Popular Radio

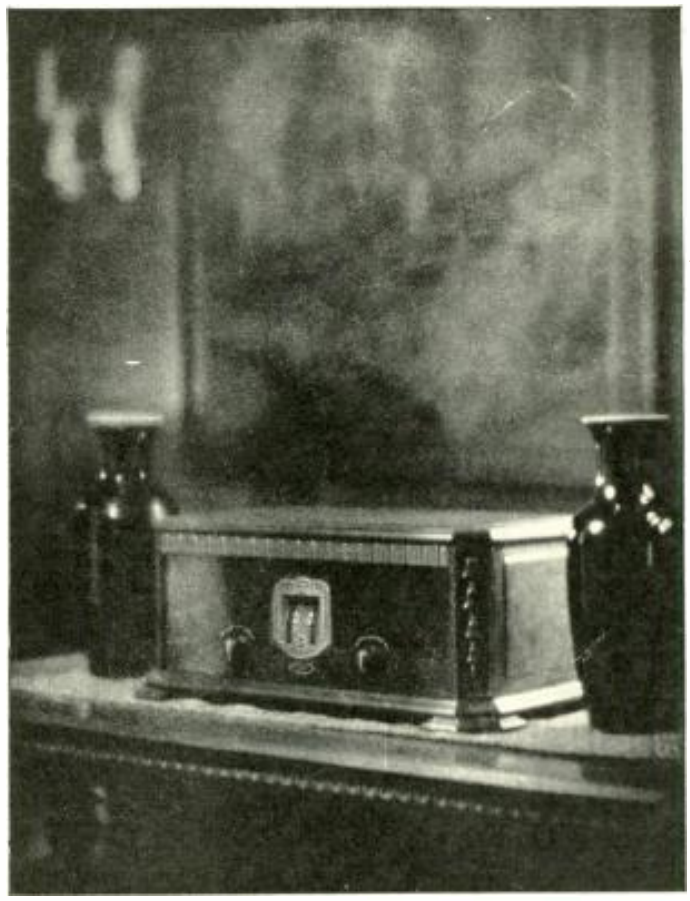
DECEMBER · 1927 ★

25¢

FIRST!

A Marvelous New AC Superheterodyne Getting 1928 Results with Your Old Receiver

The Best in Radio MUST BE CUSTOM BUILT!



TAKE a circuit continuously improved over years of experiment by ten of America's leading manufacturers working as a unit towards radio perfection—add the finest parts in the industry - put them together under your own eyes, following the creators' simple instructions—and the result is the "Hi-Q Six"—*a CUSTOM-BUILT Receiver to meet your exact individual needs.*

"CUSTOM-BUILT" usually implies high cost. With the Hi-Q Six it means economy, for the complete approved parts cost only $95.80 and produce a radio instrument that cannot be duplicated in factory-made sets at more than twice the price.

"CUSTOM-BUILT" always means quality. So with the Hi-Q Six—equal and maximum amplification on *all* wave lengths knife-like selectivity—super-sensitiveness—absolute freedom from oscillation—and tonal quality as natural as the original.

For complete details send 25 cents for a copy of "Hi-Q Construction Manual."

HAMMARLUND-ROBERTS, INC., 1182-B BROADWAY NEW YORK CITY

The basis of Radio Efficiency and Economy—the "Hi-Q" Book explains simply and completely how to build this remarkable receiver. The Hi-Q Foundation Unit includes ready-drilled steel chassis, decorated panel, shields and all special hardware—a combination which simplifies construction.

Hammarlund ROBERTS Hi-Q SIX

Associate Manufacturers

Silent Magic

Here is the Eveready Layerbilt "B" Battery No. 486, Eveready's longest-lasting provider of Battery Power.

Radio is better with *Battery* Power

TURN your radio dial, and presto! you turn your home into a theater, a concert hall, a lecture room, a cabaret, a church, or whatever you will. Turn the dial and your attentive ear does the rest. That is all there is to this magic of radio.

Or almost all. If a radio set is to work at its very best, attracting no attention to itself, creating for you the illusion that can be so convincing, you must pay a little attention to the kind of power you give it. There is but one direction, a simple one—use Battery Power. Only such power is steady, uniform, silent. It is called by scientists pure Direct Current. Any other kind of current in your radio set may put a hum into the purest note of a flute, a scratch into the song of the greatest singer, a rattle into the voice of any orator.

Don't tamper with tone. Beware of interfering with illusion. Power that reveals its presence by its noise is like a magician's assistant who gives the trick away. Use batteries—use the Eveready Layerbilt "B" Battery No. 486, the remarkable battery whose exclusive, patented construction makes it last longest. It offers you the gift of convenience, a gift that you will appreciate almost as much as you will cherish the perfection of reception that only Battery Power makes possible.

EVEREADY Radio Batteries *—they last longer*

NATIONAL CARBON CO., INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

WEAF—*New York*
WJAR—*Providence*
WEEI—*Boston*
WFI—*Philadelphia*
WGR—*Buffalo*
WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WTAM—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
KSD—*St. Louis*
WCCO—*Minneapolis, St. Paul*
WDAF—*Kansas City*
WRC—*Washington*
WGY—*Schenectady*
WHAS—*Louisville*
WSB—*Atlanta*
WSM—*Nashville*
WMC—*Memphis*

Pacific Coast Stations—
9 P. M., Pacific Standard Time

KPO—KGO—*San Francisco*
KFOA—KOMO—*Seattle*
KFI—*Los Angeles*
KGW—*Portland*

Popular Radio

EDITED *by* RAYMOND FRANCIS YATES

FOUNDED 1911

VOLUME XII December, 1927 NUMBER 6

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DEPARTMENTS

VOLUME XII DECEMBER, 1927 NUMBER 6

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Printed in U. S. A.

CHARLES L. DAVIS, *Managing Editor* LAURENCE M. COCKADAY, *Technical Editor* E. E. FREE, Ph.D., *Contributing Editor*

For These Four Reasons

Arcturize your present Radio Set—enjoy all the benefits of A-C Power from your light socket with

ARCTURUS A-C TUBES

Detector ✓ Amplifier ✓ Power

Arcturus A-C Tubes Have 4 Outstanding Features

1. Exceptional tone quality, volume and sensitivity. 2. Readily adaptable to all circuits using standard sockets. 3. Perfect operation under all normal line voltage variations. 4. Free from hum.

If you have been awaiting the perfection of A-C Tubes before modernizing your present set, send at once for detailed information on the operating characteristics of Arcturus A-C Tubes.

Ask Your Dealer

It doesn't take long or cost much to install Arcturus A-C Tubes in your present set. Your dealer's service man can get engineering instructions for the few simple changes in wiring that are necessary. Always remember that in changing over your set for A-C operation, Arcturus A-C Tubes require the least changes in wiring.

For the Technical Man

The unique advantages which we claim for Arcturus A-C Tubes are directly traceable to unique features of construction and exceptional operating characteristics.

The exceptional long life of Arcturus Tubes is due to the enormous electron supply resulting from the heater operating at a low temperature.

The highly efficient cathode is responsible for the unusual sensitivity of Arcturus A-C Tubes, and for the exceptional volume and tone quality which their use insures. This cathode produces: 1. A high amplification factor (10.5). 2. A low plate impedance (9,000 ohms). 3. A high mutual conductance (1160 micromhos).

Since the base of the Arcturus A-C Tube is of the standard four prong type, no additional terminals are required, making Arcturus Tubes adaptable to existing circuits with all the simplicity of D-C tubes. No center taps or balancing are required. A common toy transformer may be used. Filament voltage is the same (15 volts) for all types—detector, amplifier and power.

The freedom from hum which is one of the most important features of Arcturus A-C Tubes is due to the use of low A-C current, only 0.35 ampere. (Disturbing electro-magnetic fields are proportional to alternating current—not voltage.) Arcturus Tubes in all stages are four element tubes with indirectly heated cathodes.

Normal variations in line voltage do not affect the operation of Arcturus A-C Tubes. The amplification factor is practically constant over a wide range of filament voltages—13.0 to 18.0 volts.

The use of a heavy carbon filament enables Arcturus A-C Tubes to withstand even an unusual overload.

ARCTURUS RADIO COMPANY, INC.

257 Sherman Avenue, Newark, N. J.

A PAGE WITH THE EDITOR

From a photograph made for POPULAR RADIO

POPULAR RADIO SERVES THE RADIO PUBLIC

In the new laboratory of POPULAR RADIO, *shown above, the testing of new radio apparatus, which* POPULAR RADIO *has been doing in the past as a service to the radio public, is being continued on a larger scale and with greater accuracy than ever before. Increased floor space and better testing apparatus will give an opportunity for service that no other magazine can offer.*

GLENN FRANK, that amiable philosopher who does so much constructive thinking for the American people, is quoted from the *Child Welfare Magazine* as follows:

"The future of America is in the hands of two men—*the investigator and the interpreter.* We shall never lack for the administrator, the third man needed to complete this trinity of social servants. And we have an ample supply of investigators, but there is a shortage of readable and responsible interpreters, men who can effectively play mediator between specialist and layman. The practical value of every social invention or material discovery depends upon its being adequately interpreted to the masses. Science owes its effective ministry as much to the interpretative mind as to the creative mind. The knowledge of mankind is advanced by the investigator, but the investigator is not always the best interpreter of his discoveries. Rarely, in fact, do the genius for exploration and the genius for exposition meet in the same mind.

"Democracy of politics depends on democracy of thought. 'When the interval between the intellectual classes and the practical classes is too great,' says Buckle, 'the former will possess no influence, the latter will reap no benefit.' A dozen fields of thought are to-day congested with knowledge that the physical and social sciences have unearthed, and the whole tone and temper of American life can be lifted by putting this knowledge into general circulation. But where are the interpreters with the training and the willingness to think their way through this knowledge and translate it into the language of the street?

"I raise the recruiting trumpet for the interpreters."

* *

HAD Dr. Frank set to the task of outlining the function of POPULAR RADIO he could not have done so more effectively. For six years this publication has used its resources that it might perform the function of interpreter with honesty and authority, believing always that a function of this sort is one of the prime requisites of the mechanical age in which we move.

* *

AFTER having received a number of letters questioning the license we have taken in using the term "valve" in place of "tube," we feel constrained to say something in defense of this policy. One slightly irate reader complains with some feeling that we have been "high hatting" him. POPULAR RADIO obviously has no interest in "high hatting" its readers, but it does have a sincere desire to keep its terminology as scientifically accurate as possible, and, following the growing tendency of the radio engineering profession, it has forsaken the ambiguous term "tube" for the more descriptive one of "valve." After all, a tube may mean a container for toothpaste or the Hudson River Vehicular Tunnel.

* *

POPULAR RADIO feels especially gratified to be the first publication to present the details of a simplified superheterodyne employing the new AC valves. The description of this unusual receiver will be found on page 413 of this issue. Those who have the superheterodyne fever have never been presented with a better opportunity to build the receiver of their ideals with a minimum of expense and be assured of a maximum of performance.

* *

FOR several years the editors of POPULAR RADIO have attempted to interest Dr. Goldsmith (Chief Broadcast Engineer of the Radio Corporation of America) in the preparation of a manuscript for publication. Diligence has won out, and in this number (page 411) Dr. Goldsmith lays down his somewhat startling views on the broadcasting engines of the immediate future. Engineers used to talk timidly about 5,000 watts, and now Dr. Goldsmith does not care who hears him predict the construction of stations requiring 1,000 kilowatts of power. To our way of thinking, he presents the true spirit of engineering progress in his startling prognostications. And we have long since grown weary of the engineering pussy-footers who are afraid to appraise fully the acumen and daring of their own profession.

* *

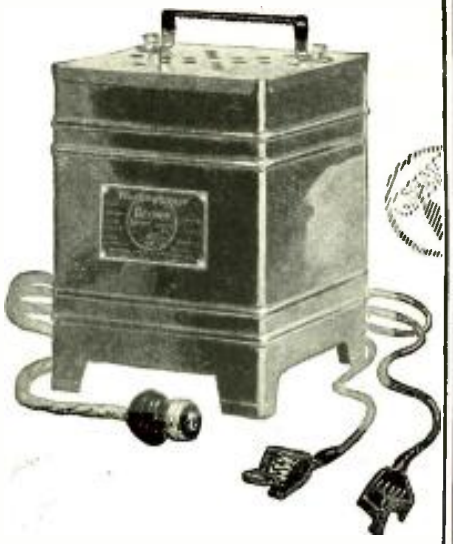
THE description of the Thordarson power-pack and amplifier in this issue once again demonstrates the ease with which an old receiver can be modernized with new power equipment.

* *

DUE to the press of editorial matter, POPULAR RADIO had to postpone the article on the new amplifier perfected by Manfred von Ardenne, which had been announced for a previous number. In giving the constructional details in this issue (pages 420-421), we feel certain that the astonishing quality of reproduction and the compactness of the unit will recommend it to every radio fan who is looking for better low-frequency amplification.

Raymond F. Yates

Want trickle charging? *Want* *full rate charging too?* then you want Rectigon!



YOU need only one charger—the Westinghouse Rectigon.

Rectigon gives you two charging rates—a "trickle" and a "high". With it you can get everything that you want from a trickle charger. But, when your set has been in almost continuous operation for a number of hours and a trickle charger can't bring the battery back—then's when you'll need Rectigon most. For Rectigon's high charging rate will give the battery its full strength quickly and surely. Another change of the Rectigon leads and you recharge your wet "B"—*all with one charger, the Rectigon.* Also charges your automobile battery.

3Ampere Rectigon
~~$18.00~~
now
$14.00

5Ampere Rectigon
~~$28.00~~
now
$24.00

Westinghouse makes Rectigon—and Westinghouse knows radio. You remember when the first program came from KDKA—perhaps you're listening to Westinghouse radio every night now. Rectigon is simple and safe. It uses no acids or chemicals—has no moving parts to break or wear out. No harm done if you tune in while charging—none if the power goes off while Rectigon is in the circuit. For the cost of a few outside chargings, you can put Rectigon in your cabinet and forget the annoyance of weak or run-down batteries.

Westinghouse Rectigon Battery Charger

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.
Offices in All Principal Cities ✦ *Representatives Everywhere*
Tune in with KDKA—KYW—WBZ—WBZA

Rectox—for trickle charging only—will transform your wet "A" battery into a light-socket power unit. Replace your power every time you turn off the set. Rectox is trouble free—uses no acids or chemicals, has no moving parts. Adjustable to ½ or ¾-ampere charging rates.

Besides Rectigon and Rectox for better battery charging, Westinghouse also makes Micarta panels and tubing for better insulation, and radio testing instruments for better reception.

Valuable to Engineer and Novice Alike

"POPULAR RADIO has always made a most cordial appeal to me. Its digest of all that is new and authentic in radio is accurate and scientific enough for the use of the professional engineer, and practical enough to meet the needs of the amateur."

H. W. Houck.

CHIEF ENGINEER,
DUBILIER CONDENSER CORP.

adequate signal strength over considerable areas.

In general, 5 kilowatts is the present-day lower limit of power for stations of importance located outside of large cities. The location of stations within large cities is, in the present state of the art, to be regarded as inappropriate.

Turning to the question of the upper limit of broadcasting power, it is clear that the cost of a transmitting station will become excessive if transmitter power beyond a certain limit is used. The first cost of the station, and its maintenance (including the cost of electrical power), all force the broadcaster to consider seriously the use of no greater power than is necessary to justify the expense of the station.

Furthermore, the use of too high a power will lead to serious local interference, even in regions where the population density is not particularly high.

It might be thought, at first, that one could increase the service area of a station indefinitely by increasing the transmitter power. This, however, is not true, because at a distance of between 75 and 150 miles from the station fading of the signals begins to be a serious limitation of the quality of the service rendered by the station at such distances. A signal which fades in and out more or less irregularly obviously cannot be regarded as satisfactory to the average listener. Should fading be eliminated, the service range of stations might be extended beyond perhaps 100 or 150 miles, but it is doubtful whether, in the present state of our knowledge of radio wave propagation, any engineer will be justified in planning a station to have a greater service range than 100 or 150 miles.

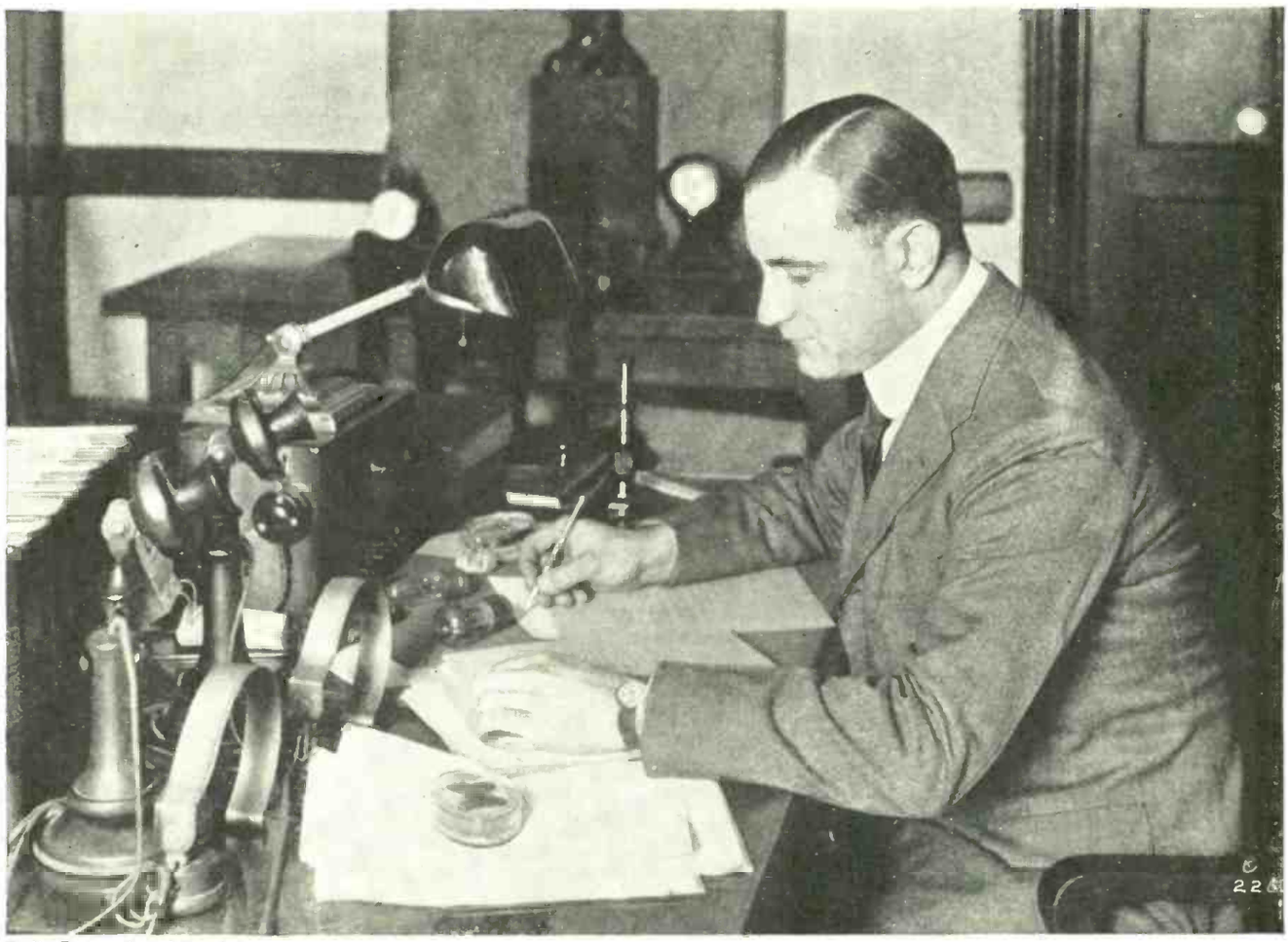
On the other hand, if we aim at a 150-mile service range, sufficient power must be used at this inner edge of the fading zone to produce a signal of adequate intensity.

To be more specific is rather difficult at present, but for stations located within 50 miles of large cities the possible upper limit of power clearly lies between 50 and 500 kilowatts at present. On the other hand, for stations located at greater distances from large cities, and particularly in the western portion of the United States, a rough estimate of the upper limit of power is between 100 and 1,000 kilowatts.

