amplitude, t amplitude of the wave of higher frequency and grea intensity varying in accordance with the frequency of the low frequency wave. When the higher frequency wave is the l intense the frequency of the composite wave is determined that of the lower frequency wave and the higher frequency wa exists on top of the other as a ripple. It is only the case which the higher frequency is the more intense that is of i terest in broadcasting, because the carrier has always t higher frequency and is always the more intense.

Suppose a carrier of 1,000,000 cycles is modulated with audio frequency tone of 10,000 cycles. The sideband theory th says that the resulting wave consists of three waves, one of 000,000 cycles, one of 990,000 cycles and a third of 1,010,000 cycl The receiver is tunder to the carrier and the other two wav would be partly tuned out. The more selective the circuit, t more the side frequencies would be tuned out. In a highly s lective circuit the side frequencies would be almost entirely su pressed, so that after detection there would be no audio note 10,000 cycles. Does this ever happen? If so, it would be in superheterodyne. But there has not been a superheterodyne selective that the 10,000 cycle frequency has been suppressed, least so most superheterodyne enthusiasts say. And they a supported by Fleming.

Now, if the signal consists of a single radio frequency wi a periodic variation in the amplitude at a rate of 10,000 variati periods per second, the tuner should not tune out the 10,0 cycle frequency. It is only the amplitude of the complex wa that varies and the tuner has nothing to do with amplitude. discriminates between different frequencies only. So from th view there should be no side frequency suppression no matt how selective the tuner. This is qualitatively borne out by e periment, and there is no theoretical ground on which to co tradict it. Even authorities who know their mathematics, a can use it as a convenient tool, agree. It is only those who u mathematics to attribute reality to fiction who speak of t existence of sidebands.

Equivalent Conceptions

There can be no quarrel about the mathematical equivalen of the two conceptions. They are numerically equal. But th does not mean that the sideband conception represents a physic reality. We all know that a twenty dollar gold piece has t same value as one $10 gold piece and two $5 gold pieces. B nobody would say that the two equal values are equal physical In one case there is a single piece and in the other, three di tinct pieces, and no amount of arithmetical juggling with t three gold pieces will make them into a single $20 gold piece.

Result of Distortion

The existence of side frequencies in the plate currents vacuum tubes cannot be denied. They are produced by t distortion in the tube, by the property of the tube which caus detection, modulation, and harmonic production. But when modulated wave reaches the antenna it consists of a single wa of varying amplitude. Those side frequency currents which a produced in any tube of the receiver are tuned out by the su ceeding tuner because at this stage they are real entities. It w this fact which the engineer referred to above proved when h produced heterodyne whistles between side frequencies. C rather, he proved that the tubes involved were not distortionle amplifiers.

nds Are Mere Fiction

NEGATIVE

By Edward Forest Wing

ARE side frequencies realities or merely mathematical abstractions introduced by mathematicians to help them solve problems which otherwise would present considerable difficulty? This is a question which has been discussed a good deal in radio circles. It seems that the reality is largely a matter of the degree of imagination a person may have, or the purpose he may have in view.

Professional experts are remarkably adaptable to practical conditions. One group of alienists, for example, will pronounce an accused person a hopeless lunatic if paid well enough to do so. Another group of alienists will pronounce the same person as sane as the prosecutor, if they have been well enough paid to do so. Both these groups may study the same person at the same time and subject him to the same tests, and they may have the same claims to being experts on mental pathology.

Engineers do the same thing, and we had had striking examples of it recently when radio engineers testified before the Federal Radio Commission. One group of engineers says that 30 kc separation between local stations is not enough. Another group made up of equally well-versed experts testifies that it is ample. Engineers, working in an exact science are more handicapped than alienists, who deal with the vagaries of the human mind, in that once they have taken a certain stand they cannot alter it when a higher bidder comes along, unless a sufficient time has elapsed to permit them to offer "changed conditions."

An Expert's Stand

Sir J. A. Fleming, the great English radio authority, has recently associated himself with Baird Television Company. This may or may not have something to do with the learned doctor's recent stand on the existence of side frequencies. It is generally conceded that to transmit high quality television signals a very broad band in the frequency spectrum is necessary. The American representative of Baird stated this as a fact at a recent demonstration of television in New York. It is also a fact that the authorities in England demand that television signals be kept within the narrow limits of broadcasting channels. This limitation is not consistent with the best television signals.

Now Dr. Fleming has come out with a statement that side frequencies are purely mathematical abstractions and that they don't really determine the quality of television signals. They are convenient tricks of the mathematician and nothing more, says he. A tuner may be as sharp as you please and there will be no impairment whatsoever to the quality of television signals, or any other signals carried by a high radio frequency.

Dr. Fleming has used these convenient tricks himself in his copious and authoritative writings on radio. It appears now that he finds it convenient as a consulting expert to call them mathematical abstractions. He is not guilty of any lack of consistency, however, though he may lean too strongly on convenience. It certainly is convenient to call side frequencies mathematical abstractions when the Baird company is trying to provide high quality television signals. If side frequencies are pure abstractions there would be no reason at all for limiting the frequency band for television or any other carrier signalling.

Equivalence Admitted

Both sides of the controversy admit the mathematical equivalence of the single wave of varying amplitude and the wave composed of a pure carrier with the sum and difference side frequencies. Anybody with a little knowledge of trigonometry can prove it and verify the proof with simple computations.

But those who contend that the side frequency theory is a pure abstraction are obviously wrong. The mathematical equivalence of the two viewpoints must have a physical basis. Two things are not identically equal mathematically unless they are also physically equal.

Simple experiments prove that the consequences expected from the side frequency theory happen in fact. Take a radio receiver which is so broad that it brings in all the broadcast stations at any setting of the dial, provided that the stations are strong enough. Listen to the high frequencies, those resulting from the presence of the so-called fictional side frequencies remote from the carrier. They are strong. The hissing sounds can be heard distinctly.

Now change the circuit so that it is exceedingly selective. This can be done in the simplest way by adding regeneration. Listen once more for those high frequencies, the hissing sounds. Are they there in fact or are they simply supplied by the imagination of the listener? They are not there at all. If the listener is a good guesser he may supply them in imagination, but sometimes he may not be able to do even that. Did anybody ever hear good quality from a station 2,000 miles away on a regenerative or other highly selective receiver? Never! When somebody says he did he is merely admitting that he is not a good judge of quality.

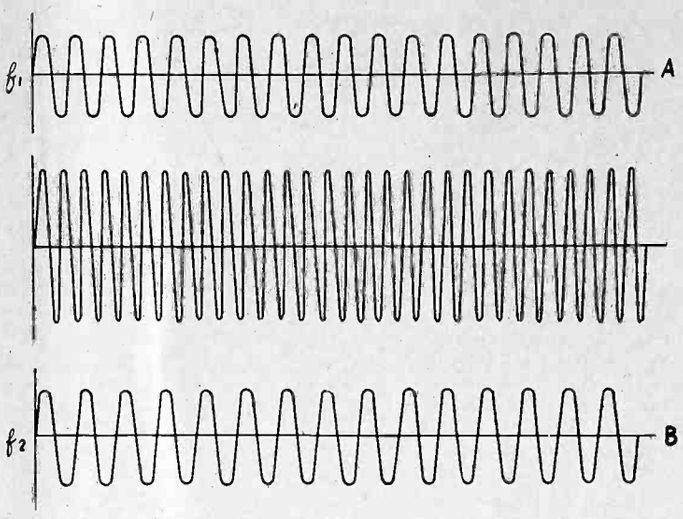


FIG. 2
THE COMPONENTS OF A MODULATED WAVE CONSISTING OF THE UPPER SIDE FREQUENCY, THE CARRIER, AND THE LOWER SIDE FREQUENCY. THESE THREE ARE MATHEMATICALLY AND PHYSICALLY EQUIVALENT TO THE WAVE IN FIG. 1.

Did anybody hear good quality on a super-selective superheterodyne, one having many highly resonant intermediate tuned circuits of comparatively low frequency? No one ever did. When he says he did, he, too, confesses that he is not a good judge of quality. He has come to associate low tones with good quality. The absence of the hissing sound is interpreted as a virtue of the receiver.

Fiction Admitted

Let us admit that the side frequency theory is pure fiction, that the side frequencies are in fact nothing but mathematical abstractions. This admission does not in the least weaken the conclusions reached by considering them as real physical entities. Exactly the same conclusions can be reached by considering a modulated wave as a carrier wave of varying amplitude. If that were not true, the mathematical equivalence of the two view points would have to be abandoned. We will not commit an absurdity by doing that for the sake of convenience. Let those who scoff at the side frequencies attempt to do that. They are the sticklers for convenience.

In arriving at the conclusions from the varying amplitude theory it is convenient, to be sure, to go through the steps of the side frequency theory, but in doing so we don't have to admit at any time that side frequencies are real. We say when we reach them that they are nothing but mathematical abstractions. But if the scoffers insist, despite their admission of the mathematical equivalence of the two viewpoints, we are willing to omit the side frequencies entirely. Indeed, we are willing to omit any reference to the carrier frequency as well. Instead of talking about frequencies we will talk about rates of change of currents or voltages with respect to time.

What Morecroft Did

Prof. John H. Morecroft, of Columbia University, has studied the effect of tuned circuits on modulation frequencies and shown the results with oscillograph records. The results clearly show that the amplitude of a high frequency component in a complex wave is reduced by a tuner adjusted to the lower frequency. The records also show the reverse, that is, if a high frequency wave is modulated by a low frequency, the degree of modulation is decreased when the wave passes through a tuned circuit adjusted to the high frequency. These results are entirely independent of any theory, for they are experimental. Neither do they depend on distortion in the tubes or anywhere else. They show that the side frequencies, regardless of whether they are real or fictional, are in effect reduced by the tuner adjusted to the carrier frequency. No amount of verbal wrangling will change the results.

RMA FINDS NO PENTODE SETS FOR THIS YEAR

(From Radio Manufacturers' Association, Inc.)

Pentode sets will not be presented this season, according to leading set and tube manufacturers who attended a meeting of the Radio Manufacturers' Association at the Hotel Astor, New York City.

There was a joint meeting of the receiving set and tube committees of the RMA and over 100 representatives of leading radio interests attended.

During the meeting, presided over by President H. B. Richmond, it became evident that many of the larger set manufacturers had already completed their plans for 1930 and no sets using the pentode tube had been included.

Lack of Data Cited

The reasons for this were also brought out, and a lack of sufficient technical information to permit plans to use the tube this year was apparent. Those reporting results of their circuits developments on the new tube painted a picture of many unsolved technical problems and the lack of any agreement among the tube and set manufacturers as to just what the characteristics of the tube should be.

A forward step was taken in the appointment of a joint sub-committee consisting of five receiving set engineers and five tube engineers to collect and study all the interesting data on the five element tube and formulate, as soon as possible, a set of definite characteristics which the tube makers would agree was possible and the set makers agree could be advantageously used.

There was every indication at the meeting that both the tube and set makers plan to continue and intensify their development work, but that at best the advantages to be gained by using the pentode tube would be by no means revolutionary or startling.

No Definite Conclusions

R. H. Langley, of Cincinnati, Ohio, chairman of the RMA Receiving Set Committee of the Engineering Division, and George Lewis, of Newark, N. J., chairman of the Tube Committee, summarized the views of the respective groups and called on many engineers and other radio representatives present for news and views regarding experiments with the five-element tube.

Mr. Langley summarized the situation by stating that the development of the pentode had not progressed to the point where any definite conclusions could be reached, but that the general feeling was that there may be possibilities for use of the tube which are not known yet definitely. Certain specific applications may have advantages, in DC and battery sets, which now constitute a very small fraction of production.

Ray H. Manson, of Rochester, N. Y., chairman of the RMA Standards Section, stated that the pentode was just one of many new developments which should be presented in an orderly way by cooperation between the tube and set makers.

Several tube manufacturers declared their readiness to bring out the pentode when set manufacturers feel that it will be advantageous to use.

Tube Manufacturers Are Willing

A large majority of the tube as well as the set manufacturers' representatives stated that experiments so far had not demonstrated that the ve-element tube could be used advantageously.

President Richmond of the RMA urged cooperation between set and tube makers in bringing out new radio developments.

"If we deliberately withhold advance information," said President Richmond, "so that the public feel that we are making definite plans to make their current purchases obsolete, they will lose confidence. If, also, we make statements which lead the public to believe a new revolutionary development is here, or just around the corner, and the public find that this development is only one of nominal improvement, again they will lose confidence.

"Never let there be any withholding of technical information. Neither let there be any premature consumer announcements of a nature tending ultimately to destroy consumer confidence.

Two Problems Stated

"Our first problem seems to be one of getting the component suppliers to announce their new devices and improvements as soon as they are ready, but first to the set manufacturer, then to the consumer.

"Our second problem is to get the set manufacturer to feel that it is not necessary for the whole industry to stay in line in lock-step fashion, but that each manufacturer can have his product individualistic, incorporating in it those advances in the art which he feels are desirable and sufficiently reliable to pass on to the public."

New Standards To Be Out in May

Promulgation of revised manufacturing standards for the radio industry is being planned by the Radio Manufacturers' Association within a few months. This will be the first comprehensive revision of commercial standards in radio since 1928 and will bring manufacturing recommendations up to date. The revised standards, it is expected, will be issued in May.

Under the direction of Ray H. Manson, of Rochester, N. Y., chairman of the Standards Section of the RMA Engineering Division, work is nearing completion on the revised standards. A meeting of the Standards Section was held in New York City recently.

South Dakota Over Its Channel Quota

Washington.

Increase in power from 15 to 100 watts and authority to move from Oldham to Huron, S. Dak., was requested of the Federal Radio Commission by KGDY.

Representative Charles A. Christopherson (Rep.), of Sioux Falls, S. Dak., appeared for the station. He said the main reason for the request in station location is that the town of Oldham has a population of only 800 or 1,000, whereas Huron has 12,000 population and is "growing rapidly."

Andrew D. Ring, Commission engineer, reported that South Dakota is over its quota in both local and regional stations, but that it is entitled to one-twentieth time on a cleared channel, which it does not now have.

RCA PROMOTES SCHAIRER

Otto S. Schairer, formerly director of patent development of the Radio Corporation of America, was elected vice-president in charge of the patent department of the Radio Corporation of America.

BIG ARRESTER ABSORBS BOLT, MILLION VOLTS

Pittsburgh.

Million-volt bolts of lightning struck repeatedly in East Pittsburgh recently, although the United States Weather Bureau reported no such atmospheric disturbances.

The lightning crashed harmlessly, however, and proved instructive to approximately 400 members of the American Institute of Electrical Engineers and the Engineers Society of Western Pennsylvania. The lightning was artificial and it came from one of the world's first 1,000,000-volt portable surge generators, built and used by the Westinghouse Electric and Manufacturing Company for studying the effect of lightning on transmission lines.

Tests Transmission Lines

This portable lightning generator, together with a portable lightning laboratory housing a cathode ray oscillograph station, has been in operation on several transmission lines during the past several months, and extremely beneficial results have been accomplished in characterizing the performance on lines struck by heavy surges.

Located in the yard between two buildings in East Pittsburgh the generator crashed its bolts through the air several times for the enlightenment of the visiting engineers. Members of the Westinghouse staff explained the operation of the equipment, of the testing devices and told of the new porous disc lightning arrester which has recently been developed by the Company.

Made To Do Tricks

First in the demonstration a million-volt surge was made to jump across a huge suspension insulator and the effect noted. Then one of the new autovalve lightning arresters was placed in parallel with the insulator and the generator functioned again. The arrester absorbed the total surge, preventing the insulator flashover.

A spectacular stunt was the sending of a surge along a miniature transmission line showing the effect of corona discharge. The final demonstration was the sending of a lightning surge into a 40-foot length of fine wire, completely burning the wire to nothing.

NORRIS IN NEW POST

Pittsburgh

E. R. Norris has been appointed Assistant to J. S. Tritle, vice-president in charge of manufacturing of the Westinghouse Electric and Manufacturing Company at East Pittsburgh. Mr. Norris, formerly general works manager, is now responsible for all plant facilities of the company, manufacturing methods, cost reduction and inspection. Mr. Norris has been associated with the Westinghouse Company since 1892.

NEW AUTO SET HAS 224 TUBES, VARIOMETERS

General Motors announces a radio receiving set for automobiles together with complete plans for servicing and national distribution. The set has been called the Delco Automotive Radio and is manufactured by the Delco Radio Corporation at Dayton, Ohio. National sales and service are under the direction of United Motors Service with twenty-seven branches and 3,000 authorized service stations.

The Delco Automotive Radio is a five-tube receiver, using three screen grid tubes, and operated by remote control from the instrument panel. It can be installed without changing a single unit of the car.

The set is entirely out of sight beneath the car's cowl. Only three devices are to be found on the instrument panel, mounted in an attractive manner, at the right, where they do not interfere with the other instruments. They are a tuning dial, a volume control and a key switch. The tuning dial is connected to the set by a flexible cable and operates three variometers, all mounted on a single shaft.

Has Two Stages of RF

Two tuned radio frequency stages are used with 224 amplifier tubes, connected in series. A similar screen grid tube is used as a detector. For audio frequency a 227 tube is used in the first stage and a 112A in the second. A voltage regulator tube is employed to keep the voltage constant in spite of varying engine speeds or extra drain on the battery when the lights are turned on.

Interference from passing objects is offset by an automatic volume control to increase the amount of current when the car passes steel buildings or overhead wires, which normally would occasion a reduction of current.

Current is supplied by the car's storage battery and by four vertical type standard size 45-volt B batteries and one 22.5 volt C battery, The B batteries are carried in a specially-designed metal box placed under the floor boards and fully protected against mud and water. The C battery location depends on the type of car.

A cone speaker is mounted on the dash out of sight, and protected by a screen across its face.

Interference Eliminators

Electrical interference from the ignition system has been guarded against by the use of spark resistors on each plug and on the coil, and by use of by-pass condensers across the generator contacts and on the starting motor. These resistors are designed to prevent oscillations in the ignition circuit and have no effect on the running of the motor.

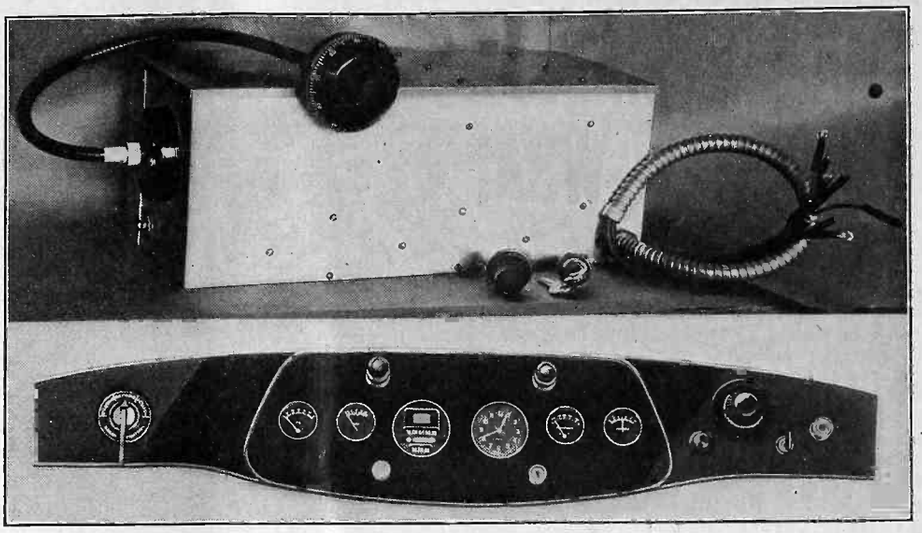
To protect the tubes against the jars and jolts of road shocks a special cushioning device is used and the dial is held secure in any position by a reduction gear.

The antenna is concealed in the top of the car. Cars factory equipped with this aerial include Cadillac, La Salle, Studebaker, Pierce-Arrow, Marmon, Jordan, Peerless, Packard and Franklin.

A THOUGHT FOR THE WEEK

TUNE in on The Recitalists on Saturday night and hear Muriel Wilson, soprano, and Richard Maxwell, tenor, and see if they're not your idea of what fine radio entertainment should be. Tiffany hasn't anything better in the line of gems.

GENERAL MOTORS' SET FOR CARS



NEW SET FOR AUTOMOBILE INSTALLATION, DEVELOPED BY GENERAL MOTORS, HAS A REMOTE CONTROL TUNER. THE EXTERNAL VIEW IS SHOWN AT TOP, THE INSTRUMENT BOARD BELOW, WITH THE THREE RADIO CONTROLS, DIAL, SWITCH AND VOLUME CONTROL AT RIGHT.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank at bottom may be used, or a post card or letter will do instead.

RADIO WORLD,
145 West 45th St., N. Y. City.
I desire to receive radio literature.

Name .....

Address .....

City or town .....

State .....

G. Schandler, Stuarts Draft, Va.

M. Ed. de Beauchamp, c. o. Central Music Shop, 109 S. Wewoka Ave., Wewoka, Okla.

Wm. A. Stead, Room 602, 385 Madison Ave., New York City.

Joe Buttry, Box 425, Armington, Ill.

Albert C. Cederroth, 651-58th Street, Brooklyn, N. Y.

Theodore Payne, Payne American Flag Co., Rockaway, New Jersey.

W. Robertson, 486 Prospect Ave., Buffalo, N. Y.

Robert McCourt, 21 Prospect Ave., No. Arlington, N. J.

Joseph Williams, 752 S. Randolph St., Philadelphia, Pa.

Victor Aramiam, 224 So. Lincoln St., Chicago, Ill.

Ben W. Dyer, 2718 Linwood Blvd., Kansas City, Mo.

A. A. Rosen, 7041 Reedland St., Philadelphia, Pa.

F. H. Waters, 100 Greenleigh Court, Merchantsville, N. J.

R. W. Emerson, 7211 Hargs Ave., Cleveland, Ohio.

A. O. Herout, 1704 Louisiana St., Houston, Texas.

Edw. H. Stard, 6606 Limekiln Pike, Philadelphia, Pa.

E. S. Cochrane, 63 Wyllys St., Hartford, Conn.

Jas. W. Riordan, 526 Tinton Ave., Apt. 4-B, Bronx, N. Y. City.

Samuel Ryant, 346 Snediker Ave., Brooklyn, N. Y.

A. W. Hollis, Box 279, Swan River, Man., Canada.

Harold Burchild, 113 E. Trent, Okmulgee, Okla.

Gaylord Thomas, 904 Burr St., St. Paul, Minn.

W. M. Mervine (E. E.), 231 Buckingham Place, Philadelphia, Pa.

F. O. Beaver, 402-4th St., Huntington, Pa.

Wm. Griffin, 1841 Pemberton St., Philadelphia, Pa.

Roberto V. Lasheras, Cabrera No. 5343, Buenos Aires, Republica Argentina.

LEARNING CODE EXPEDITED BY USE OF SYSTEM

Among the pitfalls that may be encountered in mastering the code through one's own individual efforts is that of speed. So many radio beginners with only a slight knowledge of the code attempt to send and receive on practice buzzers as rapidly as possible.

According to Rudolph L. Duncan, President of RCA Institute, this is a mistake.

"The acquisition of the radio code requires time together with a steadily increasing rate of speed," he said.

Avoid Alphabetical Order

"Another common practice, and one to be avoided, is that of mastering the code alphabetically; that is to say, A, B, C, and so on, in alphabetical order. This system is confusing in the extreme, and actually requires more time than the scientifically developed method now in use.

"The proper method is to concentrate the letters into groups of four or five characters, which have the same general characteristics. In other words, the characters made up of dots are first mastered, as a group, then the characters made up of dashes only are mastered, and then the various combinations of dots and dashes arranged in suitable groups.

Mastery Symplified

"If this system is followed, and the characters are sent and received at a gradually increasing rate of speed, the mastering of the code is simplified and actually hastened. In our schools, it is possible for almost anyone to master the radio code in three or four months. By conscientious study at home, with our automatic test sets, the code may be mastered in four to six months. Otherwise, it may require a year or more to master the radio code, with the commonplace methods."

BILLINGS OUT, MAN, 27, HEAD OF WLW-WSAI

Cincinnati.

Ford Billings is no longer director of Crosley broadcasting. The position he held for several years is now occupied by John L. Clark, 27 years old. Clark's title is general manager of WLW and its sister station, WSAI. The Crosley Radio Corporation owns both stations.

For two years Clark was commercial manager of WLW and WSAI. When he was made general manager the two stations were not only self-sustaining but were showing a profit in operation.

Clark's advancement in the Crosley organization has been rapid. He joined it in October, 1927, as sales correspondent. Later, he worked on the newspaper advertising co-operative tie-up with dealers and distributors.

In 1928, Mr. Crosley began an intensive study of the potentialities of commercial programs for the two broadcasting stations owned by his corporation. Clark's success with the co-operative radio advertising suggested him as the logical choice for Commercial Manager of the two stations and he was moved on from the radio receiving set division of the Crosley corporation.

Has Entertainment Experience

In addition to his knowledge of the advertising possibilities of broadcasting, Clark brings to his position as manager of WLW and WSAI a great deal of practical experience in the entertainment field.

While attending the Tennessee Military Academy at Sweetwater, Tenn., in 1919, he organized a dance orchestra. The next year he managed the John Clark Varsity Serenaders, a group of instrumentalists and vocalists that appeared in cities all over the United States for three years.

His experience with orchestras and his understanding of tone values brought him an offer to demonstrate and sell a new recording product for a concern that had been making phonographs for 30 years. The first year he was fourth in volume of sales of the whole United States.

Burdette is Assistant

From that position he was selected as a recording scout sent out to seek new talent for phonograph recording. After working for several days with a Negro orchestra that played by "ear" instead of from the printed page, Clark was just ready to record the music at 10:00 o'clock at night. Then he discovered that the electrician had turned off the electricity and had gone home for the night. The next morning Clark telegraphed his resignation.

He got a job next with the Crosley Radio Corporation.

Robert Burdette, formerly assistant program director, has been appointed studio director to assist Clark.

Speakers Being Built Into Wall

Architects will have to study radio to keep abroast of the times according to V. J. Gilcher, plant engineer for the National Broadcasting Company.

"Already some radio speakers are being built into homes," Gilcher said. "But the time is very near when the built-in speaker will be more important."

Amateur Rules Being Revised

Washington

Great need exists for revision and classification of the rules governing the 17,000 amateurs, it was said at the Federal Radio Commission's radio division offices. This need prompted the call by the commission of a conference here to which the American Radio Relay League officials were called.

There should be inserted in the regulations, it was stated, concrete provisions as to how, where and why, amateurs should operate, and the necessary qualifications of licensees, together with rules and regulations governing their operations.