We have, therefore, reached a point in broadcasting development where, in certain portions of this country, transmitter powers as high as 1,000 kilowatts may be considered as a possibility worthy of serious consideration. While this may come as something of a shock to those who once regarded one-half kilowatt as the maximum necessary power for broadcasting stations, yet the marked success of the 50-kilowatt station WGY has encouraged forward-looking engineers to plan further increases of power under suitable conditions in the future.

From the foregoing it is obvious that the general trend of power in broadcast transmitters is rapidly upwards. The power is being increased tenfold, on the average, about every three years. In

(*Continued on page 458*)



Radio Corporation of America

"WE ARE NOW ENTERING AN ERA OF REAL BROADCASTING"

Dr. Goldsmith, Chief Broadcast Engineer of the Radio Corporation of America, looks on beyond his achievement in designing the super-power station WEAF to the day when he will be called upon to design a 1,000,000-watt station.

There are no cumbersome batteries to run down, no trickle chargers to fuss with, no liquids to spill, in this set-up, and the stations come in with the superb quality and volume of superheterodyne reception.

Simplified Socket Power with the New AC SUPERHETERODYNE

Radio engineering has at last made possible a receiver that has long been dreamed of by radio builders—a highly simplified superheterodyne incorporating all the desirable refinements of complete power operation from the lighting lines and the high selectivity, volume and tonal quality of heterodyne reception.

By ERNEST R. PFAFF

MANY experimenters and set builders have been deterred from building a receiver employing the superheterodyne principle by the mere fact of the usually high operating expense in "B" batteries and the "A" battery drain for so many valves.

The superheterodyne receiver necessarily employs a larger number of vacuum valves than most other standard circuits. The number of valves for use in such a circuit is an average of eight, although the superheterodyne principle has been used with as low as four and as high as fourteen vacuum valves.

This new superheterodyne, however, which uses AC valves throughout, entirely eliminates the problem of battery drain, as all of the power is drawn from the lighting lines and no batteries are needed, except a 4½-volt "C" battery, upon which there is little drain.

The new set is the first of its kind and operates admirably. It is built around the use of a high-wave amplifier originally designed for reception of time signals from the well-known Navy station at Arlington. The time-signal amplifier is manufactured complete, and contains the apparatus included in the dotted enclosure, F, in Figure 1.

It has been found that this amplifier performs admirably the functions of the intermediate amplifier ordinarily used in superheterodynes by merely adding an oscillator, shown in Figure 1 at J2, and a first detector, J1.

AC valves are used throughout the receiver; these are operated by the heater transformer at L, which operates direct from the 110-volt AC lighting line. This heater transformer also lights the two small pilot lights that tell whether the set is "on" or "off."

The set is built on the same idea as the LC-28 high-frequency pack, in that it includes no low-frequency amplifier, and should be used with a separate two-stage low-frequency amplifier. For this purpose the LC-28 Unipac is recommended, as the AC superheterodyne has been especially designed to work in conjunction with it.

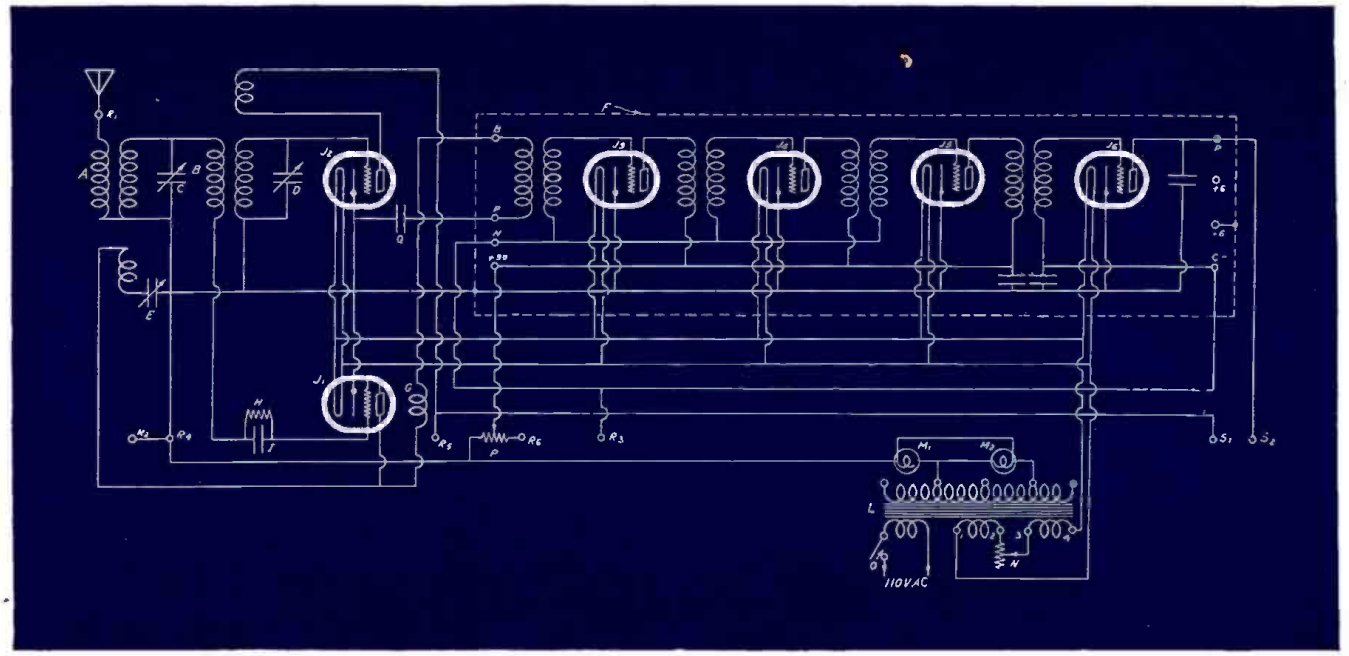
The LC-28 Unipac furnishes complete "B" voltages to this receiver and at the same time furnishes a power-operated amplifier of excellent quality that will make reception a pleasure.

How to Assemble the Instruments

The new receiver proper, which includes the intermediate-frequency pack in combination with a heater transformer for supplying the heating currents to the six Sovereign AC valves, is assembled upon a metal chassis with a metal front panel. All of the holes are drilled in these two units to fit exactly the instruments, parts, jacks and binding posts that go to make up the receiver.

It would probably be best first to assemble the instruments that are mounted on the metal chassis, U, shown in Figures 3 and 4.

Fasten down the two coils, A and B, the choke coil, G, and the two valve sockets, J1 and J2. Then attach to the metal chassis the condenser, Q, by flattening out one lug so that it screws directly into the hole in the chassis by



THE SCHEMATIC WIRING DIAGRAM OF THE RECEIVER

FIGURE 1: *This diagram shows the type of circuit employed in the new superheterodyne intermediate-frequency amplifier, F, and includes the first and second detectors and the oscillator circuit. A filament lighting transformer, L, is used to supply current for the heaters of the six vacuum valves*

means of a machine screw and nut. Next mount the heater transformer, L, by means of two bolts and nuts, in the position shown in Figure 3. The grid condenser, I, and the grid-leak, H, may next be mounted upon the grid terminal of the socket, J1, by bending over the small end of the lug of the grid-leak clip and screwing it tight underneath the screw terminal on the socket. The next job will be to mount the six binding posts, R1, R2, R3, R4, R5 and R6, along the back of the chassis, U, using the insulating washers that are furnished with the chassis to insulate the binding posts from the metal chassis, U. The ground binding post, too, may be fastened directly to the chassis, but without an insulating washer. Then mount the two tip jacks, S1 and S2, using insulating washers here to insulate them from the metal chassis.

Next mount the three-stage long-wave time-signal amplifier and detector unit, F, by means of four machine screws threaded up through the holes in the chassis and into the cover case of the unit. This will fasten it firmly.

After this the two metal windows for the dial controls may be fastened onto the front panel, T. At the same time fasten the two pilot lights, M1 and M2, in position, as shown in Figure 3. Four small machine screws and nuts are used in this operation.

Next mount the filament rheostat, N, and the gain-control, P, as well as the small variable condenser, E, on the front panel, as shown in Figure 3. The condenser, E, is fastened directly to the panel, but the two rheostats should be insulated from the panel with fiber washers.

After this has been done the two variable condensers should be attached to the mounting brackets of the drum dial, the drums attached to the condenser shaft and the whole assembly mounted on the front panel, with the control knobs fastened through the front panel. Next, fasten the front panel, T, to the metal chassis by means of eight machine screws, fastened through the panel and held tight with nuts on the inside of the metal chassis. When this is done the construction work is complete, except for mounting the switch, O, as shown in Figure 2.

The wiring may now be started.

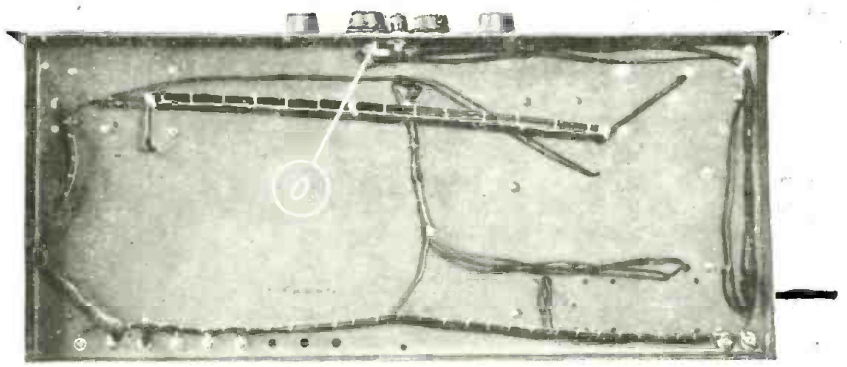
How to Wire the Receiver

By using a metal chassis which is grounded, many of the connections ordinarily necessary are done away with. All connections should be made with a braided insulated wire, such as Kellogg hook-up wire or Corwico Braidite.

If the wiring instructions, as shown clearly in the picture wiring diagram in Figure 4, are followed exactly, this job will be a simple affair. The wiring in this drawing is shown in blue, while the parts are outlined in black. Where the wiring runs underneath the metal chassis it is shown in dotted blue lines.

All of the wiring inside of the amplifier, F, is done by the manufacturer, and, of course, this has not been shown in the picture wiring diagram.

(*Continued on page 476*)

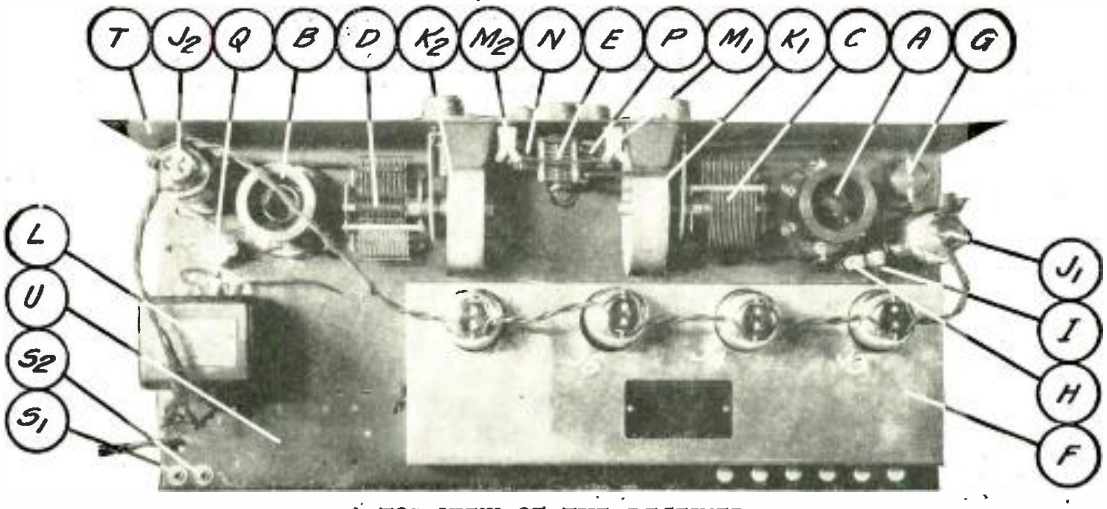


A VIEW OF THE SET FROM BENEATH

FIGURE 2: *Here is shown the under side of the metal chassis with the neat cable wiring completed. The switch, O, is the only unit mounted underneath the chassis*

POPULAR RADIO WORK SHEET

The New AC Superheterodyne



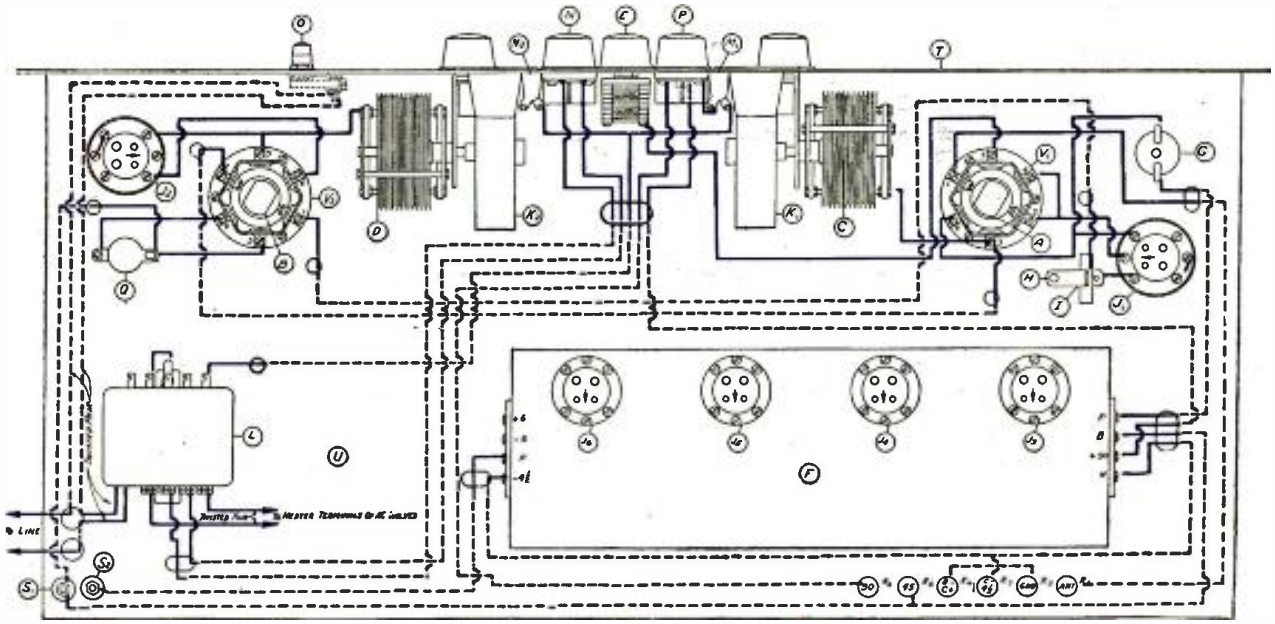
A TOP VIEW OF THE RECEIVER

FIGURE 3: *The shielded time-signal amplifier that is used for an intermediate-frequency amplifier is shown at the lower right; the filament transformer is at the left. Note the cable wiring for the heater circuits of the AC valves.*

LIST OF PARTS FOR BUILDING THIS RECEIVER

COST OF PARTS: *Not over $83.00*

A and B—S-M coils, No. 111A, equipped with S-M coil sockets, No. 515;
C and D—S-M variable condensers, No. 316B, .00035 mfd.;
E—S-M midget condenser, No. 342;
F—S-M time-signal amplifier, No. 440, 112 kilocycles;
G—S-M high-frequency choke coil, No. 275;
H—Carter grid condenser, .00015 mfd., with grid-leak clips;
I—Polymet grid-leak, 2 megohms;
J1, J2, J3, J4, J5 and J6—S-M vacuum valve sockets, No. 511 (only two required, as sockets J3, J4, J5 and J6 are part of the complete amplifier, F);
K1 and K2—S-M vernier drum dials, No. 805;
L—S-M filament lighting transformer, No. 325;
M1 and M2—Pilot lights that are furnished as part of the equipment with the No. 805 vernier drum dials;
N—Carter rheostat, type MW 1/5;
O—Carter power switch, No. 110;
P—Carter potentiometer, type MW-6,000;
Q—Carter fixed condenser, No. 105, .5 mfd.;
R1, R2, R3, R4, R5 and R6—X-L binding posts;
S1 and S2—Carter tip jacks, No. 10;
T and U—Van Doorn panel and chassis unit, drilled.



THE PICTURE WIRING DIAGRAM OF THE RECEIVER

FIGURE 4: *The instruments are outlined in* BLACK. *The wiring under the panel is shown in dotted* BLUE *lines, and the wiring above the panel in solid* BLUE *lines*

Radio "Spooks" All Over the House!

A VOICE FROM THE ETHER?

Suppose you were visiting a friend and spending the evening listening in on the radio. Suppose in the midst of the broadcast you should suddenly realize that a ghostly voice was coming from BENEATH *the chair in which you were comfortably ensconced. Well, whatever you thought, you would probably duplicate the attitude of the young man above.*

The mystery of the house of radio "spooks" is no mystery at all to the initiated, and with the information given here any radio fan should be able, with very little trouble, to mystify his friends and create endless amusement for himself during the long winter nights to come.

THE casual, unsuspecting visitor to this house of radio marvels sees practically nothing that would arouse his suspicions or that would lead him to believe that he was going to be the victim of radio trickery. A single loudspeaker of the cone type sits on the radio stand, and the genial host tunes in on one of the popular local stations. There is nothing unusual about the reception, save that it is good and that the volume is well above that afforded by the average radio receiver.

As the evening wears on, the guest quite suddenly realizes that the music is no longer coming from the visible speaker. It is just as sweet and as mellow and as entertaining, but the source of it has now become more or less perplexing. Now it seems to come from the roof; now from the living room, and now from the vicinity of the steam radiator. You can imagine how surprised a guest would be to suddenly realize that even the very chair he sits in is alive with vibrations. Sure enough, he is sitting on a loudspeaker!

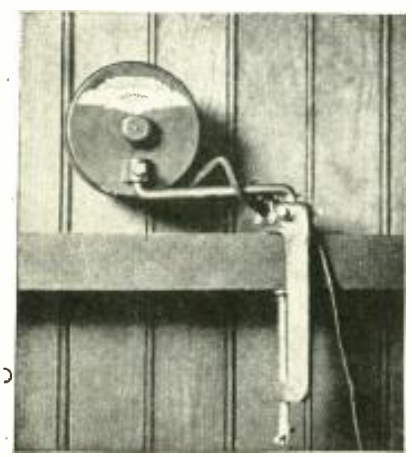
This last exciting experience actually makes Mr. Guest a little inquisitive, and this leads to a confession and demonstration, which is more or less startling. The host, who prefers to remain anonymous as far as the reader of POPULAR RADIO is concerned, claims that he has busied himself during the past year by making loudspeakers out of every conceivable household article.

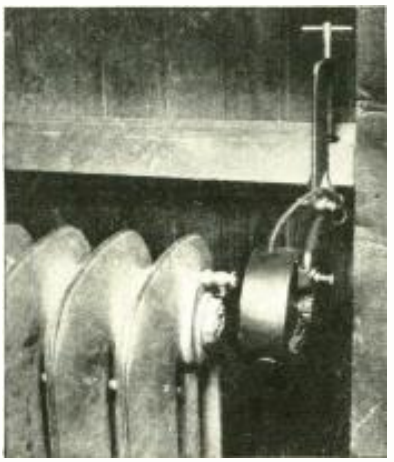
The speaker unit is one sold under the trade name of INTERNATIONAL, and it was originally intended to be used in conjunction with the sounding board of a piano. The armature of this speaker protrudes through the case, and by the use of a special bracket this armature can be pressed against the surface with which it is to be used in contact.

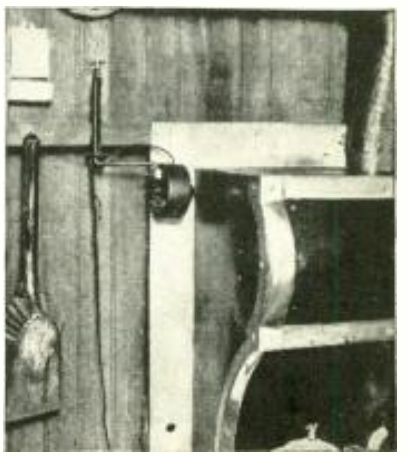
Fourteen of these units were employed in the house of radio wonders, units being attached to such places as the sounding board of the piano, the wall of the room, the panel of the door, and behind a picture on the wall.

A rather amusing means of entertaining dinner guests was provided by attaching one of these units underneath the dining-room table. A still more ingenious application was that of applying the unit to the large panel at the head of the bed in the guest room. Mr. Arthur Bagley, the gentleman who conducts the health Tower exercises

(*Continued on page 494*)

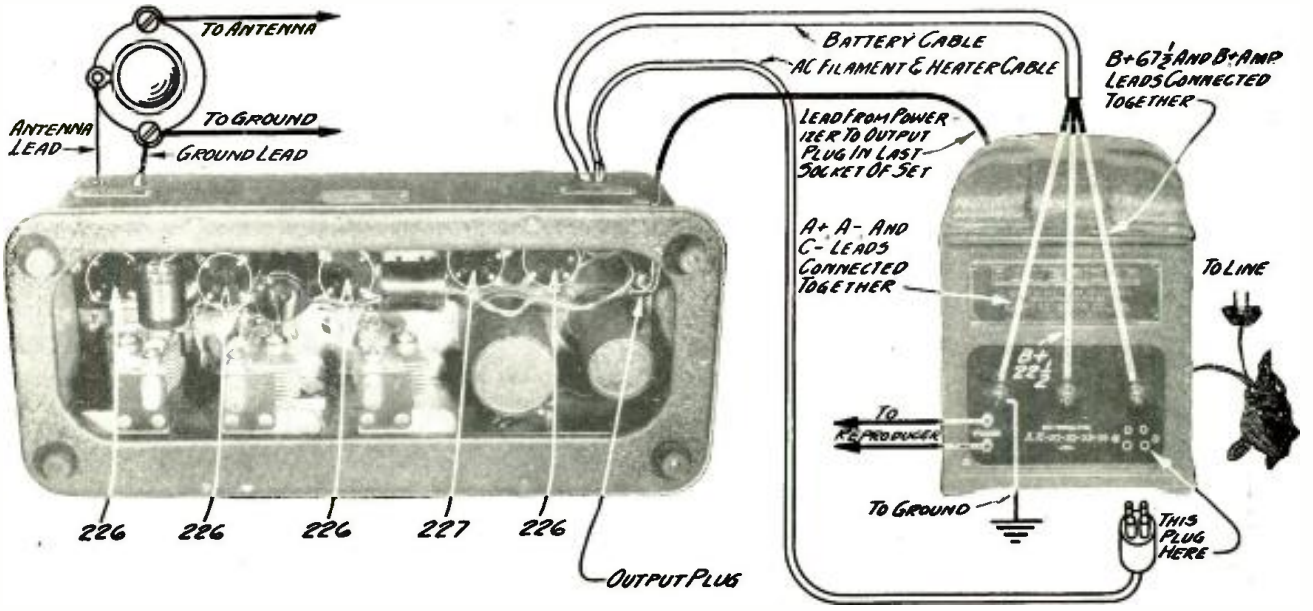






THREE "VOICES" IN THE HOUSE OF RADIO "SPOOKS"

Here are three novel sounding boards for the reproducer unit that furnishes the voice of the radio ghost. At the left the unit is shown with its driving pin against a wooden wall partition. In the center it is clamped in such a position that its driving pin presses against a steam radiator. At the right the kitchen stove is being made to speak with the tongues of radio announcers. The ingenious fan needn't stop here, for any surface that can be made to vibrate at an audible frequency may be used as a sounding board.



EASY TO INSTALL, EASIER TO OPERATE

FIGURE 1: *This illustration shows graphically all the changes necessary in installing socket power on the Atwater Kent model 35 receiver. The socket adapters and complete cable equipment for the connections indicated above come with the* POWERIZER.

NO MORE BATTERY WORRIES IF YOU INSTALL

Socket Power for Your Atwater Kent

This is the second of a series of articles that tell you how to bring your old receiver models up to date by providing them with complete AC operation from the lighting lines.

By CHARLES L. DAVIS

TO the thousands of people throughout the country who own Atwater Kent radios, the prospect of operating their receivers entirely from the light socket, without any of the worries attendant upon battery upkeep, will come as a long awaited boon. This is especially true of the installation described here, as the whole change-over operation, including the wiring of all of the AC valves and the hooking up of the special power-pack, is a matter of only a few minutes' work, and can be done by even the most inexperienced fan. The whole operation of making the AC installation on the Atwater Kent, model 35, 6-valve receiver is shown graphically in Figure 1.

The power-pack used is known as the POWERIZER, and is manufactured especially for Atwater Kent sets. With it is furnished a complete assembly of five socket adapters with a special heater cable that may be connected to the receiver in a few minutes. An output plug is also furnished for the last valve socket in the set for connecting to the 210 type power valve in the Powerizer. The standard battery cable furnished as part of the Atwater Kent set is connected to three binding posts on the connection panel of the Powerizer unit. The wires of this cable are to be grouped together as shown in Figure 1.

Four Ceco M-26 AC valves are to be placed in the socket adapter and, in turn, inserted in the first, second, third and fifth vacuum valve sockets in the set. Insert a Ceco N-27 valve in the fourth valve socket.

With AC operation, of course, it is imperative that a new volume control be installed on the receiver. This may be done on the receiver itself by following the instructions that come with the Powerizer, or the volume control may be installed externally in the antenna circuit. The volume control might be a 50,000-ohm potentiometer.

When the various connections have been made, as shown in Figure 1, the Powerizer may be installed underneath the set in the radio table or console, with the set on top, in its proper place. The power plug may be inserted in a lighting line socket and the unit completely controlled from the switch on the Powerizer. The Powerizer itself contains a complete power transformer, filter circuits, voltage dividers, all adjusted for the proper voltages and fixed, and a full-wave rectifier valve of the 280 type, as well as a power amplifier valve of the 210 type.

Once this installation has been made no further care or adjustment is necessary outside of handling the "on" and "off" switch. The set will tune exactly as before and the operation will be the same except that the new volume control is to be used instead of the old one.

The receiver will function with greatly added vigor and much improved tone quality, especially featuring the low notes of the orchestral accompaniments, and eliminating the overloaded distortion usually found in sets using only a small power valve.

In general, the results prove so satisfactory that every owner of this type of receiver should investigate the proposition so that he may more fully take advantage of modern broadcasting. Wide-awake radio dealers, as well as service men and professional set builders, will find in this new development an excellent and profitable opportunity to serve their clientele by improving reception conditions and eliminating the fuss and bother of battery replacement for themselves and their clients.

MR. GLENN BROWNING WITH HIS NEW PET

Few receivers have been more popular among set builders in the past than those designed by Messieurs Browning and Drake. Here is Mr. Browning with their latest creation, the work of a year's experiment, which promises to outdo even the splendid performances of the earlier models of their design.

WHEREIN MR. BROWNING TALKS ABOUT THE

1928 Browning-Drake

By GLENN BROWNING

THE Browning-Drake receiver, the outcome of the experimental work of Dr. Frederick Drake and the writer, was first introduced to the public some three years ago. Its popularity since that time has been steadily increasing and is due to the fact that the receiver is simple and inexpensive to build, but at the same time sensitive and selective. The low-frequency amplifiers specified with this receiver have always been of good quality, so that the results obtained were pleasing and satisfactory to the user.

Next month, in POPULAR RADIO, the writer will describe a new Browning-Drake receiver which is still easier to tune, still more sensitive, so as to cover greater distances, and still more selective, so as to cope with the congestion of present-day broadcasting. It also includes certain other refinements and improvements that will be of interest to Browning-Drake fans.

In the new set complete shielding is recommended, as it is essential to selectivity in such areas as Chicago and New York, and other congested localities.

The main feature of the new set will be an entire change in the neutralization system, using shunt-plate feed in order that standard 201-a type valves may be used in the high-frequency amplifier.

A further point of interest will be the use of either AC valves or standard valves in the new set.

In working out the new neutralization system, Dr. Drake and the writer spent a number of months in the lahoratory trying out a number of neutralization systems, and finally decided upon the one to be described. In this system the high-frequency valve in the amplifier is fed by a parallel system so that no high-frequency current is able to pass through the "B" batteries or other "B" sources. This parallel feed system consists of a high-frequency choke and a condenser placed in the plate circuit, as shown in the diagram in Figure 1.

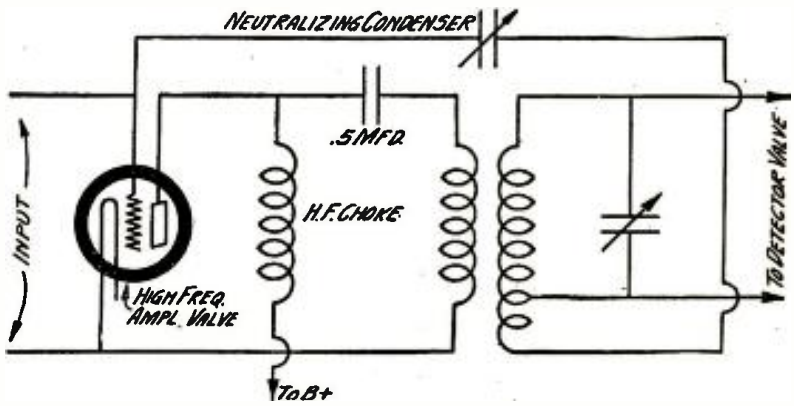
With this parallel feed system the neutralization is done by adding a differential coil onto the secondary of the high-frequency transformer, and by placing a small neutralizing condenser between the end of this coil and the grid of the previous valve, as shown in Figure 1. This system gives a practically perfect balance for the entire wavelength band, and this stability is partially due to the fact that no stray high-frequency currents are able to pass through the battery leads. The circuit is similar to a bridge. With the parallel feed system shown, including this neutralization scheme, a 201-a valve may be used as a high-frequency amplifier with improved results.

It will be remembered that in all previous Browning-Drake circuits a 199 type valve was recommended. The larger valve will give more amplification with added stability over the smaller valves.

The use of AC valves is becoming more general, and in the constructional article both AC and DC wiring diagrams of the new Browning-Drake set will be given.

The essential parts of this new receiver include the following:

1 Browning-Drake kit;
1 Browning-Drake foundation unit;
1 Browning-Drake shielding assembly;
1 AmerTran or Thordarson transformer;
2 Tobe fixed condensers, .1 mfd.;
1 Tobe fixed condenser, .001 mfd.;
1 Tobe grid condenser, .00007 mfd.;
2 Tobe resistors, .1 meg., 2 watts;
2 Tobe receivers, .25 meg., 2 watts;
2 Benjamin Cle-ra-tone vibrationless sockets.



THE NEUTRALIZING SYSTEM OF THE NEW RECEIVER

FIGURE 1: *The value of .5 mfd. for the fixed condenser in the above circuit was arrived at after careful study of Mr. Browning's and Dr. Chaffee's paper, "Detection," published in the* PROCEEDINGS *of the Institute of Radio Engineers. This value eliminates detection in the high-frequency amplifier circuit.*

New Researches Make Practical

RADIO ON TANKS

THE caterpillar tank would appear to be, through its very nature, a potential radio "dead spot." A radio receiver or transmitter operating within it is effectively shielded at all points of the compass by one half inch of armor plate, for the occupants must first be protected from bullets; and communication, although important, takes second place to safety.

A radio receiver used on a tank is not only electromagnetically sealed, but it is, at the same time, exposed to constant electrical interference produced by the spark plugs of an active gasoline motor. Still more difficulty is added by the clang and rattle of the tractors and the groan of the meshing gears, to say nothing of the din produced by the propelling motor. Conversation in a tank is almost impossible, let alone radio reception.

With all these adverse factors to thwart them, it is little wonder that radio engineers have been keenly occupied with the problem of transmission and communication between tanks since their invention during the World War. And diligent research has finally won out, for we now have receivers and transmitters that will successfully overcome the difficulties mentioned.

Captain K. E. Hartley, of the British army, has recently perfected a radio station for tank use which has afforded most satisfactory results. Hartley uses a 30-watt transmitter, operating on a short wavelength. Reception is accomplished with a special seven-tube superheterodyne containing only one stage of low-frequency amplification. This is used in conjunction with special padded headphones so constructed as to exclude practically all of the noise generated by the internal mechanism of the tank.

The aerial system of Captain Hartley's tank station is especially interesting. It is formed of hollow aluminum rods, so constructed that they may be raised and lowered as a unit, and the tank may proceed through restricted passages without danger of losing its ears and voice. The aerial is manipulated by means of a rod inside the tank.

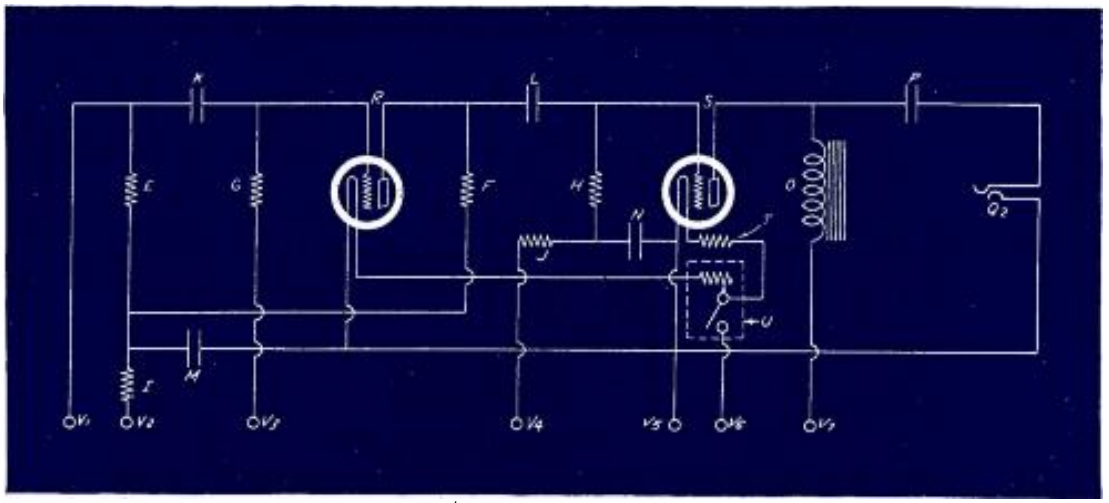
During recent testing at Moulsford, England, triangle communication was established between two tanks six miles apart and a radio station twelve miles distant. This is considered a remarkable record for radio communication, under such extenuated circumstances, since a great deal of the energy of the signal is absorbed by the armor plate of the tank body. Proposals have been made for placing the transmitting and receiving equipment in a more advantageous position outside of the tank structure, but this has been objected to by army authorities because tanks are usually exposed to thick fire, and it is doubtful if the radio equipment would survive a single attack. A tank without radio equipment is left more or less floundering about with no form of communication with its sister units, or with the base.

Radio engineers who have given special study to the problem of communication between tanks firmly believe that it may soon be possible to multiply greatly the range of receivers and transmitters, and make communication between tanks even more practical.

Underwood & Underwood

THE EARS OF THE MECHANIZED ARMY

Here is one of the British tanks that successfully maintained communication with its sister tanks and the base during the army maneuvers at Salisbury Plains. The antenna system on top may be lowered from within while not in operation.



THE SCHEMATIC CIRCUIT DIAGRAM OF THE AMPLIFIER

FIGURE 1: *The proper values for the grid-leaks and coupling condensers used in the circuit were arrived at by careful experiment on the part of the designer, Manfred Von Ardenne, and the extraordinary results obtainable with the unit are largely due to these evaluations.*

AN AMAZING DISCOVERY IN RESISTANCE-COUPLED AMPLIFIERS

Resistance-coupled amplification comes into its own in this astonishing low-frequency amplifier designed by Manfred Von Ardenne, the German experimenter, who is recognized as the outstanding authority on this type of amplification. Here are the constructional details for the amplifier, which may be constructed easily and cheaply from parts that may be obtained anywhere.

By ALBERT G. CRAIG

HERE is a new system of resistance coupling for low-frequency amplifiers. It was developed by Baron Manfred Von Ardenne and has come into wide use in his native Germany during the last few years.

During a visit to the POPULAR RADIO LABORATORY, Baron Von Ardenne outlined the theory of his new development. Briefly, the system uses high-mu valves, high values of plate resistance, comparatively small coupling condensers and high-resistance grid-leaks. The valves used have an amplification constant of approximately 30 and by the use of coupling resistances of 2 or 3 megohms an amplification (per stage) is attained which approaches the mu of the valve. By using a high value of grid-leak the coupling condenser can be quite small without having a large part of the voltage drop from the previous vacuum valve take place in it, rather than across the input of the succeeding valve where it is useful.

The amplifier to be described was built up shortly after Baron Von Ardenne visited POPULAR RADIO and has been thoroughly tested out in the Laboratory. It consists of two stages of resistance coupling and has an output filter for the power valve. Both Cunningham CX-340 and Radiotron UX-240 type valves were used for the detector and the first stage and a CX-371 or UX-171 type valve for the power valve.

The amplifier gives excellent quality of reproduction which is especially noticeable on the low notes, and has approximately the same volume as a two-stage transformer-coupled amplifier. It is cheap to build, as there are only two resistance-capacity coupling units and they use small condensers. A resistance-capacity filter has been incorporated in the "B" supply of the first two valves and in the "C" bias circuit of the last valve; these effectively prevent "motor-boating" when the amplifier is used on "B" power-packs. It might be said here that this is the system of amplification used in the German "multiplex" valves (see POPULAR RADIO for September, 1927), and it explains how a complete two-stage amplifier has been built into one glass bulb only slightly larger than the ordinary radio valve.

A schematic wiring diagram for the unit is shown in Figure 1.

How to Construct the Amplifier

To start building the amplifier, first cut the baseboard, W, to the proper size as shown in Figure 2. Then make the two small brass brackets, Y, of sufficient height to hold the binding-post strip one inch above the baseboard. Next cut the brass strap, Z, and bend it to fit over the condenser P, leaving two projecting lugs at the bottom with holes for the mounting screws.

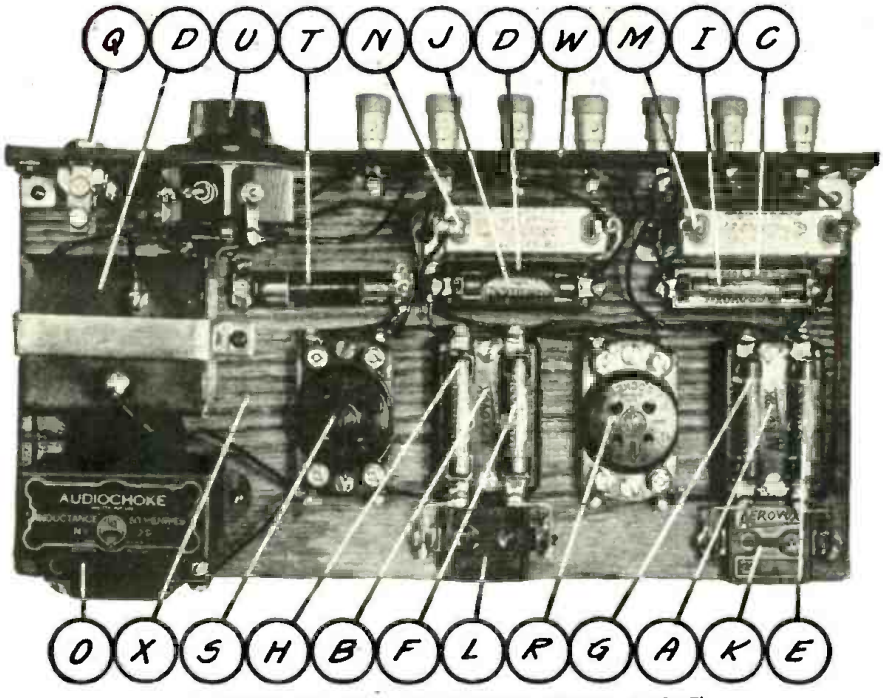
Now fasten the double mountings, A and B, in position with flat-head brass wood screws, noting that the "P" and "G" terminals are turned "away" from the binding-post strip.

Mount the sockets, R and S, with the "P" and "G" terminals "away" from the binding-post strip.