For the legal division of the Commission, Duke M. Patrick, assistant general counsel, and Arthur W. Scharfeld, counsel, participated at the conference. The Commission's engineering division was represented by Gerald C. Gross, engineer, and others, while the radio division was represented by W. D. Terrell, chief, and William E. Downey, assistant chief.

RADIO PRINTER PERMIT ASKED

Washington

Establishment of a public utility radio-telegraph printer service for the transmission of press dispatches by a new system has been proposed by the American Radio News Corporation, a Hearst organization, it was revealed in an application filed with the Federal Radio Commission.

The new corporation, which is a subsidiary of King Features Syndicate, Inc., of New York, would erect a station in New Rochelle, N. Y., and would also seek permission to erect another station in Chicago to be operated by remote control. W. G. H. Finch, secretary of the corporation, explained in his application that the proposed system would be entirely different from any system now in operation, being somewhat like a broadcasting station except that it would transmit a code capable of operating an automatic printer or typewriter.

The low frequency channels of 101 and 103 kilocycles were asked for, with a maximum power of 10,000 watts.

Advises Learning Tuning Technique

Operating a receiving set is the simplest means ever devised for providing entertainment, but one that may mar the pleasures of reception if carelessly done by the set owner, it is declared by E. T. Cunningham, Inc.

This is especially true in the "tuning in" stage, it is said, where a thoughtful decreasing of the volume control while changing from one station to another will eliminate the discordant jumble of sounds that take place. Too many set owners, in his opinion, allow the power to remain at high voltage while operating the tuning dial, permitting the speaker to blare out a chaotic jargon of cross tones that please neither the listeners within the home, nor the neighbors.

WHITE'S BILL CHANGES LAW, OMITS ZONING

Washington

Changes in existing law governing radio to make it conform with present conditions and to remove objectionable provisions have been proposed by Representative Wallace White, Jr., of Lewiston, Me., in a bill introduced in the House. The bill (H. R. 10473) was referred to the House Committee on Merchant Marine and Fisheries, of which Mr. White is Chairman. Mr. White was also co-author of the original law.

One of the proposed changes provides for the elimination of the "zone system" if radio representation, which was enacted against opposition of radio engineers and which has proved to be unworkable by the Radio Commission and objectionable to both broadcasters and the public. Other provisions deal with the clarification of procedure and appeals to the courts.

Provision Cited

The proposed bill provides that "Each member of the Commission shall be an actual resident citizen of the United States."

It also provides that each member of the Commission shall receive an annual salary of $10,000, payable in monthly installments. The Commission is also authorized to appoint a general counsel at $10,000 annually, and not more than three assistants to the general counsel at an annual salary of $7,500, also a chief engineer at $10,000 per annum and not more than three assistants to the chief engineer with a salary of $7,500 each a year, and a secretary to the Commission at $7,500 a year. Moreover, the Commission is authorized to appoint such special counsel, attorneys, engineers, special experts, examiners and other employees as it shall from time to time find it necessary for the performance of its duties and as may from time to time be appropriated for by congress.

"All employees of the Commission, except the general counsel, the assistants to the general counsel, the secretary, the chief engineer, the assistants to the chief engineer, special counsel, attorneys, engineers, special experts, and examiners, shall be subject to the provisions of the civil service laws."

Power of Subpoena

One paragraph provides that the Commission shall have power to require by subpoena the attendance and testimony of witnesses and the production of all books papers, tariffs, contracts, agreements, and documents relating to any matter under investigation. Any representative of the Commission and any examiner appointed by the Commission may administer oaths and affirmations and sign subpoenas.

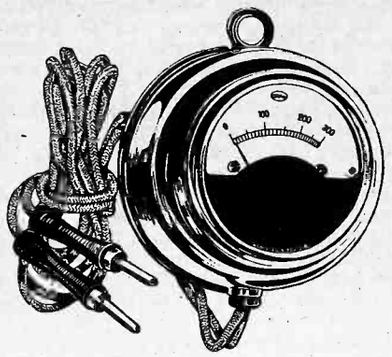
Film Recorded Programs Soon

Radio programs recorded on sound films will soon be given a practical test when the newly organized R.C.V. international broadcasting system operated by the Radio Cinema Vision Corporation releases its first program through 119 stations in the United States and Canada.

Portable Type

VOLTMETERS

for Measuring High Voltages, Including Those of B Supplies.



0-300 volts, at 200 ohms resistance per volt, 5 ma. drain at full-scale deflection. Accuracy, 2%. Case is full nickel finish. Long connecting cords have especially ornamental tip holders. Meter should be read in perpendicular position. Five-day money-back guaranty. Order Cat. F-300 @ $2.59.

O-500 volts, same as above in appearance, but the range is greater and the resistance per volt is 233 ohms., 4½ ma. drain at full-scale deflection. Accuracy, 2%. Five-day money-back guarantee. Order Cat. F-500 @ $3.73.

0-600 volts, AC and DC (same meter reads both types). DC readings accurate to 2%, also AC readings 2% at 50-60 cycles but accuracy is less on AC at substantially different frequencies.

Resistance 100 ohms. per volt, 10 ma. drain at full-scale deflection. Same general appearance as illustrated meter. Five-day money-back guarantee. Order Cat. M-600 @ $4.95.

GUARANTY RADIO GOODS CO.
143 West 45th St., New York, N. Y.
(Just East of Broadway)

Please ship C.O.D. the following makes, as advertised, on 5-day money-back guaranty:

☐ Cat. F-300 at $2.59
☐ Cat. F-500 at 3.73
☐ Cat. M-600 at 4.95

Name .....

Address .....

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

NATIONAL

Velvet B Eliminator **$16.13**
180 Volts (280 Tube Free)

Latest Model National Velvet-B, Type 2580, in handsome crackle finish black metal casing, for use with sets up to and including six tubes. Input 105-120 volts AC, 50 to 60 cycles. Output, 180 volts maximum at 35 milliamperes. Three variable output intermediate voltages. (Det., RF, AF). Eliminator has excellent filter system to eliminate hum, including 30 henry choke and 18 mfd. Mershon condenser. No motorboating! (Eliminator Licensed under patents of the Radio Corporation of America and associated companies.)

Guaranty Radio Goods Co.
143 W. 45TH STREET
(Just East of Broadway)
NEW YORK CITY

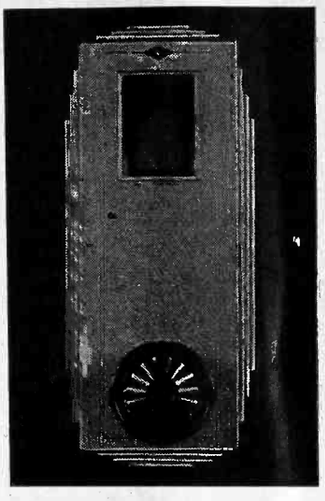
NEW DRAKE'S ENCYCLOPEDIA

1,680 Alphabetical Headings from A-battery to Zero Beat; 1,025 Illustrations, 920 Pages, 240 Combinations for Receiver Layouts. Price, $6.00. Radio World, 124 W. 45th St., N. Y C

BRILLIANT, NEW

NATIONAL

MODERNISTIC PROJECTION DIAL WITH RAINBOW FEATURE



Modernize the appearance of your receiver by installing the brilliant new National dial, with color wheel built in, so that as you turn the dial knob one color after another floods the screen on which the dial numbers are read. On this screen the numbers are projected, so that you get the same dial reading from any position of the eye. This is just what DX hunters want—laboratory precision of dial reading.

The escutcheon is of modernistic design. The Velvet Vernier mechanism drives the drum superbly.

Order today. Remit with order and we pay cartage. Shipments day following receipt of order.

GUARANTY RADIO GOODS CO.,
143 W. 45th St., N. Y. City (Just E. of B'way)

Enclosed please find $3.13 for which please send me dial marked below:

☐ Cat. HC6, National modernistic drum dial, with color wheel built in, pilot bracket, 6-volt pilot lamp for storage battery or A eliminator sets; hardware; instructions $3.13
☐ Cat. HC2½, same as above, but with 2½-volt AC pilot lamp 3.13
☐ Order C.O.D. and I pay cartage.

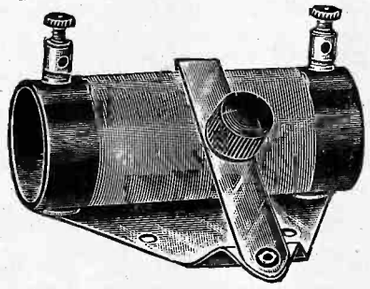
NAME .....

ADDRESS .....

CITY .....STATE .....

AERIAL TUNER

Improves Your Reception



Remove aerial lead from set. Connect aerial instead to one of the binding posts of the Aerial Tuner. Connect the other binding post of the Aerial Tuner to antenna post of your set. Then move the lever of the Aerial Tuner until any weak station comes in loudest. The lever need not be moved for every different frequency tuned in. The Aerial Tuner acts as an antenna loading coil and puts the antenna's frequency at any frequency in the broadcast band that you desire to build up. Price, 85c.

GUARANTY RADIO GOODS CO.
143 West 45th Street
New York City
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"FORD MODEL 'A' CAR." Its Construction, Operation and Repair, By Victor W. Pagé, M.E. 545 Pages, 251 Specially Made Engravings. $2. postpaid. Radio World, 145 W. 45th St., N. Y. City.

CUSTOM-RADIO

At Its Best

In the New

Battery Operated

Receiver

POWER, selectivity, tone beyond all expectation; refinement of components, unknown in factory-built sets—feature all of the famous "HiQ-30" models—Battery; D. C. and A. C.

Utilizes the remarkably efficient Three-Stage tuned Band Filter, designed and used solely by Hammarlund. Provides absolute 10-kilocycle separation of stations throughout the broadcast band—*without side band cutting.*

Three screen-grid tubes, utilized to maximum efficiency, give tremendous R. F. amplification and distance range.

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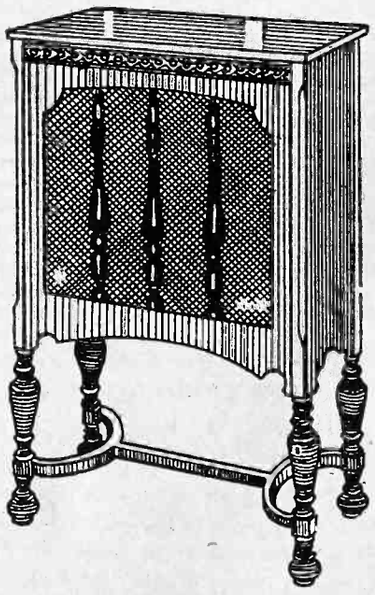

The speaker cabinet is walnut finish, 33" high, 24½" wide, 17½" deep, with carved legs. Golden cloth grille covers front opening. Built inside is No. 595 molded wood horn with baffle and No. 203 driving motor unit that stands 250 volts without filtration. Horn and motor removable. Table alone is worth price asked.

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Acoustical Engineering Associates
143 WEST 45th STREET NEW YORK CITY

RADIO WORLD

Title Reg. U. S. Pat. Off

The First and Only National Radio Weekly
***Eighth* Year**

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, business manager and managing editor; J. E. Anderson, technical editor.

The Sweetest Song

AT a recent Sunday night Atwater Kent Music Hour the announcer said that the question what was the sweetest song ever composed has been debated for a long time, and opinions differ, although many select "Connais-tu le Pays?" from the opera, "Mignon," by Charles Louis Ambroise Thomas, born at Metz. The piece first was presented at the Opera Comique in Paris, November 17th, 1866, and had its first production in the United States in New York, November 22d, 1872. So there has been ample time to apply the test of greatness to any composition from this opera, which is noted also for the graceful overture and Filina's Polonaise.

The story of the opera would fit well into the pattern of the talkies of to-day, and might have been called "The Street Dancer" for such modern use. It is the story of a girl stolen from her parents in early childhood by a band of gypsies that now make her dance in the streets for a living. Mignon has no memory of her childhood, except the beauty of the land through which she then roved, the mild climate, the fair fruit and flowers. Of this land she sings in the song, "Connais-tu le Pays?" (Knowest Thou the Land?). It so happens her father, an Italian count, Lothario, who has lost his memory for the convenient present, is at a German inn where his daughter sings the song after her refusal of brutal requests to dance for a group of actors cavorting on a balcony.

It may be that this is the sweetest song ever composed. We think so. It is not alone the singing part that makes it great. The shepherd flutes contribute considerably to the spirit and body of the composition.

This piece is heard frequently on the air, especially from stations that go in for the better sort of music on a rather large scale, which they do with eyes open to the fact that the present musical taste of the listener is not completely in that direction.

Many must have heard Walter Damrosch say, during a Western Electric Hour, a couple of weeks ago, that complaints were received because his orchestra played such "heavy" music. He even asked the audience "not to turn us off" before listening patiently, since the object was to bring the musical taste of listeners to as high a level as they wanted it to occupy.

But there is nothing heavy in the vocal piece from Thomas's opera, the song that is a candidate for preferred honors among all the songs of the world. Germans can rally to that song, because of the locale and because the book is based on Goethe's "Wilhelm Meister." Frenchmen can rally to it because it was in Paris the first performance was given, the text is in French, and the opera is usually sung in French, this particular song virtually always in French, on opera and concert stages as well as on the air, and also it was composed in a French Metz. Italians can rally to it because it is indeed of fair Italy that Mignon sings. The United States has done much to keep the opera alive, and if it will confer first laurels on this sweet soprano song from the opera, perhaps it will have a little cause on its own account to put in a claim. Or maybe for patriotic rather than musical reasons we Americans would prefer to select a work of one of our own composers.