(*Continued on page 452*)

POPULAR RADIO WORK SHEET

The Von Ardenne Amplifier



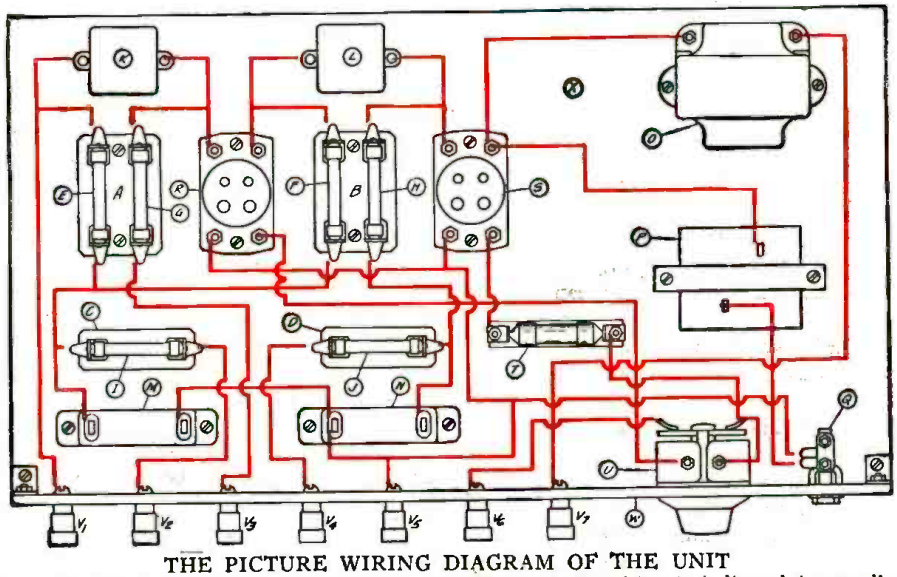
A VIEW OF THE AMPLIFIER FROM ABOVE

FIGURE 2: *Note the compact arrangement of the instruments in the new amplifier.*

List of Parts Necessary for Building This Unit

Cost of Parts—*Not over $26.00*

A and B—Aerovox double mountings, type 1050;
C and D—Aerovox single mountings, type 1049;
E and F—Durham standard metallized resistors, 2 megohms;
G—Durham standard metallized resistor, 8 megohms;
H—Durham standard metallized resistor, 6 megohms;
I and J—Durham standard metallized resistors, .5 megohm;
K and L—Aerovox mica condensers, type 1450 (moulded in bakelite), .006 mfd. capacity;
M and N—Dubilier condensers (DC working voltage 160), type 907, 1 mfd. capacity;
O—Pacent shielded low-frequency choke, No. 29;
P—Dubilier fixed condenser (DC working voltage 400), type 902, 4 mfd capacity;
Q—Frost open-circuit "Gem" jack, No 953;
R and S—Pacent sockets, No. 83;
T—Amperite No. 112, ½ ampere;
U—Frost metal frame, 20-ohm rheostat with switch No. S-1720;
V1, V2, V3, V4, V5, V6 and V7—XL push posts;
W—Baseboard, 6 by 12 by ½ inch;
X—Bakelite binding-post strip, 1 by 12 by 3/16 inch;
Y—Brass brackets for supporting binding-post strip;
Z—Brass strap for mounting condenser P;
Wire, screws, solder, etc.



THE PICTURE WIRING DIAGRAM OF THE UNIT

FIGURE 3: *The instruments are outlined in* BLACK *lines and the wiring is indicated in* RED *lines.*

TUNING WITH A PUSH BUTTON

In this ingenious system of automatic tuning, which may be incorporated in any receiver, POPULAR RADIO *sees a near future in which radio reception will be as effortless and as pleasurable as modern science can produce.*

By ELMER E. BURNS*

THE problem of automatic tuning is essentially that of taking advantage of some effect that takes place in a radio receiver at a point of resonance to control the action of the tuning unit. The only changes that appear to offer possibilities in this direction are: (1) High-frequency oscillations in the antenna circuit, (2) voltage variations across the inductances and capacities of the receiver, and (3) variations in plate current.

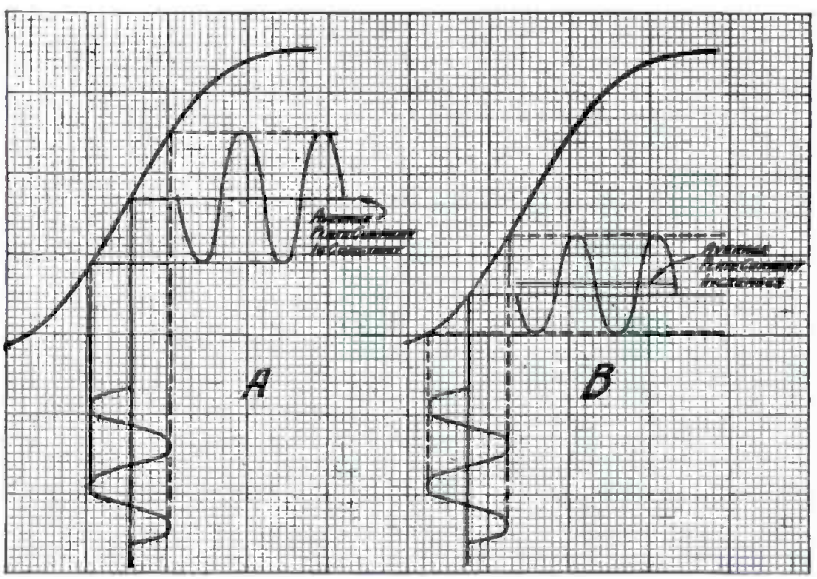
In the self-tuner which my co-worker, Mr. Theodore Cohen, and I designed, we took advantage of two effects mentioned above; namely, voltage and plate current variations.

The practical self-tuner to apply to the present-day receiver must have these characteristics:

First, the moving part of the tuning unit must be turned at about the same rate as it would be turned in tuning by hand. It should be capable of being set in motion by the simple operation of pressing an ordinary push button. Second, when the tuning unit is brought into resonance with received signals, the moving part must stop automatically. If it is necessary to stop the moving element by any manual op-

(*Continued on page 478*)

*Elmer E. Burns is a teacher of physics in the Austin High School, Chicago, Ill. Those who wish to communicate with him about his novel system of automatic tuning should address letters to 3515 Home Ave., Berwyn, Ill.



HOW THE VALVE OPERATES THE RELAY

FIGURE 1: *At the left is shown a characteristic curve of a vacuum valve operated at the mid-point of the straight portion of the curve. An incoming signal produces no change in the average plate current under this combination. At B is shown a characteristic curve with the vacuum valve operating on the non-linear portion of the curve, so that an incoming signal produces an increase in the average plate current that may be used to operate a relay.*

ADJUSTING THE RHEOSTATS

The rheostats mounted on the sub-panel of the Magnaformer receiver are more or less critical in their adjustment, and the best results from this receiver are obtained only when they have been set at the proper point for efficient operation.

FOLLOW THESE "GOLDEN RULES" WHEN

Operating the Magnaformer

Best results with superheterodyne receivers always come with careful adjustment of the operating voltages, and although the Magnaformer 9-8 in its operation is one of the simplest receivers ever designed, it can be made to live up to all of its many splendid possibilities if the operating data given in this article is followed.

By WILLIAM STEINKE

AFTER a more or less complex receiver has been constructed and put into operation, even the experienced radio fan frequently wonders whether he is operating the receiver properly. In the case of the Magnaformer 9-8 receiver there are three rheostats which might be puzzling to the builder. Two of these may be set once and thereafter require no attention. They are located in the receiver, on the sub-panel. In making the original adjustment, the rheostat which controls the second detector filament should come in for first attention. This rheostat is not critical and its adjustment is easy. With all rheostats set at the half-way point, tune in any station that happens to be on the air. Then vary the potentiometer, G, to reduce the signal volume so that it is just loud enough for comfortable audibility. Then adjust the second detector rheostat, I, by turning its knob to the lowest setting that will give maximum volume. This is probably best done by turning it all the way "on" for an instant and then turning it back in an anti-clockwise direction until the volume of reproduction starts to diminish. Just above this point is the proper setting for this control. With a standard valve this point will usually be with the rheostat about half-way "on."

In adjusting the rheostat, H, in Figure 1, which controls the filaments of the oscillator and the first detector valves, it is advisable first to tune in a distant station. This rheostat is somewhat more critical in adjustment than is the one described above. Also, the adjustment that provides the best reception of distant stations will not necessarily be the best adjustment for local reception. The real purpose of this rheostat is to regulate the strength of the oscillator or heterodyne current by varying the filament supply to the oscillator valve.

For best reception, the oscillator current should be weak for weak signals from distant stations and stronger for strong signals. However, there is no need to worry about "best" reception in the case of strong local stations, because this receiver is capable of such tremendous volume that there is more than ample for all practical purposes, even if the oscillator current is comparatively weak.

Turn the potentiometer knob, G, in Figure 1, which controls volume, to a point just below that where oscillation starts, and adjust the two tuning controls, O1 and O2, very carefully to the point of maximum response. Then increase the setting of the oscillator rheostat knob, H, to a point slightly above half way. The potentiometer and tuning controls should then be readjusted to make sure that they are still set for maximum, for the alteration of the filament current of the oscillator and first detector may throw them off slightly. Continue this process at several differ-

ent adjustments of the oscillator rheostat until the one is found that provides best reception, remembering always to readjust the volume and tuning controls after each change in the oscillator rheostat setting.

With the two rheostats, H and I, on the sub-panel adjusted properly, they may be forgotten as long as the "A" battery is kept up to normal charge and the same valves are kept in use in the oscillator and the two detector sockets. Any changes in these valves may require readjustment, particularly if the new valves be of a different make or type than those used during the original adjustments.

The filament control, F, on the front panel governs the current supply to the four intermediate-frequency amplifier valves. Its adjustment also effects the volume. The best adjustment for this rheostat, F, is obtained by varying the volume control at the same time, always keeping the amplifier just under the point of oscillation, as was done in adjusting the oscillator rheostat.

It will be found that all of the seven valves controlled by the rheostats in this receiver will operate as well or better at slightly subnormal voltages than at normal ratings. It is worth while, then, to keep the rheostat settings at the lowest points that give best results, because in this way the current drain on the storage "A" battery will be considerably below that normally required for a receiver using this number of valves.

How to Tune the Receiver

The Magnaformer 9-8 receiver has one very important feature which few other superheterodyne receivers have. It lies in the fact that the tuning controls tune alike. In the operating test made on one of these receivers at the POPULAR RADIO Laboratory the difference between the settings of the two dials for any given station did not exceed one division—and this corresponds to a half degree on other receivers, inasmuch as the dials used in the Magnaformer receiver are calibrated in 200 divisions rather than in the 100 divisions of the ordinary receiver dial.

In addition to the ease of tuning and of logging stations with this arrangement, it has the advantage that there is less trouble with repeat points.

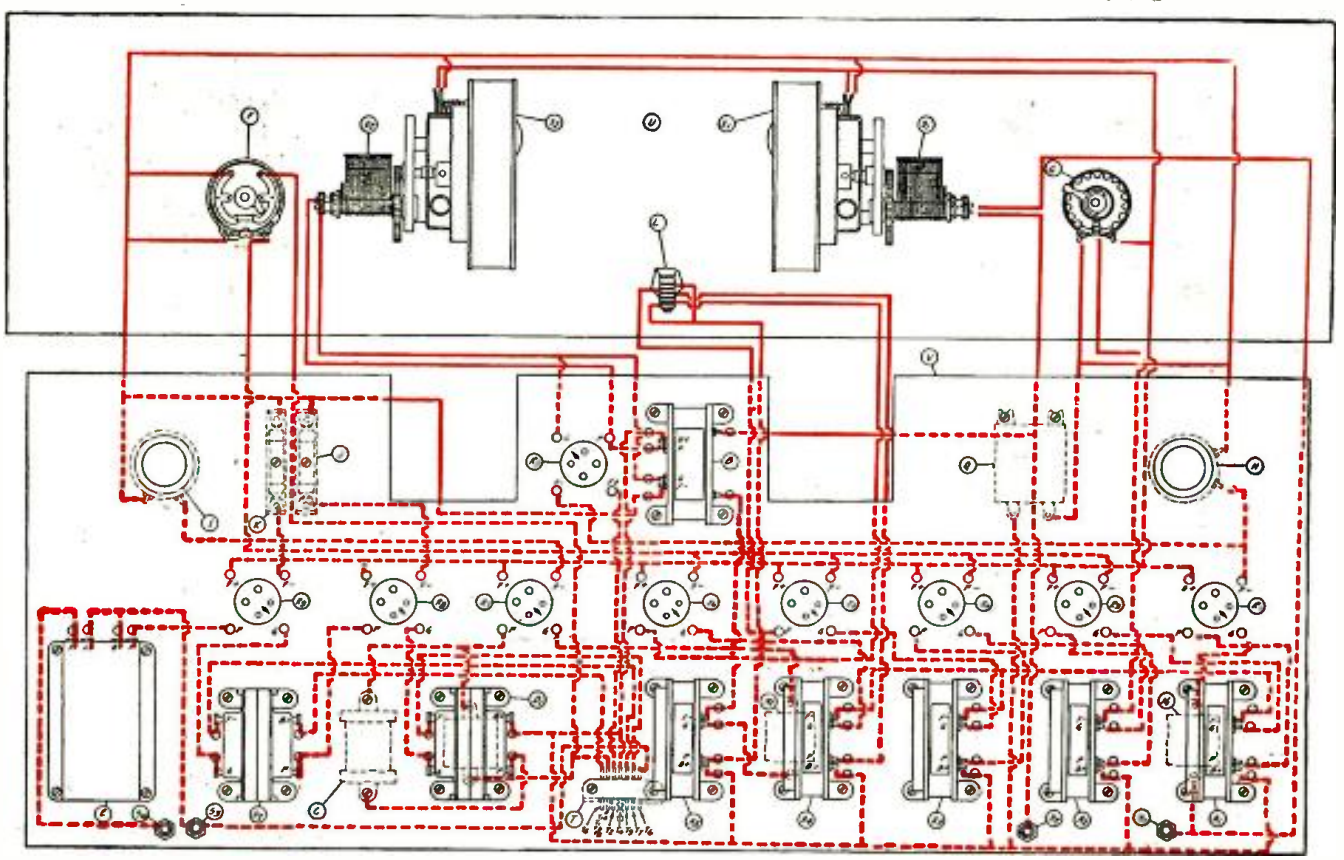
In tuning for distant stations there are two plans that may be followed. The first and best plan is to turn the volume control up until the intermediate amplifier is just below the point of oscillation. Then turn the two tuning controls in unison. When the carrier of a station is encountered, it will be indicated by a rushing sound. A slight readjustment of the dials to exact resonance will bring the signals in. It must be borne in mind that the tuning is extremely sharp in the case of distant stations and for that reason the dials should be turned slowly when "fishing" for distance.

The second plan of tuning weak signals is to turn the volume control just beyond the point of oscillation. Then, when the right-hand (oscillator) dial is tuned to a station's carrier wave, a "birdie" whistle will be heard. This whistle will increase in intensity as the loop dial is brought into resonance. Then, if the potentiometer knob is turned back slightly below the oscillation point the signals will be heard.

Adding Regeneration in the Magnaformer Loop Circuit

There are many fans who prefer to use a small amount of regeneration in the first detector circuit of a superheterodyne receiver. In the case of many supers this is quite necessary if good sensitivity and adequate selectiv-

(*Continued on page 474*)



THE REVISED HOOK-UP FOR THE MAGNAFORMER

FIGURE 1: *This is the revised and official picture wiring diagram for the Magnaformer receiver that produces such wonderful results when operated on a loop. The instruments are outlined in* BLACK *and the wiring is shown in* RED. *The dotted* RED *lines indicate that portion of the wiring that is to be connected underneath the sub-panel.*

INTERFERENCE

What Kind of a Noise Have You Been Hunting For?

Every radio fan can be his own interference detective, providing he understands the criminal record of some of the most flagrant breakers of radio peace and quiet. Radio noises are usually classified and recognized by the type of sound produced in a loudspeaker. Below will be found notes pertaining to the sounds produced by electrical appliances of various types. Perhaps the first thing to do in tracing interference is to check up the electric light sockets of the house to see that there are no loose connections. Just tapping the fixtures is sufficient to reveal any trouble.

1

1: *An irregular noise in the form of a series of sharp clicks coming close together is sometimes caused by sparking commutators on DC fans. An adjustment of the brushes and cleaning of the commutator is the remedy.*

2

2: *Percolators with thermostatic controls produce a distinct click in the speaker every time the automatic cut-out device functions. There is really no remedy for this, unless the household wants to go without coffee.*

3

3: *A loose connection in an electric toaster will cause especially heavy clicks of an aperiodic nature in the speaker. If the toaster is jiggled while in operation, this trouble may be located.*

4

4: *An AC induction motor will produce a click in the speaker only when it is coming to full speed. Commutator motors of all sorts will produce roars if the brushes are poorly adjusted.*

5

5: *Two things in electric irons cause interference—loose connections and automatic thermostatic regulators. There will be a loud click in the speaker when the thermostatic control functions.*

6

6: *Heating pads are usually controlled with a thermostat which produces clicks in the speaker. Cases are known where loose connections in pads have disturbed reception in an entire community.*

7

7: *Soldering irons become offenders only when loose connections occur in the flexible cable. Any heavy current device causes severe interference when a loose connection is present.*

8

8: *Toy trains cause interference through sparking commutators on the motor, and through sparking rails. The motor interference can be eliminated, but there is practically no remedy for the sparking rail.*

Here Are the Facts About the Latest Discovery in Radio—

The Octa-monic Circuit

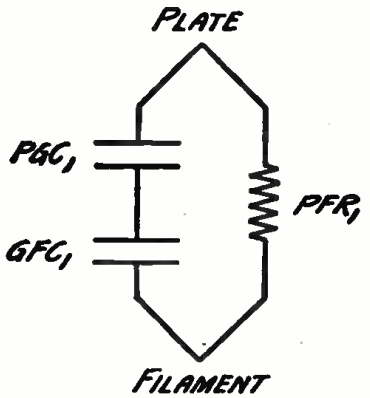
No really new radio circuits? If you think so, read this description of the Octa-monic circuit—a circuit that is fundamentally different from all that have gone before. It works on a principle opposed to that of the superheterodyne, in that detection takes place at a higher frequency, rather than a lower frequency, than that of the incoming signal. The advantages of this system are here described by—

JOHN BRENNAN

A COMPARISON of the standard type of ordinary tuned-high-frequency circuit with the Octa-monic circuit reveals some interesting points regarding the relative losses in these two types of circuits.

The electrical characteristics of a tuned-high-frequency circuit are shown in Figure 2. The high-frequency valve characteristics can be denoted electrically as two condensers, "GFC1" and "PGC1," in series for vacuum valve No. 1. These condensers represent the grid-to-filament capacity and the plate-to-grid capacity between the elements of the valve. The resistance "PFR1" represents the plate-to-filament resistance of the valve. We therefore have an equivalent electrical circuit as shown in Figure 1.

This circuit consists of a resistance "PFR1," connected in parallel with two series condensers, "PGC1" and "PFC1." It can therefore be seen that there are two paths for the signal energy through the elements of the vacuum valve, one through the capacity leg and the other through the resistance leg. At ordinary broadcast frequencies, the series condenser path offers a large resistance that may run as high as hundreds of times that of the resistance path. This latter path, or, in other words, the plate impedance, is therefore an important factor in the plate circuit of high-frequency amplifiers. The same conditions that exist in valve No. 1 also exist in valve No. 2; so we have, in the ordinary two-stage circuit, two circuits which at ordinary broadcast frequencies may add considerable resistance and may tend to broaden the tuning unless these effects are carefully accounted for.



A SCHEMATIC REPRESENTATION OF A VACUUM VALVE

FIGURE 1: *The electric characteristics of a vacuum valve in a high-frequency circuit may be considered as consisting of two capacities in series with a parallel resistance.*

In the Octa-monic arrangement, also shown in Figure 2, we have only one plate circuit to consider, so that the effect of broadened tuning from plate circuit dampening is very remote.

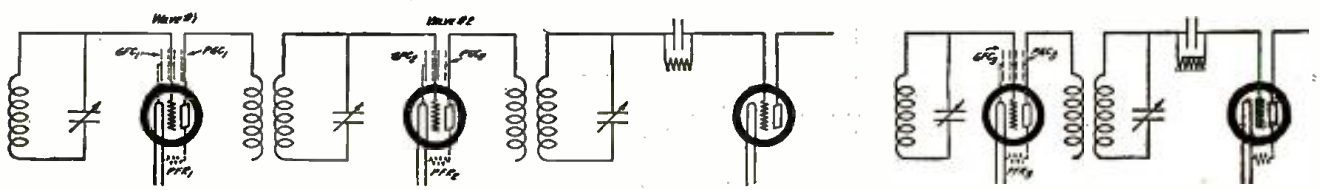
In actual practice, the tendency toward any broadness in tuning is further reduced by the peculiar action of the valve when working at double the frequency of the incoming signal.