Room for Improvement

THE standing compliment paid to radio is that it is the greatest agency in the world for the dissemination of intelligence. Just now a committee, under the authority of President Hoover, and under the immediate supervision of the Secretary of the Interior, Mr. Jardine, is investigating the posibilities of radio as an instrumentality of education. Preliminary suggestions are that the present is no time to plunge into education of juveniles, or even adults, by radio, as there are some drawbacks, and the program facilities for attaining high pedagogical standards are not yet in existence.

It is no less important to avoid miseducation by radio than it is to establish a good system of positive education. With nearly 600 stations on the air, many of them put to their wits' utmost to keep their hours on the air filled, no matter how, we are certainly subjected to a great many indifferent programs, and a jumble of mispronunciation which is one branch of mis-education.

So willing to undertake the contract, stations are not always quite able to fulfill it. The expense of maintaining adequate programs is large. The smaller stations get little of the advertising business of large national advertisers, with their high-priced talent, hence what programs are offered as sponsored features can not be measured to highest standards, for that would be a form of rejecting them, and losing a much-needed source of income. That is why we hear sales talks, with prices directly stated, and telephone numbers and addresses repeated with irritating indifference to the comfort of the listeners, and why marriage brokers offer their services, "strictly confidental," at modest prices.

The blurbs of the national advertisers that occupy choice time on chains are getting to be bad enough, so it is small wonder that the suffering little stations feel they must take their listeners into a partnership of misery.

The Radio Manufacturers Association is trying to get the advertisers who use "large" time to tone down their blurbs, as to extravagance of word and repetition, so that only at the beginning and end of the program will advertising mention be made. Here's wishing them success in their difficult endeavor. After the association has succeeded here it may seek to have the same ethics prevail at small stations, which would be a benefit to the small stations beyond their present power to envision.

Jolliffe, Chief Engineer

FOR the first time the Federal Radio Commission is about to have a permanent chief engineer, Dr. C. B. Jollife, formerly assistant chief of the radio laboratory of the Bureau of Standards, Department of Commerce. Dr. Jolliffe is excellently qualified for the post, and it is no less an honor to the position that he should fill it than it is an honor to him to be appointed.

His influence should be great, and the problems which will call for his recommendatory action will be numerous and important. Among the Commissioners, Chairman Saltzman alone is technically versed, if not trained, in radio, and it is no affront to the capable chairman to say that the prospective chief engineer knows much more about the subject than the former Chief of the Army Signal Corps.

It is not too much to expect that the Commission will be guided largely in technical matters by the recommendations of its chief engineer. While Commissioners Robinson and Sykes may be inclined to sweep some of these aside, because of their established viewpoints on technical questions, such sweeping likely will be a function of a minority, and the chief engineer will wield great although vicarious power.

Capt. Guy Hill, of the Army Signal Corps, who had been loaned to the Commission as acting chief engineer, will resume duty with the troops, and sails soon for the Philippines, glad, no doubt, like any soldier, to have his body be where his heart is. He made a good job of what he did not particularly like.

The Split Cast Works

THE plan established by RCA-Victor, in presenting operas over the air, with Metropolitan Opera House singers, whereby the singers do the singing, but the story is carried forward by another cast, consisting of actors, has worked out excellently.

All opera-goers are fully aware that the best singers are not necessarily the best actors. The situation is further complicated by the fact that some of the best singers are foreigners who, despite long residence and even citizenship in the United States, speak with a decided accent, often making it hard to understand them in English.

In fact, even when they sing in a language other than their native tongue, they usually do pretty poorly in pronunciation.

"Faust," recently given by RCA-Victor, proved all these points: the excellent acting of a cast of real actors, the excellent singing of a cast of real singers, and the trouble the American, Armenian and others have putting the proper "English" on the French ball.

Wonders

BY means of vacuum tubes, and usually by their use in radio, wonders are accomplished, to the lay viewpoint, although engineers dispassionately discuss such things only as so much work done. Battleships piloted in their courses, with nobody aboard, an electrical man that obeys signals given in light, a throat utters sounds that drives an automobile that is 400 miles away, stations all over the world listen to a program of education radiated on a short wave from New York, a hand waved over a box makes the Theremin play music that sounds something like a bass viol. When the novelty wears off the wonder ceases, but the work performed becomes more widespread and the invention more useful and valuable. As soon as we extract the wonder from a feat we inject utilitarianism. When wonders cease to be wonders it means the world has put them to work.

Forum

Wants Howlers to Lay Off

"LAY on, Macduff, and damn'd be he that first cries 'Hold, Enough.'" I think the above words, quoted from the Grand Old Bard, express rather in classic style what should be the viewpoint in dealing with some of the howlers who are finding fault with the trend of RADIO WORLD.

Your weekly is well balanced news to balance those articles dealing with the technical and basic principles of radio. The fact that your output grows larger with time in itself demonstrates that you are meeting the full approval of the reading public.

Let those who desire more news read a monthly featuring high-powered salesmanship, but for the old regulars, hold your guns just where you have them. You are doing your work well, and it's hard to say just what your terrific possibilities are.

The men who are to become the radio technicians and engineers of tomorrow must grow out of the ranks of those who are boys today. Radio is the only natural agency at present that appeals to the young lad and brings out his inborn ingenuity. Through diligent application he soon learns to build the one-tuber, gets the thrill, then with inspiration masters the full circuit. With stores carrying every conceivable toy from top to wagon, the kids no longer roll their own moving stock, but not so with radio.

What's that? They don't need long distance now? Did I read aright when I noted that if you effect the range it is done at the expense of tonal quality? To the first I say that there are thousands and thousands who live not in the shadows of Broadway, or Lake Shore Drive. In the homes of these thousands, yea millions, are home-built and custom-made sets that nighly cover the big-time circuits with dependability and realistic reproduction.

When one says local reception, he must know that there is a vast degree of difference between the type of program afforded by stations located at such large centers as New York, Chicago, Cincinnati, etc., compared with that of a local nature picked up from smaller centers.

In the first place the real musical talent of this country is found in the larger centers, and the small town station finds its greatest attraction in the chain network. Some of these small stations can only afford minimum network service, and when such hours expire one must have a job that will not only range but will cut through the strong local.

Your feature on "Audio Power Amplifiers" was the greatest piece of constructive work yet noted. You have brought out in the open the real secret of good dynamic reproduction, shown the difference between a man-sized audio transformer and the wrist-watch type, and the great advantages of individual filters over condenser banks.

As long as man seeks the best in radio there will be those who cut and roll their own, and may you live long, to straighten out the crooked way and make smooth the road that may be rocky.

A. S. HUNTER,
Durham, N. C.

* * *

A Stature Like Lincoln's

I HAVE read RADIO WORLD as well as most other radio magazines for years. I have also dabbled with building radio sets from the crystal to the present-day style, but I question whether I have ever had the real kick out of an article that I got out of M. U. Wallach's in the March 8th RADIO WORLD, because it is written in plain Abraham Lincoln style. He certainly put the punch into it.

Why doesn't he go one step further and print the circuit with which he gets so much DX, giving the list of parts? I am sure that many other bugs like myself would enjoy trying their hand at such a remarkable set.

I would appreciate very much, and I know some of my associates would as well, obtaining the circuit he is using.

E. H. PETERSON,
9301-212th Place
Bellaire, L. I.

* * *

Enthusiast Wants Wallach's Circuit

M. U. WALLACH'S writeup in RADIO WORLD is 100%. I certainly agree with him concerning the desirability of distance reception. I certainly would appreciate a schematic diagram of his hookup. It may be one of his own getup. I would like to reach beyond Denver.

I wrote Herman Bernard about a month past for a hookup that would really do the 2,000 miles mentioned in his debate writeup.

I am also anxious to know what two factory built sets Mr. Wallach had in mind that will really pull in DX so that one can understand what's being said.

A. WILLIS,
233 South Ninth Street,
Philadelphia, Pa.

* * *

He Wants Circuit, Too

AS a reader of RADIO WORLD, I have enjoyed the debates you have been running of late giving both sides of the questions.

I also enjoyed very much the article by M. U. Wallach in this week's issue, and wonder if he would give me the diagram of the circuit with which he gets so much DX.

EDGAR H. THORNTON,
99 Norwood Ave.,
Norwood, R. I.

Mr. Connaught Under Fire

ON page 16 of RADIO WORLD of March 8th you have an article "Resolved, That Multi-tube Sets Are Worth While," and an article stating the negative side by E. Jasper Connaught, in which he makes a number of statements which seem to be his personal opinion and not founded on practical experience.

He states that multi-tube receivers do not perform any better than sets with one-third or one-half the number of tubes, but from my own experience give me the 9 or 10 tube set.

While writing this letter I am listening to a program from KDKA which, barring a little static, is coming in clearly and plainly and every word can be understood. The set is an all-electrical, of nine tubes: three screen grid tubes, two 227 and two 245, with a band pass filter and voltage regulator tube. In three months it has been in use I have had the finest programs from East and West coasts, Canada and the Gulf, including Mexico and Cuba.

I have built and operated a number of sets from three tubes to ten tubes and discarded the smaller sets because they could not give the results obtained with the multi-tube sets.

A three-element tube in a small set with a regenerative detector, while it brought in numerous stations, had so many at a time that I had mixed programs and I gave up in disgust.

On 5 and 6-tube sets the two local stations and stations close by occupied so much space on the dials that there was not room for other stations and when it was possible to drag in another station there were at least two or three together.

With the multi-tube receivers I did not have this trouble. Now, it is unfortunate Mr. Connaught claims all distance records are made with simple receivers, but he does not list any of these records, showing location of the receiver, name of set, number of tubes, time of day or night, and year.

Will his simple receivers cut through locals and bring in distance regularly o occasionally?

He says the multi-tuber is always out of tune. Did he ever assemble one of the latest kits and observe the small balancing condensers intended to bring the circuits into resonance?

The shielding does not kill sensitivity, as a set in which the signal can enter only through the aerial is more sensitive and selective than a set which will pick up signals from numerous stations on the exposed wiring.

He also says the tubes are noisy and there is a power noise which makes it impossible to hear the program distinctly and clearly.

If the set is operated properly, without the volume control being advanced too far, there will be very little noise, and if good tubes are used there will be no noise from that source.

Ask the manufacturer why he builds multi-tube receivers if 90% of the listeners are content to listen to local stations and he will tell you that if his set will not bring distant stations that he will be unable to sell the set.

Mr. Connaught claims all receivers squeal. I have listened to many and have yet to find one of the latest modern receivers of the better class which will squeal.

He states that the added cost and upkeep would be worth while if the results were better with the multi-tube sets, then asks a few questions.

Is the quality of the multi-tube set better? Absolutely.

Is the selectivity better? Yes, far better.

Is the sensitivity better? Yes.

Is the volume handling capacity greater? Yes.

Is the appearance better? Much better.

All the above questions relate to the multi-tube receiver as compared to the 3, 4 or 5-tube receiver.

The multi-tube receiver is easier to tune, with less controls and neater appearance, all equipment is enclosed and out of sight, no batteries to give out in the middle of a program, no oscillations at the wrong time, just clear, plain, natural and realistic tone, and every word distinct.

Why should I listen to a local station broadcasting a poor program when by the turn of a single dial I can bring in a program from 300 to 3,700 miles away with the volume of a local, and so realistic as to sound as if it were in the same room?

If Mr. Connaught has any records made by his simple regenerative detector with 3-element tubes I would like to see a list of them and perhaps I can furnish him with a few selections from the Hammarlund-Roberts HiQ-30 that will surprise him, or if he lives in the vicinity of New York City, street address furnished, if he wishes. He may visit this company's factory and hear this set perform and I think he will be astonished at the result.

I do not claim any records but I believe I can beat his 3 to 5 or 6-tube set as I have surpassed the same kind of sets used in this location.

Distant stations are regular visitors to my home and new ones come time and again.

Hoping that this will cause a change of mind on the part of Mr. Connaught and that he will build a good multi-tube receiver and see what he has missed in the way of entertainment.

Respectfully,
J. H. CRAMER,
1226 Military Ave.,
Council Bluffs, Iowa.

THREE IMPORTANT BOOKS FOR SERVICE MEN!

"Trouble Shooter's Manual" — *The most popular and fastest-selling book in radio today. Wiring diagrams of commercial receivers are contained in this outstanding book.*

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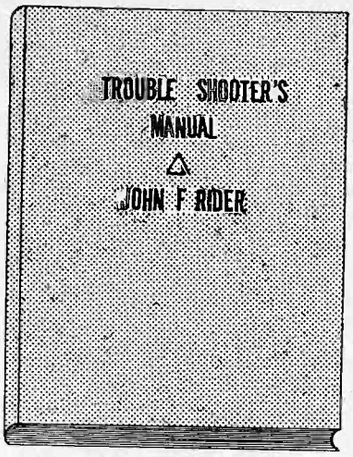

"Trouble Shooter's Manual"

is the first comprehensive volume devoted exclusively to the topic. The 240 pages include 200 illustrations devoted to wiring diagrams of factory-made receivers, besides other illustrations. It is not only a treatise for service men, telling them how to overcome their most serious problems, and fully diagramming the solutions, but is a course in how to become a service man.