It is this absence of resistance damping in the Octa-monic that produces, in the grid circuit of the detector, a resonance curve that is sharper than the resonance curve produced in the detector circuit by a single stage of tuned-high-frequency amplification. The remarkable part of this feature is that this increased selectivity is accomplished in the Octa-monic with one less stage of amplification.

It is also interesting to note that this selectivity is obtained in the Octa-monic without sacrifice of tone quality. Instead of cutting off any side-bands as a result of increasing sharpness, the fact that the Octa-monic operates at double the frequency of the incoming signal increases the frequency separation and permits the use of a wider side-band range in spite of the sharper tuning.

The effect of side-bands on quality and the limitations they impose on selectivity is an interesting study. A consideration of their importance will therefore prove of value.

A transmitting station broadcasts only one frequency or wavelength when there is no music or speech being put on the air. This frequency or wavelength is known as the "carrier wave" (shown in Figure 3). As soon as the program starts, the speech and tone frequencies of voice and instruments are superimposed on the carrier frequency, changing the carrier frequency to a composite form and increasing the frequency range according to the



A COMPARISON OF A STANDARD AMPLIFIER WITH THE OCTA-MONIC

FIGURE 2: *At the left is shown a straight two-stage, high-frequency amplifier and detector, while at the right is shown the circuit arrangement of the Octa-monic. Notice that the capacity and resistance effects of the vacuum valves appear twice in the tuning circuits of the standard amplifier and only once in the Octa-monic.*

heterodyne or "beat-note" principle.

In radio telephony there are two important beat frequencies produced for each tone or frequency which is superimposed upon the carrier wave. This means that when a broadcasting station is transmitting music which ranges in frequency from a few cycles per second up to 5,000 cycles per second, a band of frequencies 5,000 cycles wide each side of the main carrier wave frequency will thus be utilized for the transmission of sounds. In other words, a broadcasting station requires a frequency band having a width of at least 10,000 cycles or 10 kilocycles when transmitting music.

If we investigate the conditions present in the matter of separation of two broadcasting stations operating at 10 kilocycles apart we will discover an interesting difference between the ordinary tuned-high-frequency receiver and the Octa-monic.

Let us take, for instance, a station transmitting on a frequency of 600 kilocycles (500 meters) and a station operating at 610 kilocycles—a separation of 10 kilocycles.

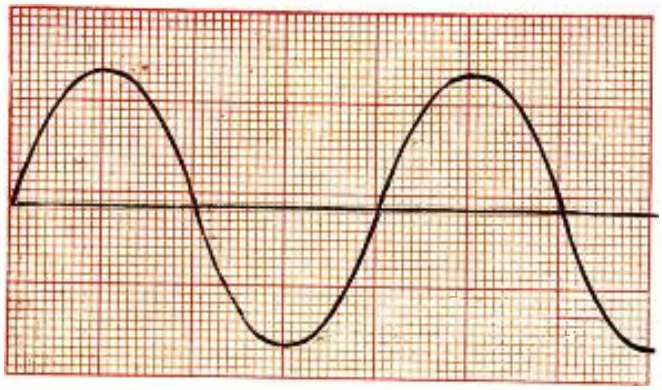
The side-bands of the 600-kilocycle station will range from 595 kilocycles to 605 kilocycles, while those of the 610-kilocycle station will range from 605 kilyocycles to 615 kilocycles, i. e., 5 kilocycles on either side of the carrier frequency. It will be seen that these two stations may sometimes be operating on practically the same frequency, or on frequencies which may overlap, viz., on 605 kilocycles. The result will naturally be interference or heterodyne whistling. To avoid interference it is necessary to tune the circuits sharply so as to limit the side-bands, and this limiting may result in the loss of some of the tone frequencies, with a consequent loss of quality.

In the Octa-monic system, on the other hand, we have an entirely different set of conditions. Since amplification takes place at double the frequency of the incoming wave, the frequency of the 600 kilocycle wave is shifted by the action of the vacuum valve detector to 1200 kilocycles, while the frequency of the 610 kilocycle wave is shifted to 1220 kilocycles.

A variation of 5 kilocycles on either side of the 1200 kilocycle wave will give a range of from 1195 to 1205 kilocycles, while the same variation on either side of the 1220 kilocycle wave will give a variation of from 1215 to 1225 kilocycles.

There is, therefore, an open space between 1205 and 1215 of ten kilocycles which allows for sharper tuning without sacrificing any of the side-bands.

This accounts for the fact that the Octa-monic system can be tuned sharper than the tuned-high-frequency type of circuit without sacrificing the quality-giving side-bands.



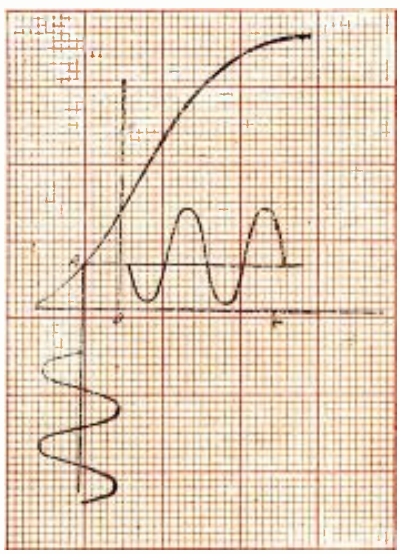
A CARRIER WAVE

FIGURE 3: *This is a diagram of the continuous alternating-current wave generated by a transmitting station. On this wave are superimposed the audible frequencies that compose the broadcast sounds.*

In the superheterodyne, on the other hand, where amplification takes place at a lower frequency (higher wavelength) the opposite holds true, so that in the case of the superheterodyne, the side-bands may be sacrificed in obtaining super-selectivity, thus resulting in impaired quality of reproduction.

The generation of harmonics in vacuum valves, the principle of which is the basis of amplification at double the frequency of the incoming wave, constitutes a special field for design, because for that purpose the valve is operated on a different part of the characteristic curve than that employed in amplifiers or in grid-leak detectors.

Figure 4 shows the characteristic curve of the ordinary vacuum valve. In order to function as a second harmonic generator (double frequency producer), the grid must be operated at about point "A" on the curve, so as to produce unequal amplification in the fundamental carrier wave. The positive half of each wave is amplified more than the negative half.



THE CHARACTERISTIC CURVE OF THE OCTA-MONIC DETECTOR

FIGURE 4: *This diagram shows the characteristic curve of a vacuum valve detector and illustrates the point of operation that must be used to generate harmonics necessary in the Octa-monic system.*

This unequal amplification results in the production of a wave of double the frequency of the incoming or carrier wave. In the plate circuit of the harmonic generator, the double frequency wave is taken off through a tuned circuit, while the fundamental or carrier wave is not used. The harmonic generator is then operated on the knee of the curve at the point employed in a "C" battery detector system. One might think from this that the harmonic generator is really a detector, but while detection does takes place it is only incidental.

In the harmonic-generator valve of the Octa-monic, the plate circuit is tuned to twice the frequency of the wave to which the grid circuit is tuned, thereby eliminating tendencies toward oscillation. This permits the design of an efficient tuned transformer for picking off the carrier wave, as more efficient coupling may be utilized.

To tune to twice the frequency of the incoming carrier wave, it is necessary to use either a smaller condenser or coil, or both.

The best commercial practice in the design of this double-frequency coil is to reduce the inductance of the coil to one-quarter of the value of inductance required for the broadcast frequencies. This eliminates the necessity for the use of special condensers, and also makes possible the ganging of the harmonic-generator tuning condenser and the detector-circuit tuning condenser on the same shaft; this gives an opportunity for single-control tuning.

(*Continued on page 477*)

MAKING A GOOD SET BETTER

Here is the Thordarson power-pack amplifier hooked up to a Crosley Bandbox, No. 601, a six-valve receiver of standard design. Low notes and high notes come through with astounding volume and clarity.

Try This New Power Unit on Your Old Receiver—

Thordarson Power-Pack Amplifier

With the unit described here you can eliminate your "B" batteries and put a 210 power valve wallop into any old or new receiver. And the construction and installation of the unit, as outlined below, can be done by any fan in a very short time.

By MORRIS M. SILVER

THERE are many times when the radio listener wishes that he could do away with the "B" batteries in his set, and at the same time use a power valve for improving his reception. The unit described here was developed for just this purpose in the Thordarson Radio Laboratories.

The Thordarson unit employs a 216-b rectifier valve, a voltage regulator valve and a 210 type power valve—the last to take the place of the ordinary power valve of the set. It may be built at home in a short time, and will supply 45 volts for the detector of an ordinary set, 90 volts for the amplifier and 135 volts for special use. It also supplies high voltage power for the 210 type valve.

The unit may be built up on a special metal chassis that is supplied by the manufacturer, upon which is mounted the power compact, including the power transformer and the two choke coils. A "B" block especially designed for the job is used for the filter circuits. Three sockets for the vacuum valves are also included, as well as an output transformer and suitable resistances for dividing up the voltages for the various potential outputs.

How to Construct the Unit

The metal chassis, K, is provided with a fiber base, L; both chassis and base are drilled and fitted with holes for the mounting screws and connecting wires used in building and wiring the unit. The first job to do will be to attach the three skeleton sockets, D1, D2 and D3, as shown in Figures 1 and 2.

Next mount the power compact, A, the condenser block, B, and the output transformer, C. The terminals for the sockets should be insulated from the metal base by means of the Bakelite spacing washers supplied with the kit.

Next mount the four resistors, E, F, G and H. These are mounted by means of machine screws of the proper lengths, inserted through the metal chassis and extending through the resistance unit, where a nut and lock nut threaded on will fasten them down tight. Four Bakelite spacing washers should be used for mounting these resistors and insulating them from the metal chassis.

Next mount the four binding posts, I1, I2, I3 and I4, and the constructional work will be complete.

Refer constantly to Figures 1 and 2 in building up the unit and in locating the instruments.

How to Wire the Unit

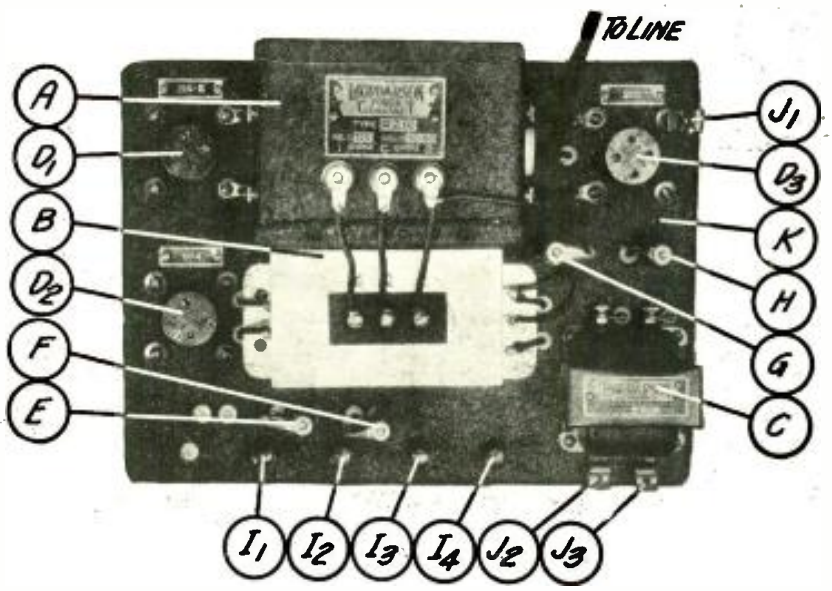
The picture wiring diagram, in Figure 2, shows the exact way to run the wires which connect the instruments, parts and binding posts. Follow this diagram exactly, using heavy rubber insulated hook-up wire. It will be noticed that the wiring in the diagram is shown in heavy red lines. The dotted red lines indicate that portion of the wiring that is to be run beneath the metal chassis. Solder all connections firmly, using soldering lugs wherever possible, fastened underneath the mounting screws or the terminal screws on the instruments.

Place two Fahnestock clips on the output terminals, J2 and J3, of the transformer, C, and place a Fahnestock clip on the grid terminal of the socket, D-3, shown in Figure 2.

(*Continued on page 469*)

POPULAR RADIO WORK SHEET

The Thordarson Power-Pack Amflifier



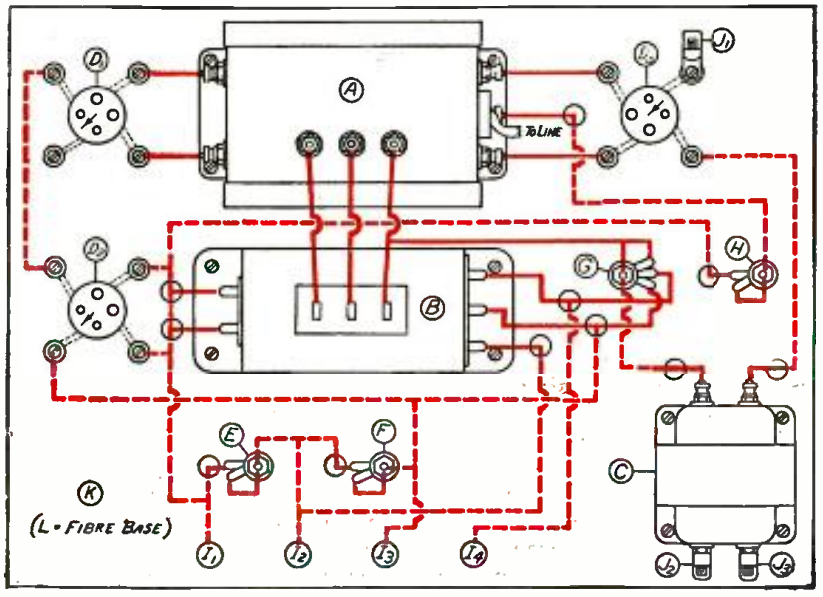
THE UNIT VIEWED FROM ABOVE

FIGURE 1: *In the simplified panel arrangement of the Thordarson power-pack amplifier, the rectifier valve and the voltage regulator valve are placed in the sockets to the left of the power transformer, and the 210 power valve in the socket at the right.*

List of Parts Necessary for Building This Unit

Cost of Parts—*Not over $54.00*

A—Thordarson power-pack, type R-210;
B—Tobe "B" block, type R-210;
C—Thordarson transformer, type R-76;
D1, D2 and D3—Benjamin Cle-Ra-Tone panel mounting sockets;
E and F—Ward Leonard Vitrohms, 10,000 ohms;
G—Ward Leonard Vitrohm, 8,000 ohms;
H—Ward Leonard Vitrohm, 1,000 ohms;
I1, I2, I3 and I4—Eby binding posts;
J1, J2 and J3—Fahnestock clips;
K—Metal base;
L—Fiber base that is furnished with the metal base, K.



A SIMPLE WIRING JOB

FIGURE 2: *The solid* RED *lines indicate the wiring above the panel and the dotted* RED *lines the wiring under the panel. The instruments are outlined in* BLACK. *Dotted* BLACK *lines indicate the parts of instruments that extend under the panel.*

Every Day of the Year Is Big Bargain Day Down On

New York's Radio Row

How the "fruit-stand" merchandisers of radio sell $27,000,000 worth of instruments to the public every year.

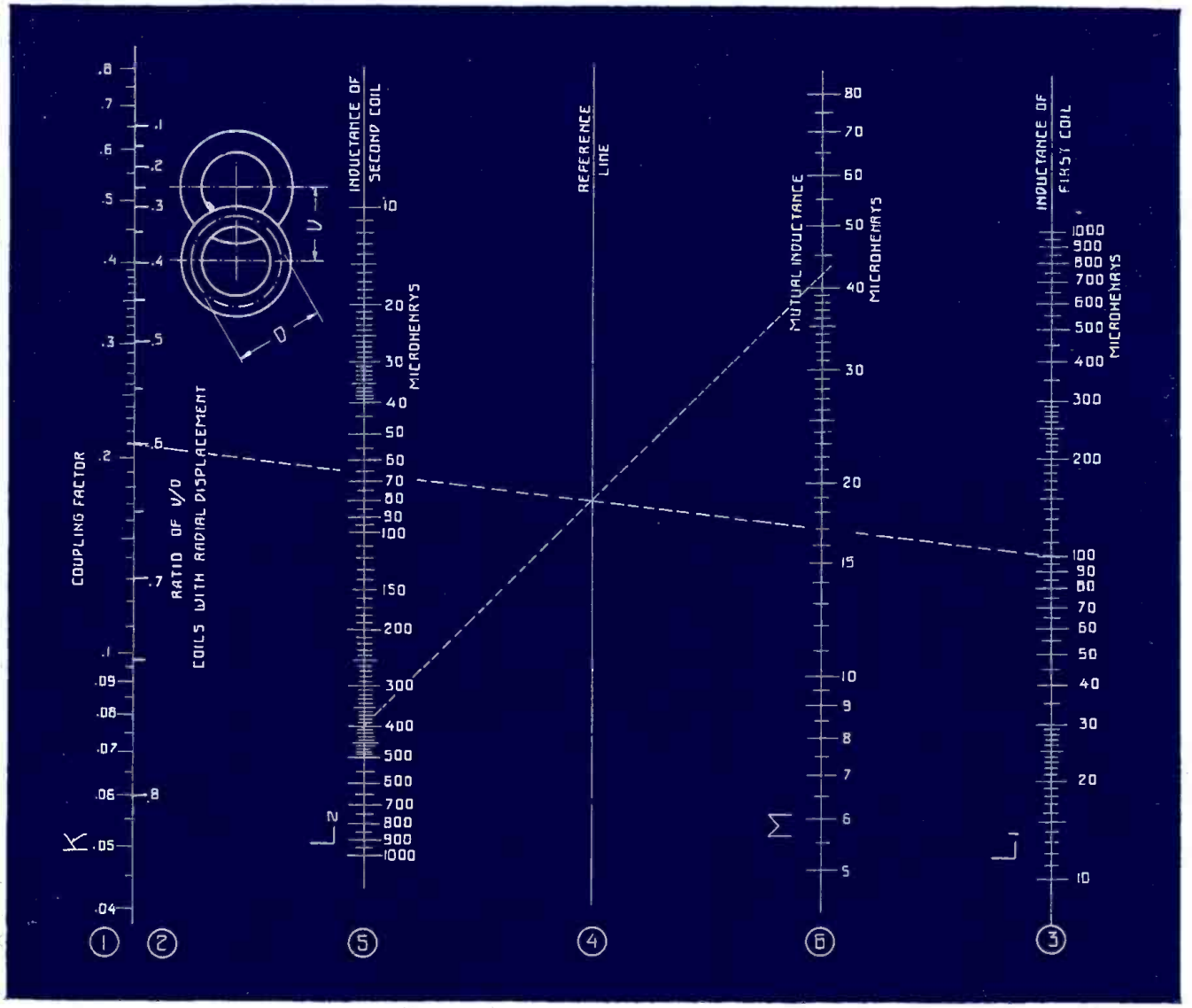
BACK in 1922, Cortlandt Street was just like any other downtown street in New York; but just as Fulton Street became far famed for its fish markets, so has Cortlandt Street become the "radio row" of the United States. Indeed, there is no other radio mart in the world even remotely like it. With Cortlandt Street as a center, one could draw a circle three blocks in diameter and include literally hundreds of radio retailers, large and small, with merchandising methods that extend all the way from "fruit-stand" tactics to large and beautifully appointed demonstration rooms to suit the most discriminating purchasers of radio receivers.

The history of New York's radio row is one of amazing growth. Back in 1922, when the industry was suffering from the effects of overproduction, a very wise and ingenious merchandiser, taking advantage of the distressed condition, set himself up in a two-by-four shop and did such a land-office business that at times the police reserves had to be called to control the crowds that stormed his cut-price emporium. The man who makes money quickly and easily in New York always finds a number of imitators, and the radio shops on Cortlandt Street multiplied fast and furious, until today over $27,000,000 worth of merchandise of all kinds and colors is sold to the New York and New Jersey radio public.

Radio Row has its buying sleuths scattered throughout the country, and these men always have their ears to the ground, anxiously waiting for the distant rumbling of a bankruptcy, so that they may rush in and offer the distressed manufacturer cash for his goods.

At various times and in various ways, Cortlandt Street has gone into the manufacturing business on an enormous scale. Not only has it done this, but it has subsidized manufacturers of "B" batteries, "B" eliminators, valves and loudspeakers. It buys in enormous quantities and it pays not one-sixteenth of a cent more than it has to pay for what it buys. Merchandise is passed along to the public at a very small margin of profit; for Cortlandt Street believes in the merchandising doctrine that if you sell enough you don't need much profit on the piece.

In the old days Radio Row used methods that were not in favor with the Better Business Bureaus, but while there are a few unscrupulous dealers left, much has been done to purify the atmosphere of this famous locality, and today even the man who is not an expert in radio values may buy with some feeling of security.



A MEASUREMENT CHART

For Use in Calculating the Mutual Inductance of Coils with Radial Displacement

By RAOUL J. HOFFMAN, A.M.E.

IN designing a new receiver, it is quite often found necessary for the engineer or experimenter to know the amount of mutual inductance between two coils. This may be calculated from the standard formula:

$$M = K\sqrt{L_1 \times L_2}$$

wherein

M = the mutual inductance;
L_1 = the inductance of one coil;
L_2 = the inductance of the other coil;
K = the coupling factor of the coils with a given displacement.

For coils having a radial displacement, illustrated by the small diagram in the chart, the value of mutual inductance of radial displacement has been calculated and prepared in the form of an allignment chart. Of course, in this case we must know the inductance of the coils that are to be coupled together.

To explain the use of the chart, let us consider the following example:

We want to find the mutual inductance of two coils that have an equal diameter of 3 inches and that are spaced 1.8 inches radially with an inductance of 100 and 400 microhenrys, respectively.

The spacing ratio is found by dividing the radial spacing, V, by the diameter, D, which in this case is 1.8 divided by 3, which equals .6. Looking at scale No. 2 on the chart, we find .6 in line with .21 on scale No. 1, which is the coupling factor, K. Connecting .6 on scale No. 2 with 100 on scale No. 3 and then connecting the intersecting point on reference line No. 4 with 400 on scale No. 5, we find this line intersecting scale No. 6 at 42, which is the value of the mutual inductance, M, in microhenrys.

Of course, any other values of coupling, within the values of inductance covered by the chart, may be determined in a similar manner.

This chart, and the others of this series, will be found invaluable in radio receiver and transmitter designs.

GET READY, FANS, HERE COMES A BIG NEW SET—

The Harkness Counterfonic

Unique ideas in high-frequency amplification are combined with the latest advances in double-impedance, low-frequency amplification in this most recent creation of Kenneth Harkness—the Counterfonic Six. Other features, as outlined in this advance article, include single-control tuning and simplicity in construction that will make the assembling of the new receiver a matter of only a few hours' work.

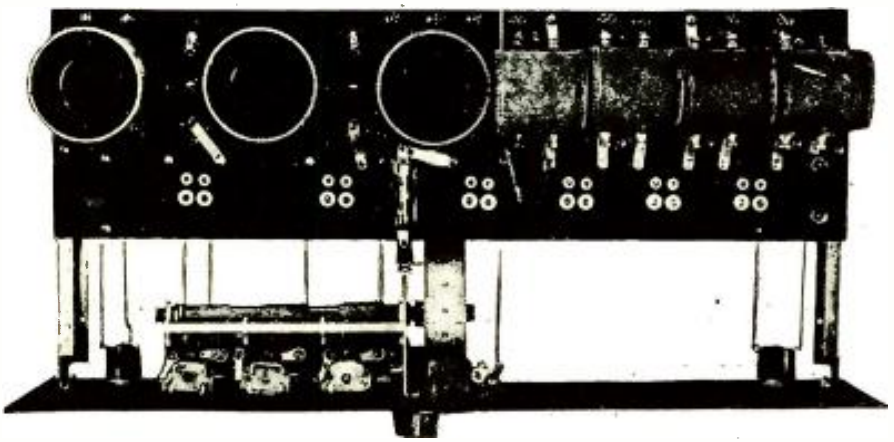
HARKNESS AND HIS LATEST CREATION

Here is Kenneth Harkness, the designer of the unique Counterfonic Six, giving his latest creation a workout in the POPULAR RADIO LABORATORY. *The tests show that the Counterfonic is a receiver of an astounding number of virtues—at a comparatively low cost.*

By CARL DORF

THE receiver designer of to-day has at his disposal a number of innovations that the past year in radio progress has made possible. The problem is to combine them in a circuit that makes the best use of all of them. It was with the idea of solving this problem that Kenneth Harkness set about in designing the Counterfonic receiver. The results have been satisfactory to the fullest degree. The completed Counterfonic is an easily constructed receiver that may be built for less than $60, and that combines the following outstanding features in a well-rounded and efficient ensemble:

1. Self-shielded coils;
2. Jiffy construction;
3. A simple selectivity control;
4. Easy neutralization;
5. The famous Hiler double-impedance amplification scheme;
6. An output filter of improved design.



SIMPLICITY AS A WATCHWORD

FIGURE 1: *Notice at the left the three high-frequency coils, individually shielded with copper tubing. The four units at the right comprise the new three-stage, double-impedance, low-frequency amplifier with an output filter. The triple-gang condenser that permits single-control tuning is at the lower left. The wiring has been so simply laid out that the set almost wires itself.*

The new high-frequency coils, designed by Harkness especially for the new set, consist of straight solenoid coils, shielded individually by heavy copper cylinders. The copper cylinders are open at each end so that the inductance of the coils is not materially impaired, although satisfactory shielding results are obtained. Figure 4 shows the coils in detail.

The antenna coil consists of three windings, one in the antenna circuit, one in the grid circuit, and the third winding for neutralization. The second coil is similar, consisting of the same three windings. The first winding is to be connected in the plate circuit of the first high-frequency valve, and the second winding in the grid circuit of the second high-frequency valve; the third winding is for the purpose of neutralization. The third coil consists of but two windings, one in the plate circuit of the second high-frequency coil and the second in the grid circuit of the detector valve.

The arrangement of the parts has been simplified by using a sub-panel assembly incorporating ready set-up sock-

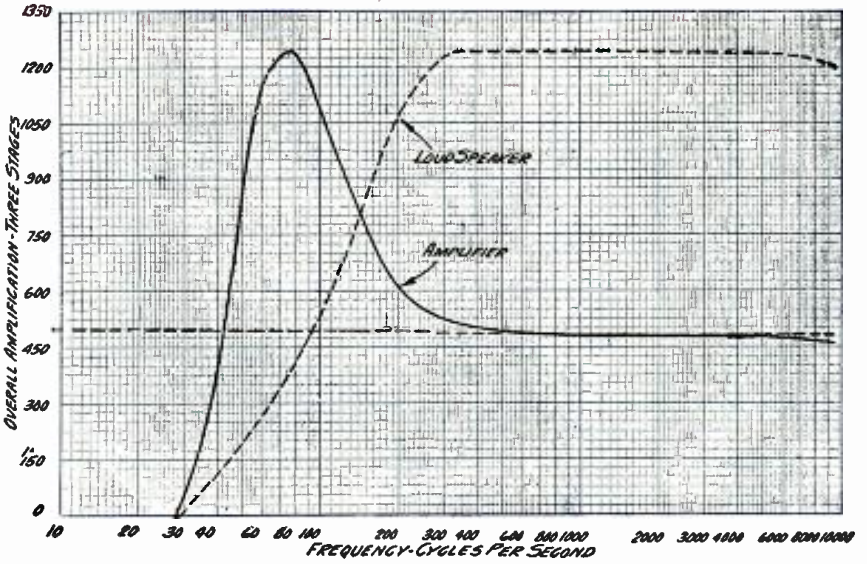
ets with strip connections, so that wiring and assembly operations are cut to a minimum. A triple-gang condenser is furnished with a drum dial. Each tuned circuit, comprising the secondary windings of the three high-frequency coils and one section of the triple-gang tuning condenser, is adjusted to exact resonance by means of a midget variable condenser. This feature guarantees highest efficiency in tuning with single control.

An antenna switch arrangement for short-circuiting a fixed condenser in the antenna circuit gives a double selectivity range for the receiver, and also enables the set to be operated on either a long or a short antenna at highest efficiency.

By using a third winding in the two high-frequency circuits and two small semi-variable condensers, each high-frequency circuit may be individually neutralized in a few seconds with a common screwdriver. The set can be easily adjusted so that oscillation is entirely eliminated once and for all.

Now we come down to the part of the receiver that gives such marvelous tone quality.

The receiver incorporates three stages of double-impedance amplification following the detector, which is equipped with a high-frequency filter to keep high-frequency currents out of the amplifier. The low-frequency, double-impedance amplifier is tuned to highest efficiency at audible frequencies that lie between thirty and two hundred cycles. Figure 2 shows the amplification curve of the amplifier in comparison with a composite outline curve of a number of modern loudspeakers. It will be seen that the effect of the high amplification peak in the amplifier makes up for the lack of reproduction of low notes in the loudspeakers, thus insuring a wealth of the beautiful low tones that are missing from old-time receivers.



HOW THE LOW TONES ARE REALIZED

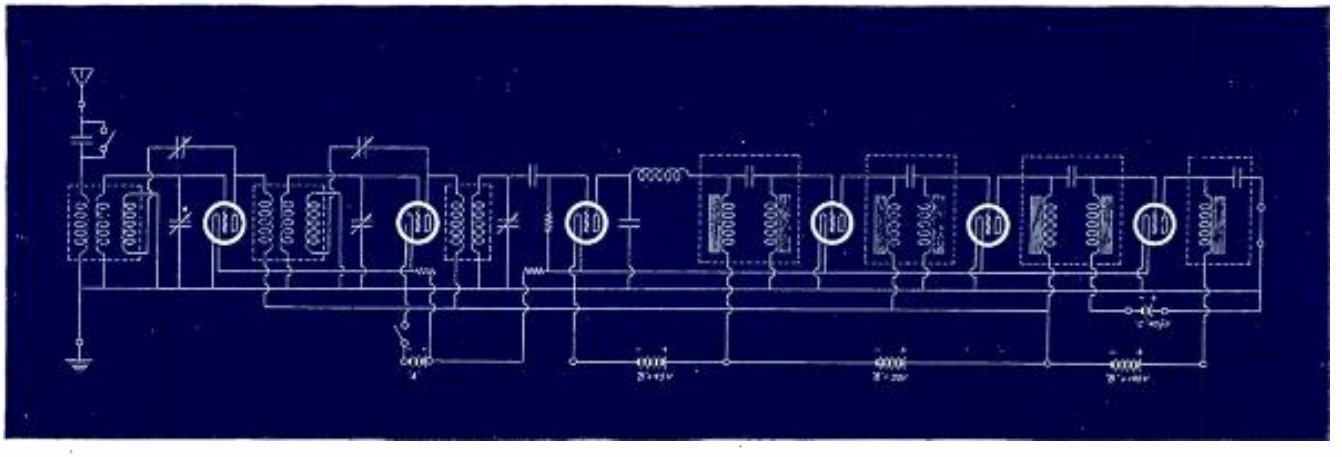
FIGURE 2: *The curve shown in the solid black line indicates the resonant peak of the tuned-low-frequency amplifier of the Counterfonic Six, between 60 and 100 cycles—the lower notes of reproduction. The curve in dotted black is a composite curve of reproduction for a number of loudspeakers, showing how their amplitude falls off at the lower frequencies, thus eliminating the low notes. The Harkness amplifier is tuned to compensate for these inherent defects in loudspeakers, so that the final output of the loudspeaker has an amplitude that is the same for both high and low notes.*

The output of the last power valve in the new receiver is fed into the output filter, which again eliminates a large amount of distortion and protects the loudspeaker windings from the high-voltage direct current that would ordinarily flow through its windings.

An idea of the simplicity of the new receiver, with its well-designed layout, may be gained from a study of Figure 1. If a line were to be drawn through the center of the receiver, the portion at the left would contain the complete high-frequency amplifier, including the detector, while at the right is the complete low-frequency amplifier; thus the receiver is divided into its two separate functions of high-frequency and low-frequency amplification. At the center is the illuminated drum dial with its control knob that does all the tuning in a single operation. Underneath the control knob is the volume control knob, which is the only other control on the receiver except an "on" and "off" switch.

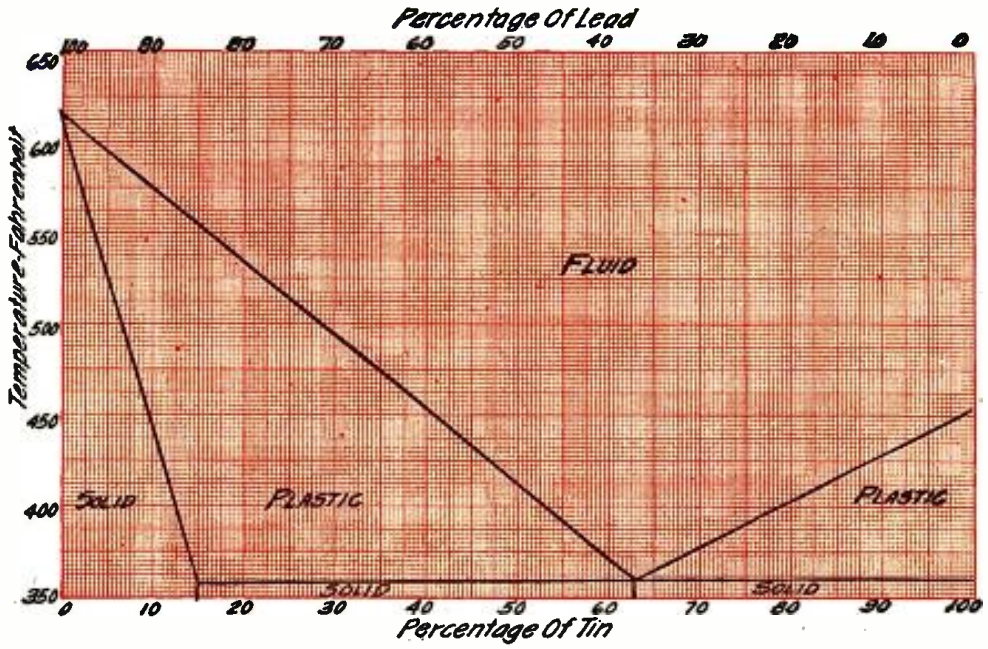
The new set has been especially designed for the prospective broadcast listener who wants a set that will be medium priced, that he can easily build at home on the kitchen table, and that

(*Continued on page 460*)



THE SCHEMATIC DIAGRAM OF THE COUNTERFONIC CIRCUIT

FIGURE 3: *At the left are the two high-frequency stages and the detector stage, with their novel schemes for shielding and neutralization. The tuned double-impedance, low-frequency amplifier is at the right, with the output filter.*



HOW DIFFERENT SOLDERS REACT TO HEAT

This chart shows graphically the physical states through which tin-lead solders of various percentages pass on the application of heat. The alloy of 63 per cent tin and 37 per cent lead passes from the solid to the liquid state immediately, while alloys of other percentages pass through a plastic stage of a duration depending on the proportions of tin and lead present.

The New Science of Soldering

By P. C. RIPLEY*

SOLDER, as we know it to-day, is formed by alloying the metals tin and lead. Tin, the more expensive metal of the alloy, is of a distinctly white color, crystalline in structure, and almost entirely devoid of tenacity. In its pure state it has a melting point of 450 degrees Fahrenheit.

Lead, the other component metal of solder, is less expensive. It is bluish white in color, soft, plastic, and almost entirely non-elastic. In a pure state, it has a melting point of 621 degrees Fahrenheit.

By alloying the two metals tin and lead, we secure an alloy with a melting point that is considerably lower than that of either of the component metals. By adding the metals bismuth and cadmium to the tin and lead, we can still further lower the melting point, but by so doing we destroy some of the valuable attributes that tin-lead alloys display. For all practical purposes in the construction of radio receiving and sending apparatus, tin-lead alloys serve admirably, and the average home constructor of receivers need give little concern to alloys containing bismuth or cadmium. Their cost is excessive and the strength of such alloys is measurably lower than those of tin and lead.

Now, by varying the proportions of tin and lead in the making of the alloy, we secure certain well-defined characteristics in their physical behavior in the molten and solidified states. This largely determines the selection of an alloy for specific use. At one point in the possible ninety-eight alloy percentages we discover a strangely different behavior from any other alloy of the group. This occurs when we take 63 per cent tin and 37 per cent lead and melt them together. In this percentage we have what is termed the eutectic mixture of the tin and lead group. It gives us the lowest melting point that we can secure in the alloys of tin and lead without the intermixing of bismuth or cadmium. One property that this alloy displays that none of the other alloys manifest is that in passing from molten fluidity to solid, or vice versa, the transition is instantaneous; there is no plastic or mushy intermediate state in the change. Any other alloy percentage will display this intermediate plasticity, although alloys closest to the eutectic will possess the shortest periods of plastic state. Regardless of how rapidly or how slowly we cool the eutectic alloy, the change will be just as well defined and sudden. The ordinary commercial alloys more commonly employed for solder are combined in such proportions as 50 per cent tin and 50 per cent lead, or 45 per cent tin and 55 per cent lead, or 40 per cent tin and 60 per cent lead, or 35 per cent tin and 65 per cent lead.

To illustrate the changes in alloys under the action of heat and the resultant stages, refer to the chart at the beginning of this article, which graphically illustrates the approximate temperatures such stages and changes occupy in the various alloys. From this chart it is possible to calculate roughly the softening point and the point of fluidity of any alloy of the tin and lead group, and also the amount of temperature increase above the melting point of the eutectic necessary to induce complete fluidity.

Unless you are qualified to judge solder, it will be a wise plan in your selection of solder for use on your radio receiver to purchase a kind that carries the endorsement of the manufacturer as being suitable for radio use. The ordinary commercial solders are frequently made from reclaimed or scrap metals and are likely to contain

(*Continued on page 473*)

*Mr. Ripley, the author of this illuminating article on solder, is at present Chief Engineer of the Chicago Solder Co.

The appearance of the Hi-Q receiver, when installed in its console cabinet, makes it a suitable and tasteful addition to any home. The cabinet in the picture at the left is done in walnut.

HOW TO GET PERFECT RESULTS WITH

The Hammarlund Hi-Q "Six"

With the help of the suggestions given in this article, the operation of the Hammarlund Hi-Q "Six" can be simplified to a remarkable extent, and the receiver can be made to operate far more efficiently and with better results in quality reproduction—at less expense.

By RAYMOND FRANCIS YATES

IN building a radio receiver an experienced set builder usually learns a great deal about the theory and operation of the circuits employed, by study and careful consideration of the function of each instrument as he puts the set together. However, for set builders in general, whether they be amateurs, broadcast listeners, professional set builders or just plain novices building their first set, an article of hints for operating the Hi-Q Six receiver may help in solving some point of operation.

The Hi-Q receiver, as has been explained in previous articles on theory and construction, is a well designed, well executed piece of radio engineering, and if it has been built according to instructions, and wired correctly, results of a very high order should be obtained.

Let us consider that the set has been constructed and wired, checked and found correct, and that it has been installed in its cabinet and the batteries connected, as shown in Figure 1. The switch on the receiver should be turned to the "on" position. The volume control should also be turned full "on" and the two tuning controls revolved simultaneously, keeping both at approximately the same settings. If signals are not received immediately, connect a pair of headphones across the terminals marked "P" and "B" of the first low-frequency transformer. If signals are heard in the headphones but not in the loudspeaker it is certain that the trouble is in the low-frequency circuit, and it should be checked over again. If signals are not heard in the headphones the trouble is in the detector or high-frequency circuits, and these should be traced until the trouble is found and corrected.

On most wavelengths the two tuning controls should be set approximately alike except for a slight variation that may occur in the first dial with varying lengths of antenna.

Never turn the volume control higher

than is absolutely necessary to get the proper strength of signal.

If, upon turning the set "on," a continuous howl goes up, a defective or microphonic valve may be the cause. If this trouble occurs, tap each valve with the finger nail and find out which one is causing it.

Such valves sometimes give trouble as detectors or low-frequency amplifiers, but are perfectly efficient in the high-frequency stages. If any one valve cannot be made to work properly by placing it in a different socket, a new valve should be substituted.