This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers.

Besides 22 chapters covering thoroughly the field of trouble shooting, this volume contains the wiring diagrams of models, as obtained direct from the factory, a wealth of hitherto confidential wiring information released for the first time in the interest of producing better results from receivers. You will find these diagrams alone well worth the price of the book. The wiring diagrams are of new and old models, of receivers and accessories and as to some of the set manufacturers, all the models they ever produced are shown in wiring diagrams! Here is the list of receivers, etc., diagrams of which are published in this important and valuable book:

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60, 62, 20, 64, 30, 105, 51, 16, 32, 50, 25 A.C., 28 A.C., 41, Receptor S.P.U., 17, 18, 33.

FEDERAL
Type E series filament, Type E series filament, Type D series filament, Model K, Model H.

ATWATER-KENT
10B, 12, 20, 30, 35, 48, 32, 33, 40, 38, 36, 37, 40, 42, 52, 56, 44, 43, 41 power units for 37, 38, 44, 43, 41.

CROSLEY
XJ, Trirdyn 3B3, 601, 401, 401A, 608, 704, B and C supply for 704, 704A, 704B, 705, 706.

STEWART-WARNER
300, 305, 310, 315, 320, 325, 500, 520, 525, 700, 705, 710, 715, 720, 530, 535, 750, 801, 802, 806.

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Philco-electric, 82, 86.

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COLONIAL
26, 31 A.C., 31 D.C.

WORKRITE
8 tube chassis, 6 tube chassis.

AMRAD
70, 7100, 7191 power unit.

SPARTON
A.C. 89.

MISCELLANEOUS
DeForest F5, D10, D17, Super Zenith Magnavox dial, Thermiodyne, Grimes 4DL inverse duplex, Garod neutrodyne, Garod EA, Ware 7 tube, Ware type T. Federal 102 special, Federal 59, Kennedy 220, Operadio portable, Sleeper RX1, Amrad inductrol.

HERE ARE THE 22 CHAPTER HEADINGS

Service Procedure
Practical Application of Analysis
Vacuum Tubes
Operating Systems
Aerial Systems
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Troubles in "A" Eliminators
Trouble Shooting in "A" Eliminators
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Speakers and Types
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Troubles in Detector Systems
Radio Frequency Amplifiers
Trouble Shooting in RF Amplifiers
Series Filament Receivers
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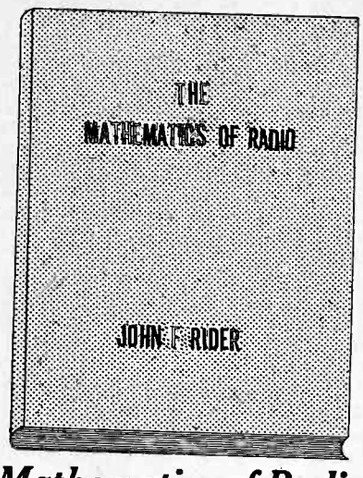

"Mathematics of Radio"

TABLE OF CONTENTS:

OHM'S LAW.
RESISTANCES: Basis for resistance variation, atomic structure, temperature coefficient, calculation of resistance variation, expression of ampere, volt and Ohm fractions, application of voltage drop, plate circuits, filament circuits, filament resistances, grid bias resistances.
DC FILAMENT CIRCUITS: Calculation of resistances.
AC FILAMENT CIRCUITS: Transformers, wattage rating, distribution of output voltages, voltage reducing resistances, line voltage reduction.
CAPACITIES: Calculation of capacity, dielectric constant condensers in parallel, ondensers in series, voltage of ondensers in parallel, in series, utility of parallel condensers, series condensers.
VOLTAGE DIVIDER SYSTEMS FOR B ELIMINATORS: Calculation of voltage divider resistances, types of voltage dividers, selection of resistances, wattage rating of resistances.
INDUCTANCES: Air core and iron core, types of air core inductances, unit of inductances, calculation of inductance.
INDUCTANCE REQUIRED IN RADIO CIRCUITS: Relation of wavelength and product of inductance and capacity, short wave coils, coils for broadcast band, coupling and mutual inductance, calculation of mutual inductance and coupling.
REACTANCE AND IMPEDANCE: Capacity reactance, inductance reactance, impedance.
RESONANT CIRCUITS: Series resonance, parallel resonance, coupled circuits, bandpass filters for radio frequency circuits.
IRON CORE CHOKERS AND TRANSFORMERS: Design of chokes, core, airgap, inductance, reactance, impedance, transformers, half wave, full wave windings.
VACUUM TUBES: Two element filament type, electronic emission, limitations, classifications of filaments, structure, two element rectifying tubes, process of rectification, tungar bulb.
THREE ELEMENT TUBES: Structure of tube, detector, grid bias, grid leak and condenser, amplifiers, tube constants, voltage amplification, resistance coupling, reactance coupling, transformer coupling, variation of impedance of load with frequency, tuned plate circuit.
POWER AMPLIFICATION: Square law, effect of load, calculation of output power, undistorted output power, parallel tubes, push-pull systems, plate resistance.
GRAPHS AND RESPONSE CURVES: Types of paper, utility of curves, types of curves, significance of curves, voltage amplification, power amplification, power output, radio frequency amplification.
MULTIPLE STAGE AMPLIFIERS: Resistance coupling, reactance coupling, tuned double impedance amplification, underlying principles, transformer coupling, turns ratio, voltage ratio, tyes of cores, late current limitation, grid current limitation.
ALTERNATING CURRENT TUBES: Temperature variation hum, voltage variation hum, relation between grid and filament, filament circuit center tap, types of AC tubes.
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(Just East of Broadway)

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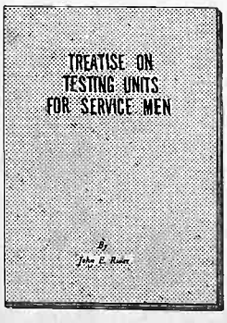

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for cigars or cigarettes, with button switch at top. Press the switch and light up!

Model A lighter, microphone design, with 5-ft. AC cable and plug. Works on 110 volts, AC any frequency and on direct current. .....Price $1.00

Model B lighter, microphone design, on tray, with 5-ft AC cable and plug. Works on 110 volt AC, any frequency, and on direct current. Exactly the same lighter as the other, only tray is added. Price.....$1.50

This lighter is instantaneous. Hold button down only long enough to light a cigar or cigarette. The two models are furnished in attractive sprayed finish. Both are very compact! For instance, the tray is only 4½" in diameter. Use these lighters in your home and for holiday gifts.

The heater element is renewable. Price 35 cents.

RADIO WORLD, 145 West 45th St., N. Y. City
☐ Please send me Model A Microphone Lighter at $1.00
☐ Please send me Model B at $1.50.
Please ship C. O. D.

Name .....

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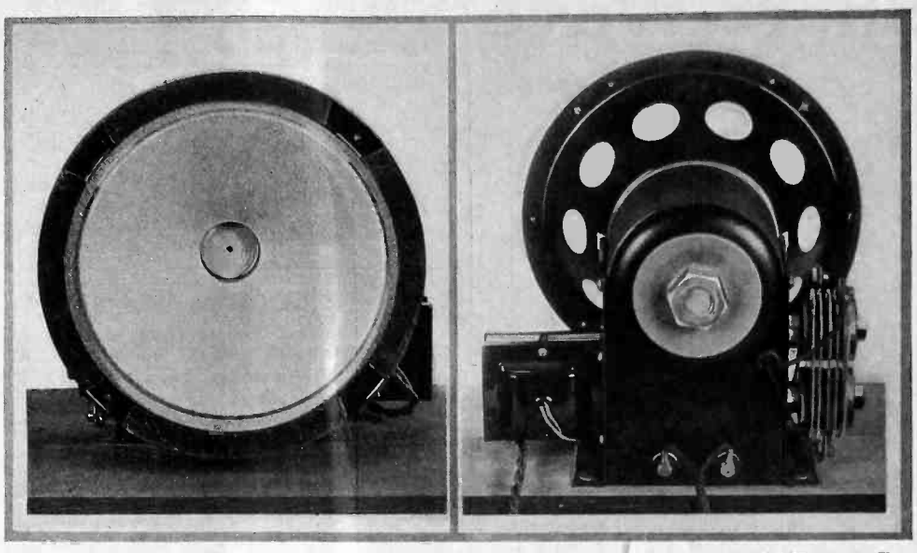
has been found of great value not only by radio fans, constructors, etc., but also by radio and other technical schools throughout the country. See the radio books advertisements in this issue.

Nothing Finer Than This Dynamic in Tone Quality!



Try This AC Dynamic Erla—No Matter on What Set and You Will Verify These Facts: Tone Unexcelled, sensitivity most remarkable

TO WORK this speaker, put plug into AC wall socket, lamp socket or convenience outlet of set, connect speaker tips to output posts of set, and tune in.

Here are the technical data on the AC dynamic Erla:
10 feet long power leads with plug
10 feet long speaker leads with one-inch terminal tips
Outside diameter of cone, 9 inches
Depth of speaker, 8 inches
Overall width of speaker, 9.5 inches
Mounting board, detachable, 10¾x12¾x⅞ inches
Burtex cone
Diameter of central magnet pole, 1.5 inches
Flexible spring mounting of tip of cone, and moving coil
Moving coil accurately center-mounted
Depth of magnet structure, 4.5 inches
Outside diameter of magnet structure, 4.5 inches
Built-in full wave, dry rectifier
Husky output transformer built in; heavy core, shielded
Superior workmanship
Thick felt buffers on front of cone edges
Built-in power transformer for rectifier
Will stand output of 250 tubes in push-pull and work superbly in any tubes, single or push-pull
Tone quality is unsurpassed

$12.50

Our Guaranty!

We have had considerable experience with AC dynamic chasses, and it is our firm conviction this is the best one we have offered so far.

So convinced are we that you will be overjoyed from the reproduction afforded by this Erla chassis that we ask you to buy it at no risk to yourself whatsoever. Order one shipped C.O.D. Try it for five days. If for any reason you desire to return it in that time, do so and we will refund your purchase price and expressage you laid out. This widest guaranty applies only to the Erla chassis.

Acoustical Engineering Associates
143 West 45th Street New York, N. Y.

Please ship at once, express C.O.D., one Erla dynamic chassis, 110 volt AC, 50-60 cycles, as advertised, at $12.50, on a five-day guaranty or money-back if not completely satisfied, including cartage money, which applies to the Erla offer only.

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MB-29

AC TUNER — WRITE FOR WHOLESALE PRICES!

Push-Pull Amplifier

The National Velvetone Push-Pull Power Amplifier (shown at right) consists of an AC-operated filament-plate supply, with two stage transformer audio amplifier and output transformer built in. Made only for 110-V., 50-60 cycles. Sold only in completely wired form, licensed under RCA patents.

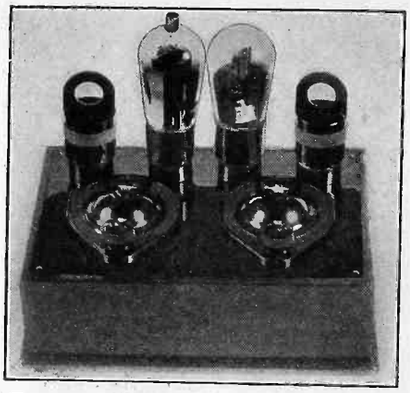
The new Power Amplifier has been developed and built to get the very most out of the MB-29. It is a combination power supply and audio amplifier, using a 280 tube for a rectifier, one stage of transformer audio with a 227 tube and a stage of push pull amplification with two 245s. It furnishes all power for itself and for the MB-29, as well as the audio channel. Order catalog PPPA, list price, completely wired and equipped with phonograph jack, (less tubes) $97.50. Your price.

WRITE FOR WHOLESALE PRICES

View of National Velvetone Push-Pull Power Amplifier, an expertly made A, B and C supply and audio amplifier, producing marvelous tone quality.

GUARANTY RADIO GOODS CO.
143 WEST 45TH STREET NEW YORK CITY

New AC Screen Grid Short-Wave Adapter



For use with AC screen grid sets only.

Order what parts you want.

- ☐ C1, C5—Two short-wave tuning condensers @ $1.50 ..... $ 3.00
- ☐ C2—One .00025 mfd. fixed condenser ..... .25
- ☐ C3, C6—Two 1 mfd. bypass condensers @ $.50 ..... 1.00
- ☐ C4—One .01 mfd. mica fixed condenser ... .35
- ☐ CT—One Hammarlund 80 mmfd. equalizing condenser ..... .35
- ☐ R1—One Electrad 800 ohm. wire-wound biasing resistor ..... .20
- ☐ Ant., Gnd.—Two Eby binding posts ..... .20
- ☐ Two sets of short-wave plug-in coils, three coils to a set, @ $1.50 a set, total six coils 3.00
- ☐ One AC short-wave adapter cable, 5-prong 1.50
- ☐ Two four-prong sockets ..... .40
- ☐ Two five-prong sockets ..... .40
- ☐ One grid clip ..... .06
- ☐ Two dials @ $.50 ..... 1.00
- ☐ One panel and cabinet 3.00

- ☐ All parts $14.71
- ☐ 227 tube ..... .90

GUARANTY RADIO GOODS CO.
143 West 45th St. New York, N. Y.

- ☐ Please ship C.O.D. all parts for AC screen grid short wave adapter @ $14.71.
- ☐ If 227 tube is desired also, put check here.
- ☐ Please ship C.O.D. only those parts noted separately.