Hook-up Combinations for the Hi-Q

The type of batteries and the size of amperites required in this set depend upon the kind of valves employed. For maximum efficiency it is recommended that with battery operation the new 112-a or 171-a type valves be used in the last stage; with dry-cell hook-ups a 120 type valve would be best. The new 112-a and the 171-a type valves are similar to the old 112 and 171 type valves except that they employ oxide filaments that consume only .25 ampere instead of .5 ampere.

Four hook-up combinations are listed below, and Combination No. 1 is recommended for ordinary use:

COMBINATION No. 1

Five 201-a or SX-401-a type valves in sockets Nos. 1, 2, 3, 4 and 5.
One 112-a or SX-412 type valve in socket No. 6.
One 6-volt storage "A" battery or Balkite "A" Eliminator.
Three 45-volt "B" batteries.
Two 4½-volt "C" batteries.

COMBINATION No. 2

Five 199 or SX-499 type valves in sockets Nos. 1, 2, 3, 4 and 5.
One 120 or SX-420 type valve in socket No. 6.
One 4½-volt dry-cell "A" battery.
Three 45-volt "B" batteries.
One 22½-volt "C" battery.
One 4½-volt "C" battery.

COMBINATION No. 3

Six 199 or SX-499 type valves throughout.
One 4½-volt dry-cell "A" battery.
Two 45-volt "B" batteries.
One 4½-volt "C" battery.

COMBINATION No. 4

Six 201-a or SX-401-a type valves throughout.
One 6-volt storage "A" battery or Balkite "A" Eliminator.
Two or three 45-volt "B" batteries.
One or two 4½-volt "C" batteries.*

If valve combination No. 2 or No. 4 is used, three Carter No. RU-20 (20 ohms) resistance units should be substituted for the resistances furnished in the foundation unit. A Carter No. IR-20 (20 ohm) or a Carter No. IR-25 (25 ohms) Imp rheostat should be substituted for the Carter No. IR-6 (6 ohms) rheostat specified in the standard parts list for building the set.

*Note: If only two 45-volt "B" batteries are used, only one 4½-volt "C" battery is necessary, and both the green and brown cable leads should be connected to 4½ volts negative (—). The yellow and gray cable leads should both be connected to 90 positive (+).

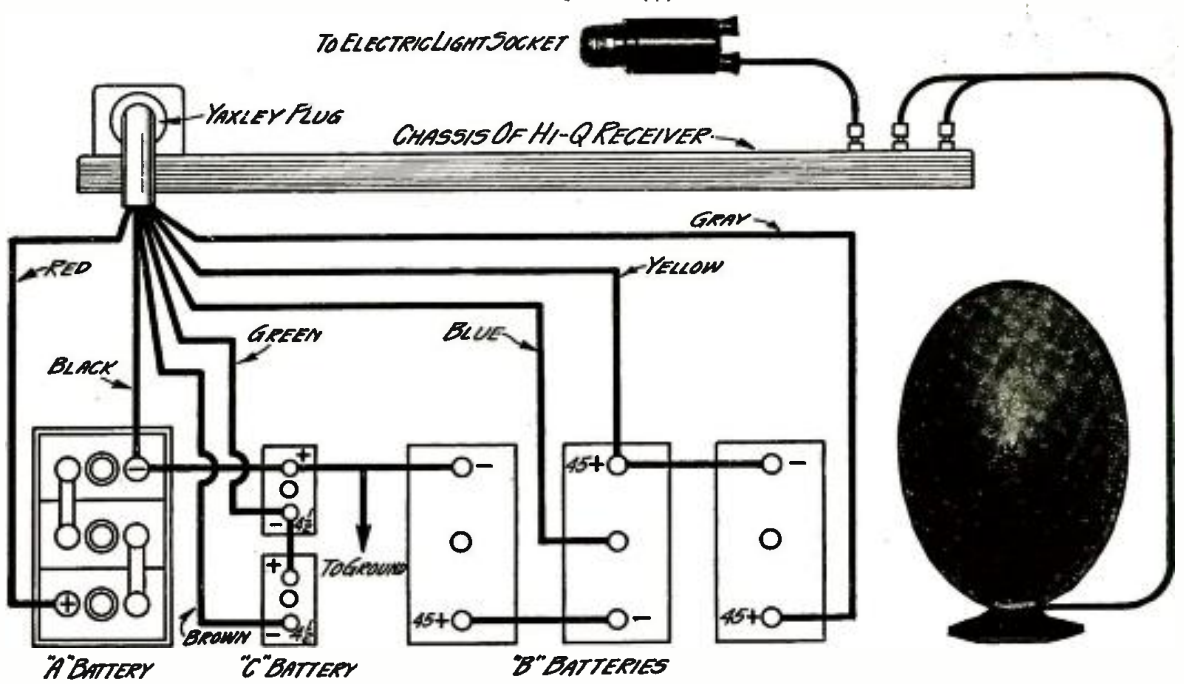
To secure the full advantages of the 171-a or 171 valves, four 45-volt "B" batteries should be used and a 40-volt "C" battery should be connected to the brown wire of the cable. With these voltages the plate current drawn under normal conditions is 18 or 20 milliamperes, which is too much to pass safely through the windings of the average loudspeaker.

This difficulty can be easily overcome by connecting a Samson No. 30 choke coil directly across the loudspeaker binding posts. Mounting holes for this choke are provided on the steel chassis near the loudspeaker binding posts. As the resistance of the average loudspeaker winding is considerably higher than the direct-current resistance of this choke coil, most of the 18 or 20 milliamperes of plate current will pass through the choke coil. This will prevent the burning out of the loudspeaker winding by the heavy direct current of the power valve.

Accessories Recommended for Use With the Hi-Q "Six"

For those desiring to do away with the regular "A" batteries, the Balkite "A" power-pack has been found exceptionally well suited for use with this receiver. The unit consists of a rectifier and an electrolitic filter condenser combined in a single pack. It is complete and requires no other accessories, and furnishes noiseless filament current from the lighting lines. It requires no

(*Continued on page 453*)



AN IMPROVED HOOK-UP FOR THE HI-Q "SIX"

FIGURE 1: *This diagram shows the complete hook-up for operating the Hi-Q most efficiently with batteries, and it includes the socket antenna, shown at the top, that does away with the problem of erecting an antenna.*

What's New *in* RADIO

Conducted by

THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY, it will be duly recorded in this Department for the information and benefit of all.

From a photograph made for POPULAR RADIO

A SHIP MODEL THAT TALKS

This decorative ship model of Columbus' craft, LA PINTA, *constitutes one of the most unique loudspeakers that has ever been shown in these columns. The ship itself is a perfect gem from a decorative standpoint, and the mainsail acts as a cone loudspeaker, giving excellent quality of reproduction and volume enough for any home use. It is manufactured by the Miniature Ship Models Company.*

A "B" Power-Pack That Requires No Adjustment

Name of instrument: Socket Power No. 671.

Description: This unit contains a rectifier, a filter and a voltage divider, combined in a single enameled case to provide smooth, uninterrupted supply of plate voltage for the operation of any receiver employing up to seven valves, including a UX-171 type power valve in the last low-frequency stage. This power-pack is designed to provide long service. It employs a gaseous rectifier valve of the Raytheon BH type, and gives a maximum output voltage of 180 volts for the power valve, with intermediate and detector voltages of approximately 90 volts and 45 volts, respectively. A "C" bias suitable for use with a UX-171 type valve is also provided. All connections between the power-pack and the receiver are made by means of a cable which is included with the power-pack. The cord and plug for connection to the electric light socket is equipped with a pendent switch for tuning the unit "off" and "on."

Usage: To supply all plate voltages for the operation of receivers with up to seven valves, including a power valve. Operates from the 110-volt, 60-cycle lighting lines.

Outstanding features: Sturdy. Ample factor of safety in all parts. Operates on input voltages from 105 to 130. Neat appearance.

Maker: A. H. Grebe Co.

A Battery Charger With Two Charging Rates

Name of instrument: Combined battery charger and automatic control switch, model ATCSR.

Description: This battery charger makes use of a 2½-ampere Tungar rectifier bulb and provides two charging rates of 1½ and ½ ampere. A toggle switch is provided on the case of the instrument to permit changing from one rate to the other without the necessity for changing the connecting wires. The case also includes a self-contained relay switch which automatically turns the charger "off" when the receiver is turned "on," and vice versa. In addition to this, a receptacle on the front of the charger case provides a connection for the "B" power-pack, if one is used. This is to provide automatic control of the "B" power-pack; that is, to turn it "on" when the receiver switch is turned "on," etc. The case is of metal with a crystalline finish and is perforated to provide adequate ventilation to dissipate the heat from the rectifier valve. The trickle charge rate of ½ ampere should be adequate to keep the storage battery charged, except in cases where the service is unusually heavy, in which event the high charging rate may be resorted to occasionally to bring the battery up to full charge.

Usage: For the charging of a storage battery and automatic control of the charger, as well as the "B" power-pack.

Outstanding features: Saves space in cabinet because of the combining of the charging and switching units into one. Provides a low charging rate for normal use and a high rate for occasional use where the battery is used at heavy loads.

Maker: Acme Electric & Mfg. Co.

A Handy Instrument for Checking Batteries

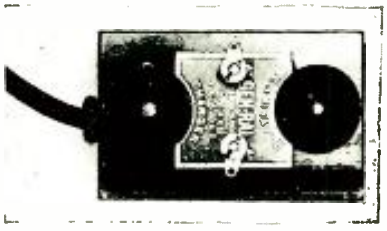
Name of instrument: Two-range voltmeter.

Description: This instrument is inclosed in a nickel-plated case that protects the mechanism. The face of the instrument is equipped with a highly visible double scale. The upper scale provides voltage readings up to 150 while the lower scale has a maximum of 7.5 volts. The meter is of the moving-coil type and is small enough in size to fit easily into the pocket. It is equipped with a leather carrying case.

Usage: To check the "A" and "B" battery voltages in a radio receiver.

Outstanding features: Compact in size. Calibrated with the necessary degree of accuracy. Equipped with leather carrying case. Contains a zero adjustment feature.

Maker: Hoyt Electrical Instrument Works.



Automatic Control for "A" and "B" Power

Name of instrument: Gen-Ral automatic relay switch, type AX-12.

Description: This switch is operated by a magnet energized by the "A" battery current flowing to the receiver. The contacts of the switch are of silver. When the panel switch on the receiver is turned "on," the current to the filaments flows through the magnet winding of the automatic switch, and this causes contacts to be made inside of the switch; this closes the line circuit to the "B" power-pack. When the receiver switch is turned "off," the power-pack circuit is opened and the circuit to the trickle charger is closed, thus putting the battery on charge. The entire unit is enclosed in a bakelite case, on the top of which are receptacles for the plugs from the charger and the power-pack; there are also two binding posts for connection to the "A" battery circuit. The instrument is equipped with an extension cord and plug for connection to the 110-volt, alternating-current lighting lines.

Usage: To automatically control the AC supply to the trickle charger or power-pack, or both, by means of the filament switch on the receiver.

Outstanding features: Small in size. Positive in operation. Switch contains silver contact points. Easily installed.

Maker: General Mfg. Co.

The Wire Cannot Sag on This Folding Loop

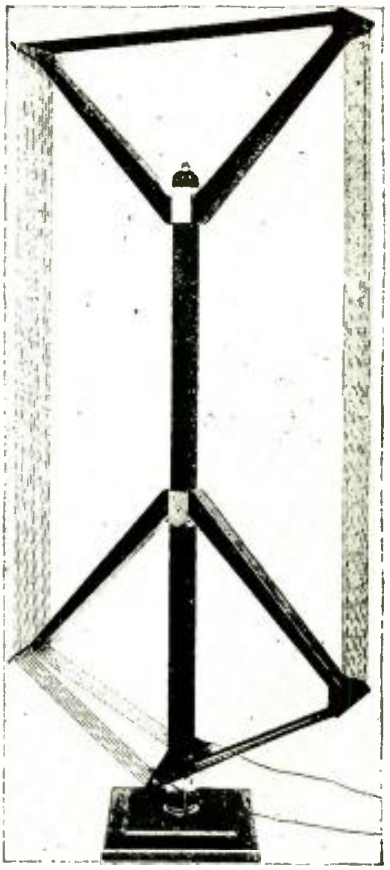
Name of instrument: Quali-Tone loop antenna.

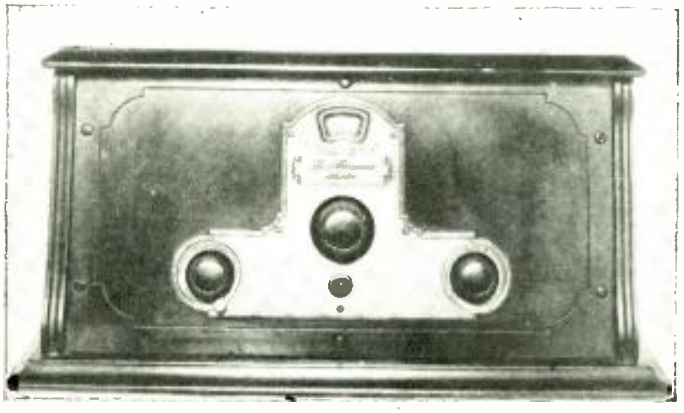
Description: This loop, when open, measures 16 inches across by 34 inches in height. When closed it is 14 inches by 6½ inches by 3 inches. The frame is of walnut finish, with nickel-plated metal trimmings. A thumbscrew adjustment is provided by means of which the loop winding can always be kept absolutely taut—a feature which adds much to the appearance, as well as to the permanently accurate values of inductance and distributed capacity. The loop is set in a swivel base and is provided with three long, flexible leads for the connections to the receiver. These leads represent the two outer terminals of the loop winding and a center tap. Each is equipped with a phone tip. The loop is designed for use with a .0005 mfd. variable tuning condenser.

Usage: As an antenna for use with superheterodyne and other receivers that are designed for loop operation.

Outstanding features: Winding always taut. Fine appearance. Provided with flexible connecting leads and a center tap.

Maker: Duro Metal Products Co.





A Small Receiver With Large Results

Name of instrument: Freed-Eisemann NR-9 receiver.

Usage: For radio broadcast reception.

Outstanding features: Sensitive to weak and distant signals. Fine tone quality. Plenty of volume. Compact.

Description: There has been a decided trend recently toward radio receivers of large dimensions, and many of the uninitiated public seem to have gained the impression that the value and ability of a receiver vary in proportion to size. It is true that many of the most expensive receivers are large in size, but even in these cases the great size is not necessary to the efficiency of the receiver. Instead the huge console cabinets are provided to house the reproducer or power-packs and also to make the outfit more impressive in appearance. An internal inspection of even these expensive receivers will disclose that the space occupied by the receiver itself is comparatively small. In purchasing a large receiver, a good part of the purchase price goes for the cabinet. If one desires a large, impressive looking piece of furniture, this is

(*Continued on page 468*)

A Transformer That Gives Lifelike Reproduction

Name of instrument: Superaudioformer low-frequency transformer, type No. 27-A.

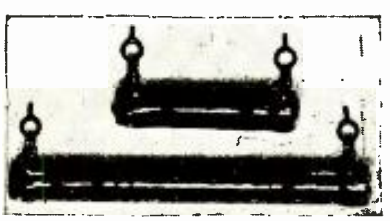
Description: This transformer is of generous proportions and is designed to provide practically even amplification throughout the range of audible frequencies. Its characteristic curve shows an equal voltage amplification at frequencies from 200 to 1,500. Below 200 cycles there is a gradual falling off, until at 60 cycles the amplification is about 75 per cent of that obtained above 200 cycles. At 1,500 cycles the curve begins to rise gradually to a maximum at 4,500 cycles. This maximum value is approximately 25 per cent. higher than the amplification value from 200 to 1,500 cycles.

The transformer is inclosed in a metal case that is finished in satin bronze. It is equipped with terminal mounting strips of composition material and with mounting flanges at the bottom of the case for use in attaching the transformer to the baseboard or sub-panel of a receiver. The terminals are clearly marked on the top of the transformer case, so that there can be no error in connecting the instrument.

Usage: To provide coupling between the valves of a low-frequency amplifier and for use in both first and second stages.

Outstanding features: High amplification. Turn ratio 3 to 1. Good voltage amplification characteristic. Logical arrangement of terminals. Neat appearance.

Maker: Pacent Electric Co., Inc.



Wire Wound Resistors Rated at 20 and 40 Watts

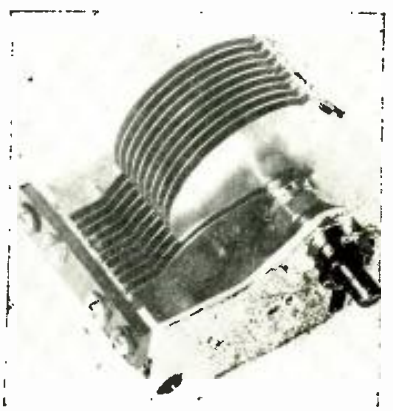
Name of instrument: Aerovox Pyrohm resistors, type Nos. 994 and 992.

Description: These resistance units consist of suitable resistance wire which is wound on tubes of refractory material and is then coated with a porcelain enamel to protect the wire from oxidization, moisture and breakage. The materials used are carefully selected so as to have the same coefficient of expansion and thus these resistances may be worked under heavy loads without injury to the wire. Contact is made by means of broad metal bands which are clamped onto the wire before the enamel is baked on. These connections terminate in soldering lugs. The larger resistance shown here is a 25,000-ohm unit with a current-carrying capacity rating of 40 watts. Its size is 3¾ by ½ inch. The smaller unit is rated at 20 watts and has a resistance of 25,000 ohms. Its size is 2 by ½ inch. Either of these types of resistors may be obtained in resistance values from 500 ohms to 50,000 ohms.

Usage: Voltage-reducing or voltage-dividing resistances in the output circuits of "B" power-packs. Or for any service that requires the use of a high resistance that is capable of dissipating 20 watts or more.

Outstanding features: Small size. Clearly labeled as to resistance values. Will withstand heavy duty without any material change in resistance values.

Maker: Aerovox Wireless Corp.



A Tuning Condenser for Limited Space

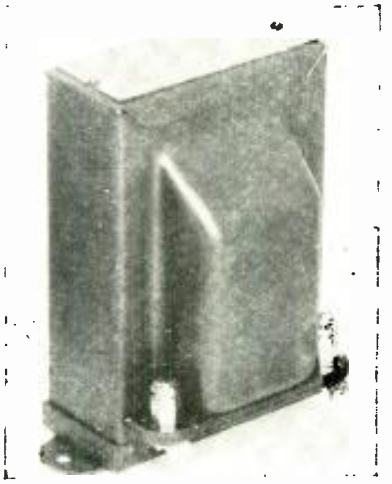
Name of instrument: Universal compact variable tuning condenser, type UX.

Description: The rotor and stator plates of this condenser are of unusual shape and are so designed as to take up a minimum space. The rotor plates, which in most condensers are much longer than they are wide, are almost round. The arc through which they swing is therefore small and the total space required for mounting this condenser is 3⅛ by 3 by 2⅜ inches. The plates are of brass, except the end plates, which are of aluminum. The stator is insulated from the rotor by means of two narrow strips of high-grade insulating material. All plates are securely held in place and accurately spaced. The tuning curve of this condenser is a modified straight-frequency line. The shaft is removable and can readily be replaced with a long shaft for the purpose of operating several of these condensers on a single shaft for single-control tuning of multi-stage receivers. Also, there is no front or back to this condenser. It is identical on both ends and may be mounted with either end next to the panel to provide clockwise or anti-clockwise movement, as desired.

Usage: For any purpose where a variable capacity is required, particularly for tuning the high-frequency stages of a radio receiver.

Outstanding features: Compact. Electrically efficient. Removable shaft. Good tuning characteristic.

Maker: United Scientific Lab., Inc.



A Choke for Use in Power Amplifiers or Power-Packs

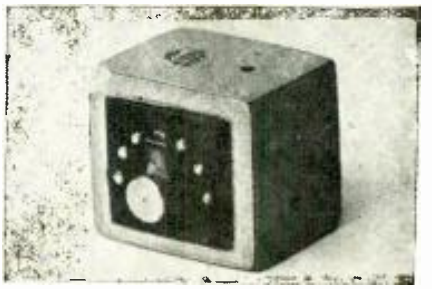
Name of instrument: Audiochoke (low-frequency choke).