Name .....

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For cigars or cigarettes, with button switch at top. Press switch, and lighter acts instantaneously. $1.00. Model B lighter on tray, $1.50. Radio World, 145 W. 45th St., N. Y. C.

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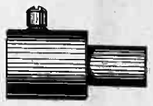

Here is a handy aid to salvaging condensers and coils that have ¼" diameter shafts not long enough for your purpose. Fits on ¼" shaft and provides ⅜" extension, still at ¼". Price 10c net.

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ARISTOCRAT FLOOR SPEAKER

With Molded Wood Horn and Horn Motor built in. Good value. $12.00. Acoustical Engineering Associates, 143 W. 45th St., N. Y. C.

FULL EXPOSITION OF HB COMPACT, BATTERY MODEL

Complete details on the theory and construction of the HB Compact were published in a four-part article in Radio World, written by Herman Bernard, designer of the circuit and inventor of the Bernard Dynamic Tuners used in the circuit. Full details on how to wind your own coils. Full-sized pictorial diagram of the wiring. Order the August 24th, 31st, September 7th and 14th issues, 60c—

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Ansonia Gothic Speaker, a tremendous bargain at..... $4.89!

A loudspeaker that gives you real performance, that stands up to a 171 or 171A tube without requiring an output filter, and that works splendidly from output filters in sets using 210, 245 or 250, single or push-pull, in a genuine walnut cabinet, all at less than the price of a good magnetic unit alone! And the magnetic unit in this Ansonia Speaker is of the very best Ansonia type.

The cabinet is of the popular Gothic type, and is a beauty indeed. Why, the cabinet alone cost the manufacturer in thousand lots more than the price now asked for the complete speaker.

Use this speaker on any set, battery-operated or AC, and you'll be delighted.

GUARANTY RADIO GOODS CO.
143 West 45th Street, New York, N. Y.
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Please ship C. O. D. one Ansonia Gothic magnetic speaker, in genuine walnut cabinet, @ $4.89 plus post office charges, on 5-day guaranty of quick refund of purchase price if I am not satisfied with speaker for any reason.

Please send me a square model (not Gothic), but same unit in square walnut cabinet @ $4.24.

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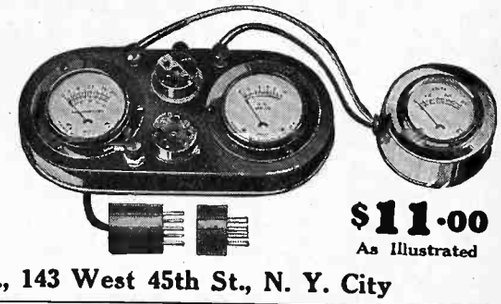
2 meter assembly, cable plugs, Cat. 215 @ $7.00
0-600 AC-DC meter alone, Cat. M600 @ $4.95



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"AUDIO POWER AMPLIFIERS," by J. E. Anderson and Herman Bernard, the first and only book on the subject. $3.50. Hennessy Radio Publications Corporation, 145 West 45th St., N. Y. City

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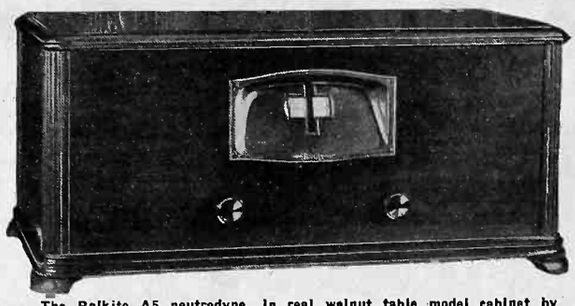


The Balkite A5 neutrodyne, in real walnut table model cabinet by Berkey & Gay. Volume control at left, AC switch at right, drum dial at center, with space to mark in call letters.

You want DX—the more DX the merrier! But why take any chances? We positively guarantee that the Balkite Neutrodyne, made by Gilfillan, will get you all the DX you could desire! Try the set for five days. If not completely satisfied, return it in that time for prompt refund of purchase price!

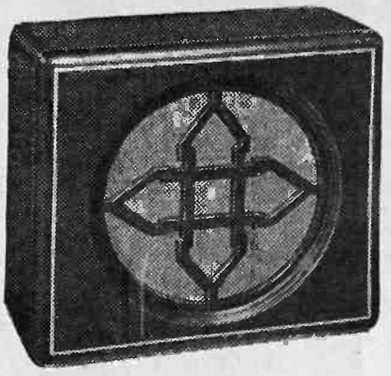
Three stages of tuned RF, neutrallzed, so there's no squealing; easy tuning; operation on short piece of wire indoors perfectly satisfactory; no repeat tuning points; no hum; phonograph pickup jack built in; excellent tone quality; good selectivity. These are outstanding points of the receiver, ONE OF THE MOST SENSITIVE BROADCAST RECEIVERS EVER DEVELOPED. The receiver alone lists for $135. Here you get the set, speaker and tubes at $9.50 less than half the list price of the receiver alone!

8-Tube Push-Pull AC Balkite Neutrodyne with Matched Speaker and All Tubes, Complete $57.50

A good many bargains in radio receivers are available today, because set manufacturers overproduced, and had to let their stock go at sacrifice prices. It does not follow that all sacrificed receivers are worth even the cut price. We turned down many "opportunities" to obtain large quantities of "sacrificed" receivers. When the Balkite was offered to us we tested its performance for five days and were delighted. We took the set apart completely to see what calibre of parts was used and how the wiring was done. When we tell you all the parts were ace-high and the wiring the best we've seen, you will know this is an extraordinary receiver. The tubes used are five 227, two 112A and one 280. The undistorted maximum power output is 780 milliwatts.

The line input must be 50-60 cycles, 105 to 120 volts. There is a voltage adjuster built in. The magnetic speaker has a matched impedance for the output of the receiver, and is itself housed in a real walnut cabinet with marqueterie inlay.

FIVE-DAY MONEY-BACK GUARANTEE ON RECEIVER, TUBES AND SPEAKER!



The speaker is of hand-rubbed genuine walnut and its list price alone is $35.00.

Guaranty Radio Goods Co., 143 West 45th Street, New York, N. Y.

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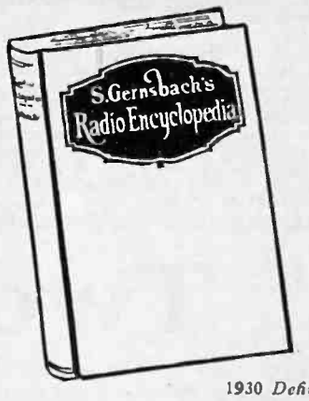

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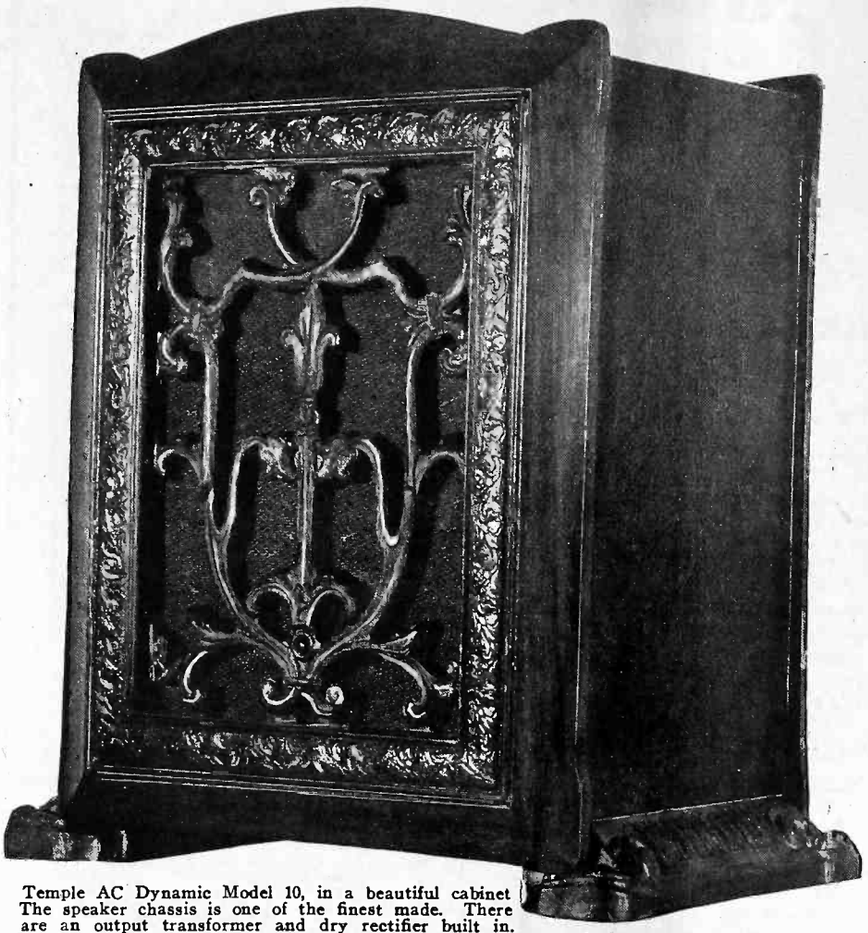
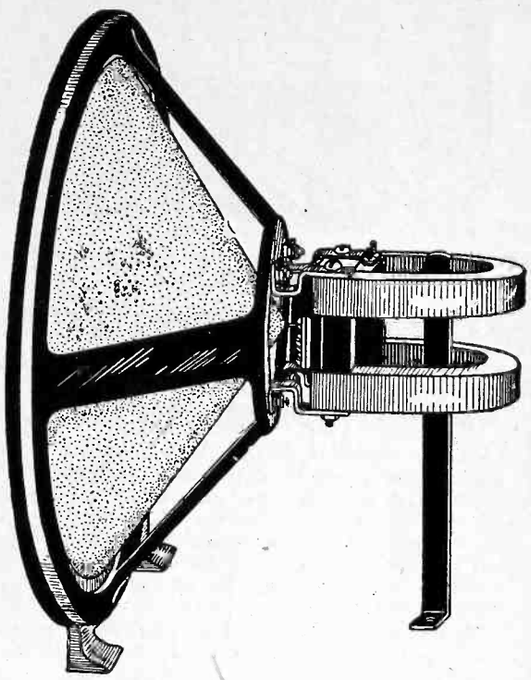


Temple AC Dynamic Model 10, in a beautiful cabinet The speaker chassis is one of the finest made. There are an output transformer and dry rectifier built in. The cabinet has decorated walnut front and back, with carved grille ornament. An AC switch is accessible underneath cabinet. Rear is removable for adjustment of resistor knob to match the impedance of your receiver's output tube. Connect plugged AC cable to 110 volts AC, 50 to 60 cycles, and connect tipped cords to speaker post of receiver. This remarkable speaker Cat. TEM-10 at only.....

$15.34



Farrand Inductor Chassis, consisting of the unit, cone, spider, bracket, assembled, but not in a cabinet.

Model 6-G-CT for connection to push-pull, requiring no output device, because unit is constructed as a center tapped output impedance. Center tap is yellow and goes to B+. Tipped cords go direct to plates. Outside diameter 8".....
[For other than push-pull, ignore yellow lead.]

$10.00

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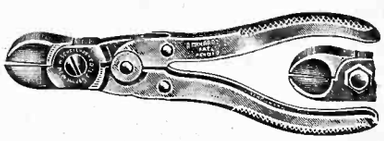
Spring Action Diagonal Nipper



A DIAGONAL cutting nipper is the second most useful tool for radio work, next to the soldering iron. Non-friction spring action adds convenience of use, as the handles are sprung back just far enough for a comfortable grip, and the jaws are closed by easy pressure on the handles.

For cutting wire, a constant operation in your work, this tool is most serviceable, as it makes a clean cut, right through fuzzy insulation as well as through metal. The cut is far more incisive than with the common diagonal cutting pliers. With the diagonal nipper you can cut wire not only along its length, but wherever it may be attached, since accessibility is perfect. A cut can be made any place where the diagonal nipper can enter, since the cutting can be done at the tip. Pliers with diagonal cutters can only ply, not cut, at the extremity.

With the diagonal nipper insulation can be bared from wire ends for soldering. Also screws up to 8/32 machine screw used in radio can be nippped off at any point with one firm application of pressure with one hand.

The device is used extensively in radio set factories and by custom set builders and radio experimenters.

Size 5½" long; weight 1⅝ lbs.; material, drop forged steel; finish, nickel plated.

Send $3.00 for 6 months' subscription for Radio World and ask for No. 177 Nipper, free. RADIO WORLD, 145 West 45th Street, New York, N. Y.

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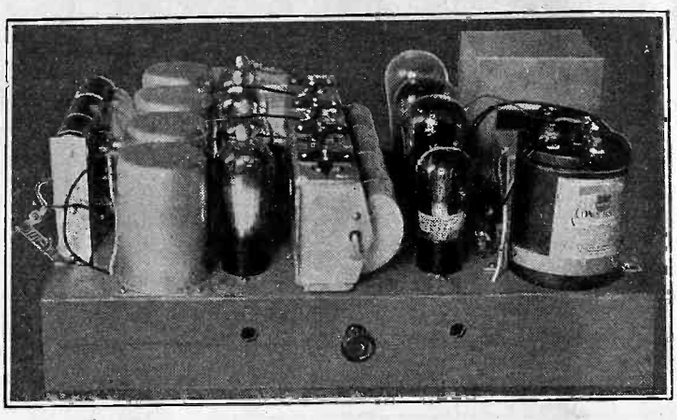
High Gain at Low Cost

HB44 - - - $45.35



The HB44, assembled, presents in compact form, on a 17½ x 11½" steel chassis, a completely AC operated shielded receiver, using four 224 screen grid tubes, one 227, two 245s in push-pull, and a 280 rectifier, eight tubes all told. Here is the circuit that will bring 'em in from all over the country—and at a price you can afford—$45.59. This price includes EVERYTHING except speaker, cabinet and tubes.

It's the Real Thing!

(a) Three stages of tuned R.F., using 224 screen grid tubes.
(b) Tuned input to 224 power detector.
(c) Audio, consisting of first stage resistance coupled, second stage 245s in push-pull.
(d) Four totally shielded R.F. coils.
(e) A chassis all drilled for necessary parts.
(f) A four gang condenser, guaranteed accurate, with equalizing condensers built in.
(g) 61 mfd. of filter and bypass capacity.
(h) Thirteen different fixed voltages available from the output.
(i) Single dial control.

LIST OF PARTS FOR THE HB44

☐ SL1, SL2, SL3, SL4—Four stage individually shielded coil cascade for .00035 mfd. (Four Cat. SH-3 of Screen Grid Coil Co.)	$ 3.80
☐ C1, C2, C3, C4—One four gang .00035 mfd. condenser with equalizers E1, E2, E3, E4 built in	3.95
☐ C5—One .01 mfd. mica condenser	.35
☐ C6, C7, C13, C14—Four 1 mfd. 200 volt DC bypass condensers	2.00
☐ C8—One 1 mfd. 550 volt AC filter condenser	.85
☐ C9, C10, C11, C12—One Mershon, consisting of four condensers, two of 8 mfd. and two of 18 mfd. with bracket (Cat. Q-2-8, 2-18-B).	5.15
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☐ R3—One Lynch 5.0 meg. metallized grid leak, with mounting	.40
☐ R4—One 5,000 ohm resistor with mounting	.50
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☐ T2—One Polo filament-plate supply (Cat. PFPS)	7.50
☐ Ch—One double filter choke coil, 30 henrys each section, 100 ma.	3.71
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☐ PL—One 2.5 volt pilot lamp and bracket	.70
☐ Speaker (+), (—), Ant., Gnd.—Four binding posts with insulators.	.40
☐ One Clarostat Humdinger, 30 ohms	.50
☐ One subpanel 17½" x 11½", with five UY and three UX sockets.	3.00
☐ One vernier dial	.50
☐ Four National grid clips	.24
☐ All parts (less cabinet, tubes and speaker)	$45.35
☐ Tubes: four 224, one 227, two 245, one 280	9.51

GUARANTY RADIO GOODS CO.,
143 West 45th Street, New York, N. Y.
(Just East of Broadway.)

☐ Please ship all parts for HB44 @ $45.59
☐ Eight tubes for HB44 ..... 9.51
☐ Please ship C.O.D.
☐ Enclosed find $..... remittance.
(Canadian must be P. O. or Express M. O.)

NAME .....

ADDRESS .....

CITY ..... STATE .....

FIVE DAY MONEY-BACK GUARANTY

Highest Grade Key Tubes at

Defiant Prices!

Screen Grid Tubes

224	at	$1.43
222	at	1.88

Power Tubes

250	at	4.95
210	at	3.25
245	at	1.28
112A	at	.78
171A	at	.78

Other Tubes

227	at	.90
226	at	.68
280	at	1.13
281	at	2.95
201A	at	.53

The above constitute the nine most popular tubes used in radio today. Despite the severely low prices the Key tubes are firsts of the very first quality. Besides, there is a five-day money-back guaranty! The above tubes are manufactured under licenses granted by the RCA and its affiliated companies.

All prices are net and represent extreme discount already deducted.

GUARANTY RADIO GOODS CO., 143 West 45th St., N. Y. City. (Just East of Broadway).

Enclosed please find $..... for which ship at once tubes marked below:

☐ 224 AC screen grid	$1.43
☐ 245 AC power tube	$1.28
☐ 226 AC amplifier	.68
☐ 227 AC det.-amp.	.90
☐ 280 AC rectifier	$1.13
☐ 222 battery screen grid	$1.88
☐ 112A power tube	.78
☐ 171A power tube	.78
☐ 201A battery tube	.53
☐ 250 power tube	4.95
☐ 210 power tube	3.25

Name .....

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

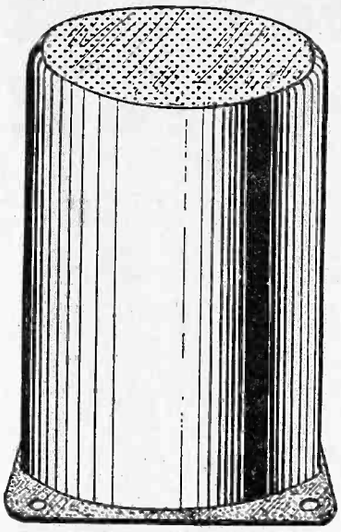
☐ Put cross here if C. O. D. shipment is desired.

Canadian remittance must be by postal or express money order.

5-Day money-back guaranty

The Latest in Tuning Equipment

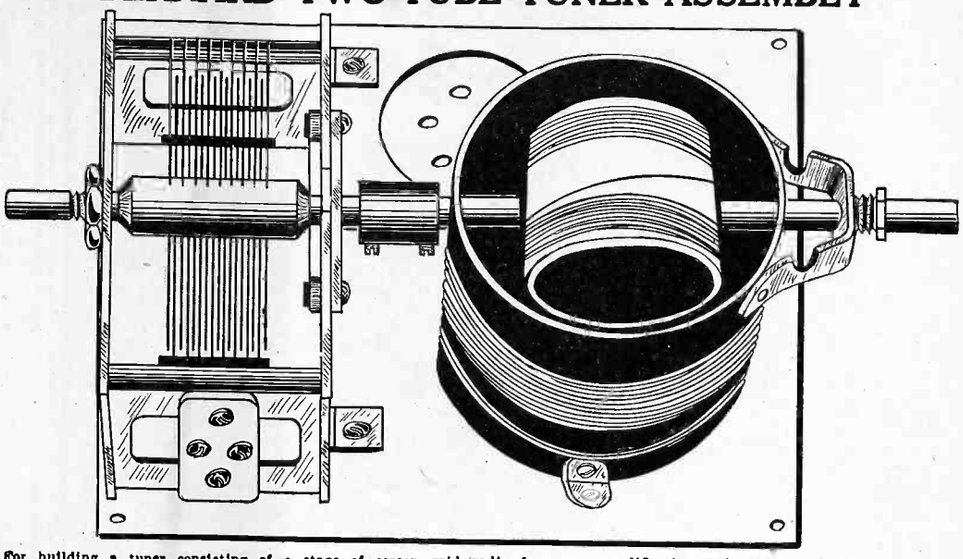
SHIELDED COIL



RF transformer in aluminum shield 2¾" square at bottom, 3¾" high. If metal sub-panel is used no extra base is needed. Coils have brackets on. You must assemble in shield yourself and solder winding terminals to built-in lugs. For all circuits and stages, including screen grid tubes.

Cat. No. SH3 for .00035 mfd. $0.95
Cat. No. SH5 for .0005 mfd. $1.00
Cat. SHB (extra base) $0.10

BERNARD TWO-TUBE TUNER ASSEMBLY



For building a tuner consisting of a stage of screen grid radio frequency amplification and a detector, AC or battery-operated, use the Bernard two-tube tuner assembly. Suitable for single control with one drum dial or separately tuned stages with two flat-type dials. The assembly consists of antenna stage (BTL-AC or BTL-DC), having Bernard Tuner BT3A, a .00035 mfd. condenser, socket, link and aluminum base. The detector input stage (BTR-AC or BTR-DC) consists of the same parts, but the coil has a tuned primary with untuned input to detector. Assemblies are unwired but are erected.

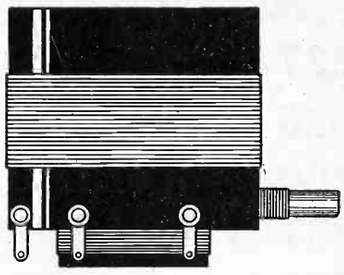
The condenser has shaft protruding at rear, so if two dials are used coil is put at front panel in either instance and condenser at front panel for the other.

For AC operation, 224 RF and 224, 227 or 228 detector, order Cat. No. BTL-AC and BTR-AC at $6.00 for both.

For battery operation of filaments, 222 RF and 222, 240, 201A or 112A detector, order Cat. No. BTL-DC and BTR-DC at $6.00 for both.

[Note: for drum dial single control an 80 mmfd. equalizing condenser is necessary. This is extra at $0.35. Order Cat. EQ-80.]

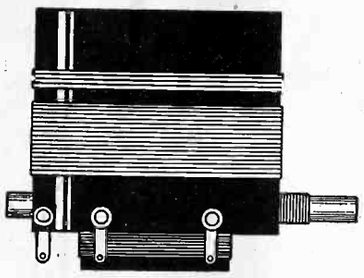
ANTENNA COUPLER



Cat. No. VA5—$0.85
FOR .0005 MFD. CONDENSER

Moving primary and fixed secondary, for antenna coupling. Serves as volume control.
Cat. No. VA3 for .00035 mfd. $0.90

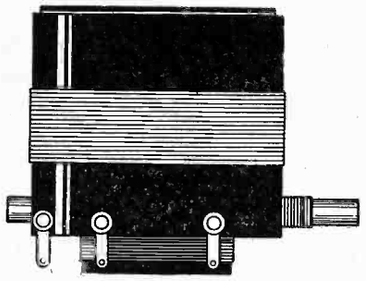
BERNARD TUNERS



Bernard Tuner BT5A for .0005 mfd. for antenna coupling, the primary being fixed and the secondary tuned. This coil is used as input to the first screen grid radio frequency tube. Secondary has moving coil.
Cat. No. BT3A for .00035 mfd. ..$1.35

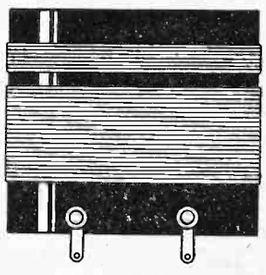
Bernard Tuner BT5B for .0005 mfd. for working out of a screen grid tube, tuned primary, untuned secondary. Primary has moving coil.
Cat. BT3B for .00035 mfd. ..$1.35

Cat. No. BT5A—$1.35
FOR .0005 MFD. CONDENSERS



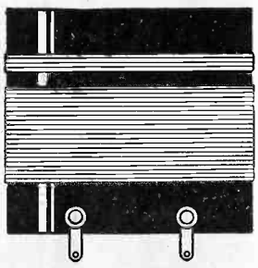
Cat. No. BT5B—$1.35
FOR .0005 MFD. CONDENSER

SG TRANSFORMER



Cat. No. SGS5—$0.60
FOR .0005 MFD. CONDENSER

Interstage radio frequency transformer, to work out of a screen grid tube, primary untuned.
Cat. No. SGS3 for .00035 mfd. $0.65



Cat. No. RF5—$0.60
FOR .0005 MFD. CONDENSER

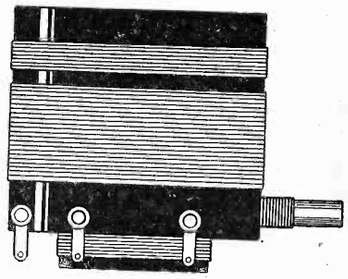
DIAMOND PAIR

Cat. No. RF5—$0.60
FOR .0005 MFD. CONDENSER

Antenna coil for any standard circuit, and one of the two coils constituting the Diamond Pair.
Cat. No. RF3 for .00035..$0.65

Cat. No. SGT5—$0.85
FOR .0005 MFD. CONDENSER

Interstage 3-circuit coil for any hookup where an untuned primary is in the plate circuit of a screen grid tube.
SGT3 for .00035 mfd...$0.90



Cat. No. SGT5—$0.85
FOR .0005 MFD. CONDENSER

FL4 $0.30
Flexible insulated coupler for uniting coil or condenser shafts
Order Cat. FL4 at $0.30

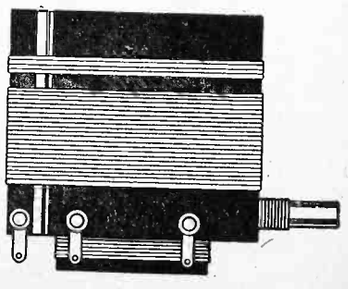
Order the Diamond Pair, Cat. DP5 for .0005 mfd. at $1.45

Order the Diamond Pair, Cat. DP3 for .00035 mfd. at $1.55

[Note: These same coils are for AC or battery circuit.]

Equalizing condenser, 80 mmfd., for connection across any tuning condenser where ganging is resorted to, or for equalizing independently tuned circuits to make dials track.
Order Cat. EQ80 at $0.35

STANDARD TUNER



The standard three-circuit tuner is used with primary in the plate circuit of any RF tube, AC or battery type, excepting only screen grid tube.

For .0005 mfd. order T5 at $0.85
For .00035 order Cat. T3 at $0.90

All coils have 2½" diameter, except the shielded coil, which is wound on 1¾".

The coils are wound by machine on a bakelite form, and the tuned windings have identical inductance for a given capacity condenser, i. e., .0005 mfd. or .00035 mfd. Full coverage of the wave band is assured.

All coils with a moving coil have single hole panel mounting fixture. All others have base mounting provision. The coils should be used with connection lugs at bottom, to shorten leads.

Only the Bernard Tuners have a shaft extending from rear. This feature is necesary so that physical coupling to tuning condenser shaft may be accomplished by the insulated link.

Screen Grid Coil Company,
148 West 45th Street,
New York, N. Y. (Just East of Broadway.)

Please ship at once C. O. D.:

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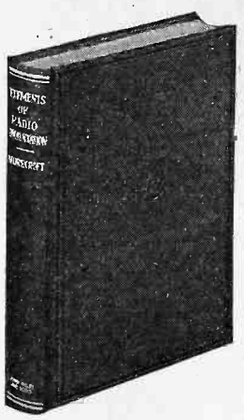

The latest book by Prof. John H. Morecroft, of the Engineering Department of Columbia University, and past president of the Institute of Radio Engineers, is his "Elements of Radio Communication," a book for the novice to enjoy. We regard this as the best elementary book to inform you authoritatively on the technical phases of radio in plain language, without requirement of mathematical knowledge. The book is a complete course on the elements of radio, containing much material never before published. It has 226 pages, 170 illustrations and a complete index. Just out, it is the book of the year in radio. Cloth bound. Order Cat. ME @ $3.00

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The need for an elementary book on radio tubes that answers all the important questions has been filled by James A. Moyer, Director of University Extension, Massachusetts Department of Education, and John F. Wostrel, Instructor in Radio Engineering, Division of University Extension, Massachusetts Department of Education.

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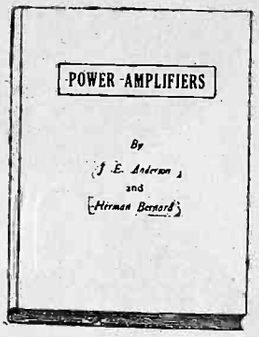
"Practical Radio Construction and Repairing," 319 pages, a companion volume. Order Cat. MWPRC @.....$2.00

[NOTE: *The standard book on tubes for advanced students is "The Thermionic Vacuum Tube," by Hendrik Van der Bijl. Order Cat. VDB @.....$5.00*]

ANDERSON and BERNARD
"Power Amplifiers"

Here is the *first* book to be published on the subject of "Power Amplifiers." Now printing) it is certain to fill a void in radio literature. The whole subject is fully covered in a masterful theoretical discussion of audio amplifiers and power supplies, supplemented by constructional chapters, with complete wiring diagrams and specification of parts. Learn while you build! J. E. Anderson, M. A., technical editor of RADIO WORLD, and Herman Bernard, LL. B., managing editor of RADIO WORLD, both of the Institute of Radio Engineers, have explained fully the phenomena of power amplifiers. Learn all about motorboating and its cures, push-pull theory and practice, grid bias methods and effects, vacuum tubes in audio circuits, AC and battery type AF amplifiers, phase relationships, common impedance, filter systems, by-pass condenser effects, necessities for tone quality, values of coupling constants, and a host of other topics associated with power amplification, including speech amplifiers and "talkie" installations.



More than 200 pages and more than 100 illustrations are devoted to an analysis of this outstanding radio subject. "Power Amplifiers" is authoritative, original and comprehensive. It is free from the traditional errors that have crept into this subject. The theoretical part of the book can be understood by most novices, while the constructional part, that capitalizes the previously imparted knowledge, is thoroughly understandable by anybody. There is virtually no mathematics in the book. Cloth bound. Order Cat. PAM @.....$3.50

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Two new books by John F. Rider, R. E., Member, Institute of Radio Engineers, constitute the series grouped by him under the heading "Service Man's Manual." Part I is "Mathematics of Radio." Part II is "Trouble Shooter's Manual."

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This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers. The home experimenter, the radio engineer, the custom set-builder, the teacher, the student—all will find this new book immensely informative and absolutely authoritative.

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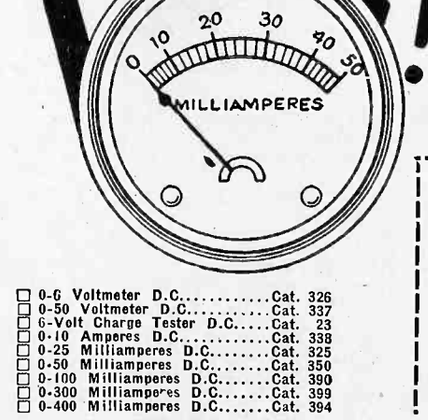

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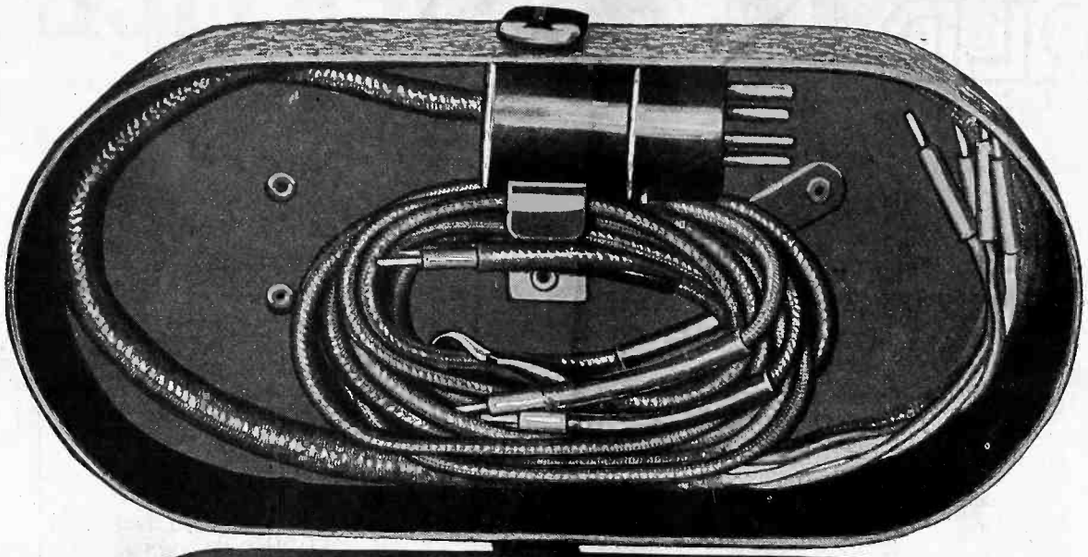
NEW J-245-X TROUBLE-SHOOTING JIFFY TESTER

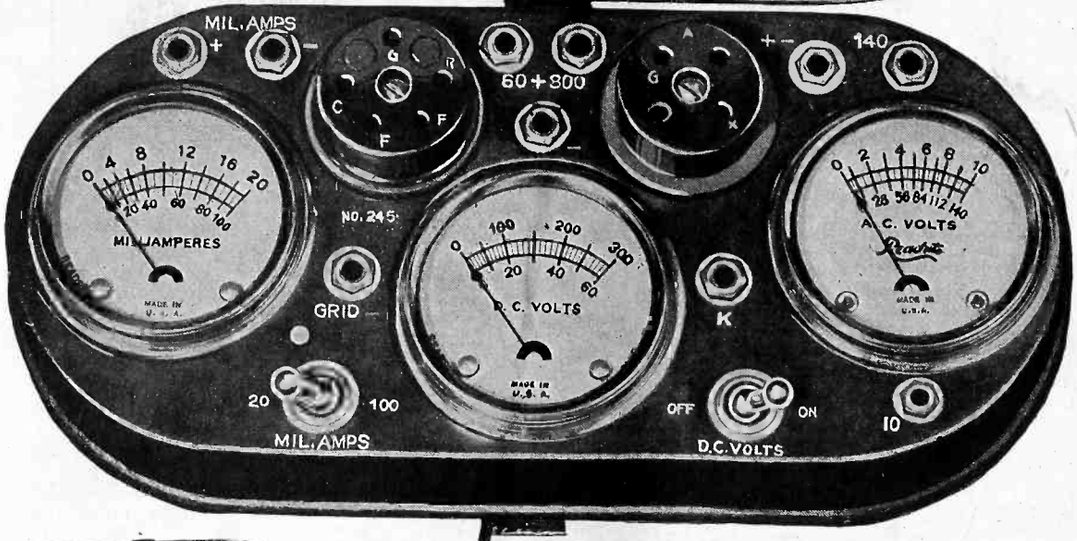
Illumination Continuity and Polarity Tester FREE with Each Outfit!

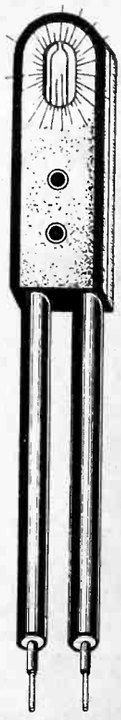


Your Price

$15.82

Complete

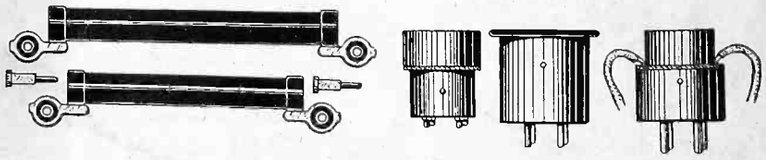




Illumination Tester, Vest Pocket Size, Shows Shorts and Opens Visually, also polarity of DC lines. A Neon lamp is built in.

The three-meter assembly, in the crackle-brown finish carrying case, with slip-on cover in place. The handle is genuine leather. The buckled strap holds the cover on.

Illustration above is 2/3 scale.



J-111 Multiplier, upper left, with tip; below it, J-106 Multiplier with tip; plugs, left to right, J-19, conforms UV socket to UX plug; J-20, conforms UX tester socket to UV199 tube; J-24, to test Kellogg and old style Arcturus tubes.

Makes All Necessary Tests in a Jiffy and Simplifies Service Work!

THE new Jiffy Tester, J-245-X, is a complete servicing outfit. It consists of a three-meter assembly in a metal case, with slip-on cover and a cable plug. There are ten adapters. It is vital to have the complete outfit so you can meet any emergency.

With this outfit you plug the cable into a vacated socket of a receiver, putting the removed tube in the tester, and using the receiver's power for making these tests: plate current, up to 100 milliamperes; plate voltage up to 300 volts; filament or heater voltage (AC or DC), up to 10 volts.

Each meter may be used independently. One of the adapters—a pair of test leads, one red, the other black, with tip jack terminals—serves this purpose. Multiplier J-106 extends the range of the DC voltmeter to 600 volts, but this reading must be obtained independently, as must readings on the 0-60 scale of the DC voltmeter. Independent reading of the AC voltmeter for line of voltage is necessary; also to use 0-140 scale while Multiplier J-111 extends the AC scale to 560 volts for reading power transformer secondaries.

The other adapters permit the testing of special receiver tubes, so that tests may be made, in all, of 22 different tubes: 201A, 200A, UX199, UV199, 120, 240, 171, 171A, 112, 112A, 245, 224, 222, 228, 280, 281, 227, 226, 210, 250, Kellogg tubes and old style Arcturus tubes.

WHEN servicing a radio set, power amplifier, speech amplifier or sound reproduction or recording equipment, the circuits and voltages are almost inaccessible, unless a plug-in tester is used.

The Jiffy 245-X plugs in and does everything you want done. It consists of:

(1)—The encased three-meter assembly, with 4-prong (UX) and 5-prong (UY) sockets built in; changeover switch built in, from 0-20 to 0-100 ma.; ten vari-colored jacks, five of them to receive the vari-colored tipped ends of the plug cable; grid push-button, that when pushed in connects grid direct to the cathode for 224 and 227 tubes, to note change in plate current, and thus shorts the signal input.

(2)—4-prong adapter for 5-prong plug of cable.
(3)—Screen grid cable for testing screen grid tubes.
(4)—Pair of Test Leads for individual use of meters.
(5)—J-106 Multiplier, to make 0-300 DC read 0-600.
(6)—J-111 Multiplier, to make 0-140 AC read 0-560.
(7)—Two jack tips to facilitate connection of multipliers to jacks in tester.
(8), (9), (10)—Three adapters so UV199 and Kellogg tubes may be tested.
(11)—Illumination Tester.

The illumination tester will disclose continuities and opens and also the polarity of DC house mains. It is as handy as a pencil and fits in your vest pocket. It works on voltages from 100 to 400. There are two electrodes in a Neon lamp in the top of the instrument. On AC both electrodes light. On DC only one lights, and that one is negative of the line, the light being on the same side as the lead. Hence the illuminator shows whether tested source is AC or DC, and if DC, which side is negative.

Even the output of the speaker cord will show a light.

Also, the device will test which fuses are blown in fused house lines, AC or DC. Besides it tests ignition of spark plugs of automobiles, boats and airplanes, also faulty or weak spark plugs.

Just flash on the illumination tester momentarily. It will last about 4,000 flashes.

GUARANTY RADIO GOODS CO.
143 West 45th Street, Just East of Broadway, N. Y. City.

☐ Please send me on 5-day money-back guaranty your J-245-X Jiffy Tester, complete, with all 10 adapters, and with Illuminated Tester FREE with each order. Also send instruction sheet, tube data sheet and rectifier tube testing information.

☐ Please ship C. O. D. @ $15.82 plus cartage and P.O. fee.

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