Description: This choke consists of a large iron core and coil winding of high inductance and comparatively low direct-current resistance. It is inclosed in a metal case of exactly the same size, shape and finish as the Superaudioformers, types No. 27-A and 27-B. This choke is capable of handling up to 60 milliamperes and at this current has an inductance of 32 henrys. At 50 milliamperes DC the inductance is 36 henrys and increases to 50 henrys at no DC load. The DC resistance of the choke is 575 ohms, and it will withstand up to 500 volts continuously.

Usage: In power amplifiers or in the filter systems of "B" power-packs, with voltages up to 500, and currents up to 60 milliamperes.

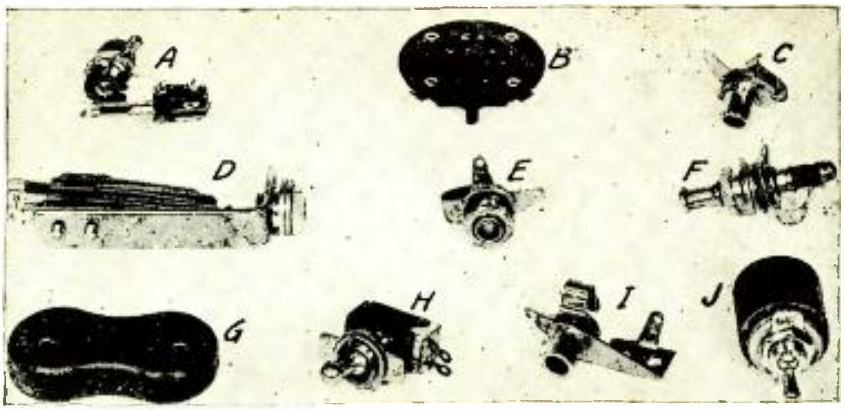
Outstanding features: High inductance and high current-carrying capacity. Good design and construction.

Maker: Pacent Electric Co., Inc.



ANOTHER "SMALLEST" SET

This addition to the long succession of Lilliputian radio receiver models measures less than one inch square, although it uses 35 feet of wire. Ordinary pins do the work of tuning points. It is the work of Harold C. Palm, of Cherokee, Ia.



Small Parts for the Set Builder

Name of instruments: Radio connection and switching devices.

Description: (A) A panel mounting type of single-pole, single-throw switch. The frame is of metal. The contact members are of spring metal and are well insulated from each other by composition material. The switch is intended for single-hole, panel mounting and is operated by a rotary knob.

(B) A valve socket that is intended for mounting on the under side of a receiver sub-panel. It consists of a molded composition body on which are riveted the contact springs. These springs extend beyond the body to serve as soldering terminals, thus providing one-piece terminals. Mounting holes are provided in the body to permit the use of either one or two mounting screws or rivets.

(C) A panel mounting jack that is mounted by means of a single machine screw and nut. It is extremely simple in construction and compact in size. The insulation is thorough, and terminals are provided in the form of soldering lugs which are extensions of the contact elements.

(D) A standard panel-mounting jack. This consists of a strong metal frame with the usual screw bushing for attachment to the panel by means of a single hole. The contact springs are solidly anchored and thoroughly insulated. These springs are heavy and provide strong contacts. The jack illustrated is a double-circuit, filament control type, for use in the first low-frequency stage of a receiver.

(E) Another small jack which is mounted on the panel in the same manner as the large standard jacks. When mounted in position it extends back only a half inch from the panel and is therefore convenient for use where space is limited. Good substantial contact is provided. It is connected into the circuit by means of one-piece lug terminals.

(F) This push-pull battery switch consists of the jack (E) with a brass plunger. The plunger is equipped with an insulated collar so arranged that when the plunger is pushed in the collar comes in contact with one of the terminals of the jack and breaks the circuit. When the plunger is pulled out it short-circuits the jack terminals and permits the current to flow through the circuit.

(G) This extension cord connector consists of a composition block inside of which are four spring receptacles for phone tips. These receptacles are connected together in pairs so that an extension cord may be connected to the ends of the loudspeaker cord by inserting the reproducer terminals in the holes in one end of the connector and the extension cord terminals in the corresponding holes in the other end of the connector.

(H) An extremely compact battery or power switch of the "toggle" type. It is mounted on the panel of a receiver by means of a single hole and is equipped with a marker plate which fastens under the nut on the panel front and bears the designations "off" and "on". The current is turned "off" and "on" by pushing up or down on the small lever which projects in front of the panel. The overall size of the portion behind the panel is approximately ¾ inch by ½ inch. The parts that appear on the front of the panel, including the bushing, nut, lever, and marker plate, are all nicely finished in gold. It may be used in power lines to carry up to 3 amperes at 125 volts and is approved by the Underwriters Laboratory for this use.

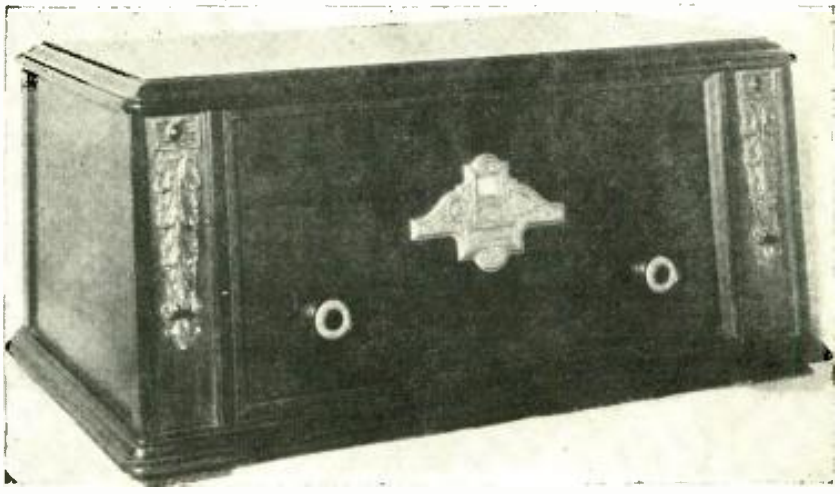
(I) This single circuit jack is designed for baseboard mounting. The jack itself is identical with that described in C above but has an extension frame with two screw holes for use where the jack is to be attached to the baseboard instead of to the panel of a receiver. Especially useful in making experimental layouts and in other experimental work where no panel is used.

(J) Another toggle switch for controlling the filament supply. This switch consists of a composition barrel which incloses the contact elements. Terminals are provided in the form of screws at the back of the switch. It is equipped for single hole, panel mounting and has an "off-on" marker plate. Metal parts are finished in nickel.

Usage: For various switching and connections purposes in a radio receiver.

Outstanding features: All rugged in construction. Well finished. Neat in appearance. Compact in size. Extremely moderate in price.

Maker: Saturn Mfg. & Sales Co., Inc.



A Receiver With Real Single Control

Name of instrument: Pfanstiehl Overtone Receiver, Model 30.

Usage: For radio broadcast reception.

Outstanding features: Absolutely single-control tuning. Highly sensitive. Good selectivity. Attractive appearance.

Description: This six-valve receiver employs three stages of tuned high-frequency amplification, a detector and two stages of transformer-coupled, low-frequency amplification.

In external appearance the receiver is somewhat unusual. It conveys an impression of massiveness without actually being so, and this lends an added attractiveness. The entire cabinet is of American black walnut, carefully selected for graining. A hand-rubbed finish brings out the natural beauty of the wood.

The front panel is of the same material as the cabinet and is inset between narrow side panels embossed with decorations finished in bronze. The front panel contains a gold-plated escutcheon plate located slightly above the panel center, and contains the small window through which the calibrated tuning drum is visible. At the lower left-hand corner of the panel is a round wood knob with a gold decoration that controls the combination volume control and filament switch. A similar knob at the lower right-hand corner is the single tuning control.

One of the decided advantages possessed by this receiver is the absolute simplicity of operation. The lower left-hand control knob is given a slight turn to the right to turn "on"

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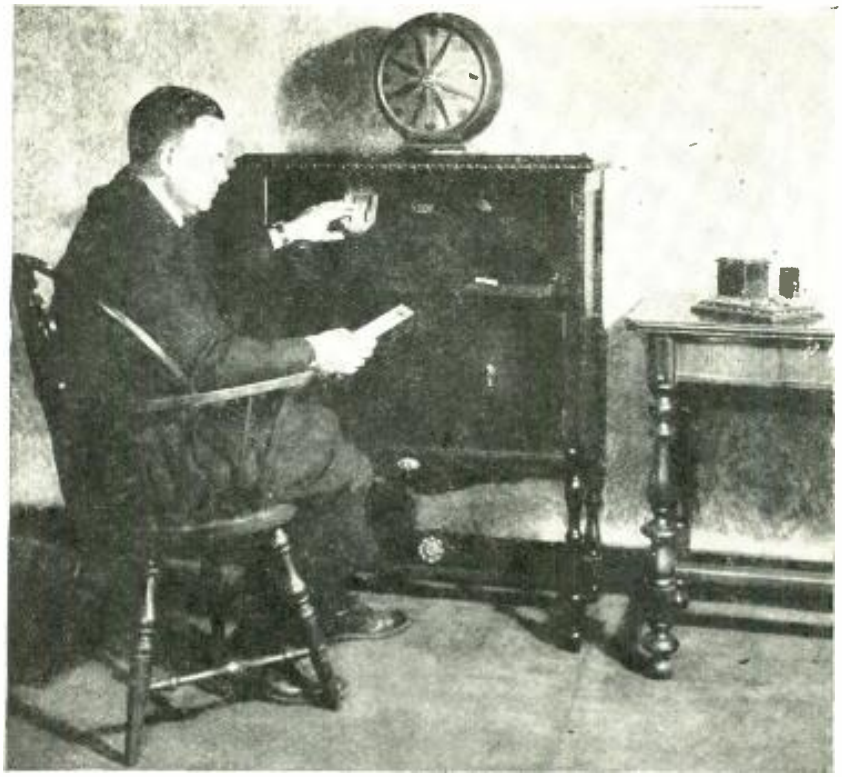


THE COMPLETE LC-28 IN ACTION

The LC-28 high-frequency pack, installed as shown here in a Corbett console cabinet, with the power-pack amplifier in the lower compartment, leaves nothing to be desired, either in quality results or outer appearance of the receiver.

QUALITY AND VOLUME ARE ASSURED WITH THIS

LC-28 AMPLIFIER

Here is the second of a series of articles giving hook-up combinations for the LC-28 high-frequency pack. The Amertran power-pack amplifier, employing the system of amplification that proved so popular with the old LC-27, is used in an improved form to obtain even more astounding results with the LC-28. An additional feature of this hook-up is that it may be used with the new light-socket antennas.

By LAURENCE M. COCKADAY

LAST year there were, literally, thousands of radio fans who built the LC-27 receiver incorporating the famous Amertran low-frequency amplification.

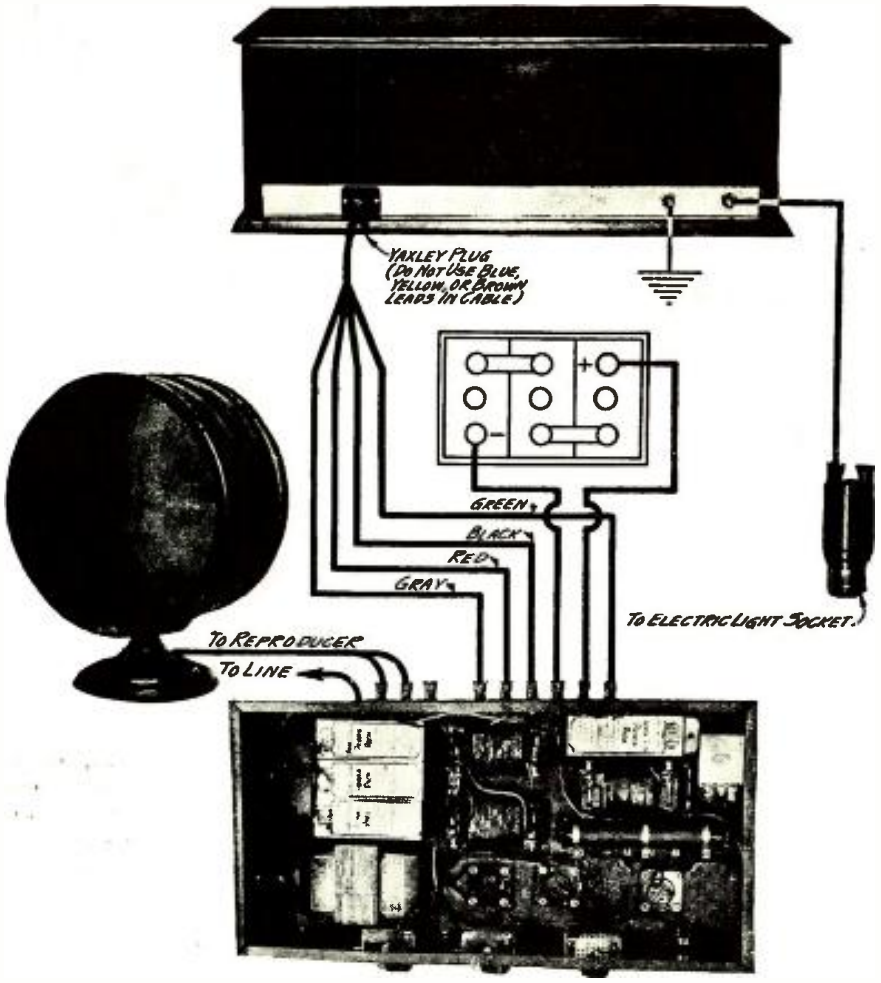
This year there have been numerous requests for a power-pack amplifier for the LC-28 corresponding to that used with last year's set.

In the October, 1927, issue of POPULAR RADIO was described an improved Amertran power-pack amplifier consisting of two stages of transformer-coupled, low-frequency amplification supplied with current through a power transformer and a rectifier and filter system, all completely contained in a neat, metal compartment that shields the instruments and at the same time protects the operator from shock. This amplifier was described as an addition to an old receiver, but works admirably with the LC-28.

When this unit is used with the LC-28 high-frequency pack really amazing results may be obtained in the way of quality of reproduction and volume.

The complete power-pack amplifier carries three control knobs on the front that may be set once and left adjusted. These are the only adjustments that are necessary, and once installed the set will function without any more fuss than turning "on" and "off" the filament switch.

In Figure 1 is shown a combination diagram in the top portion of which is seen the back view of the LC-28 high-frequency pack installed in a standard Corbett cabinet. At the left is shown the Yaxley plug with its leads that connect to four of the binding posts on the power-pack amplifier. The storage battery is connected directly to the power-pack amplifier, and indirectly



HOW TO MAKE THE INSTALLATION

FIGURE 1: *This combination diagram shows the back of the LC-28 pack, installed in the Corbett LC-28 Cabinet. The connection between the Yaxley plug and the power-pack and the single storage battery is indicated in black lines. In this combination a light-socket antenna is recommended; a Temple exponential horn is used for the reproducer. The battery and the power-pack amplifier may be placed underneath the set in the compartment of the radio table.*

through a relay in this unit to the vacuum valves in the set.

At the right end of the set is shown the antenna connection. A light-socket antenna, such as the Dubilier Ducon, is recommended as an antenna, although any other type may be used, if desired.

There are two binding posts on the Dubilier device and it may be found that one or the other is considerably the better for the antenna connection. Or again, it may be found that both of them may be used, connected by a single wire. Also, it may be found that reception is improved by turning "on" the switch of the socket into which the device is inserted. On the other hand, reception may be better with the switch turned "off." This can only be determined by experiment.

Two connections, of course, run from the reproducer to two binding posts on the power-pack amplifier, and the extension cord and plug on the power-pack amplifier is to be inserted in a lamp socket of the 110 volt, 60 cycle lighting lines.

In using the set the switch rheostat on the set itself should be left set at the "on" position all the time. The set should then be turned "on" and "off" by the switch on the power-pack amplifier, which controls all the vacuum valves in the set and the amplifier as well.

In the set-up shown in Figure 1, a radio table with a compartment underneath may be used, with the storage battery and the power-pack amplifier placed in this compartment, and with the Yaxley cable running up the back to the LC-28 cabinet on the top.

In the illustrations a Baldwin "99" reproducer and a Temple exponential horn are pictured as representative of the types of loudspeakers that have been found suitable for use with this type of set. The reproducer should preferably be connected by a long extension cable and placed on the other side of the room from the receiver, or in any other position where the quality of reproduction sounds best.

If a trickle charger is to be used with the storage battery, its lighting plug may be inserted directly into the relay in the power-pack amplifier marked "trickle charger." This will make the battery charging an automatic feature needing no attention or care on the part of the operator except adding distilled water 2 or 3 times a year. The Westinghouse Rectox trickle charger has been found very suitable.

The three adjustments on the front of the power-pack amplifier, spoken about earlier in this article, are intended to control the "C" bias on the first and second stages of low-frequency amplification, and to control the detector plate voltage.

The first control shown at the left in Figure 1 is for adjusting the "C" bias on the power valve in the last stage of amplification, which is a 210 type valve. The center control is for adjusting the "C" bias on the first-stage valve, which may be a standard 201-a type valve. The control on the right adjusts the plate voltage of the detector valve and may usually be set all the way "clockwise."

The adjustment for the "C" bias on the last valve is usually left nearly all the way "anti-clockwise." The center control may be varied and the proper adjustment will probably be found somewhere along the middle of the range.

The use of the new 281 type rectifier valve, in place of the older style 216-b rectifier valve, gives increased "B" voltages and added power for the operation of the 210-type power valve. This results in improved quality and allows a greater volume to be obtained with less distortion than in the unit used with the old LC-27 receiver.

The fact that the power-pack amplifier contains an automatic relay switch greatly facilitates the automatic operation of the receiver as a whole, and takes care of the charging of the "A" battery, as explained above.

The complete apparatus may be assembled as indicated in Figure 1 and installed neatly without unsightly wires or complicated switching arrangements that would have been necessary with the more old-fashioned combinations.

This same apparatus may be assembled in a regular Corbett Console type cabinet, as shown in the illustration at the head of this article, if desired.

When once assembled and adjusted the LC-28 with this power amplifier will give the highest type of reproduction. will be easy to operate for both distance and local reception, and will have an appearance on a par with that of the most expensive of the factory-built receiver.

An *SOS* Message That Sends Itself

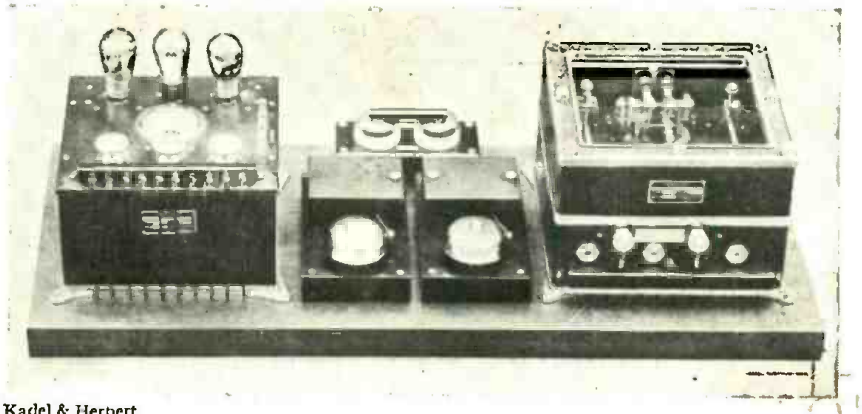
THE tedious vigil of the marine radio operator has been made more or less unnecessary through the perfection of an electric automaton that sends and receives SOS signals. For a number of years the British Marconi Company has been working on the problem of relieving marine operators of the necessity of constant and worrisome vigilance; and this research has culminated in the perfection of a device which not only automatically sends SOS signals, but causes an alarm bell to ring on all ships equipped with the special alarm receiver.

The conventional SOS signal is preceded by a series of three four-second dashes. The receiver is so constructed as to respond only to this combination of extra long signals.

The operator of a distressed vessel need only press a button and there is immediately broadcast a series of these long dashes, followed by the SOS signal, so that ships not provided with the special receiver may be warned.

The "key" consists of a clock-driven mechanism which actuates the regular transmitter of the ship through contacts on a segmented drum. The receiver is a three-valve set of a conventional design, the output of which is connected to an especially sensitive relay. This relay controls the local supply of current connected to the electric bells.

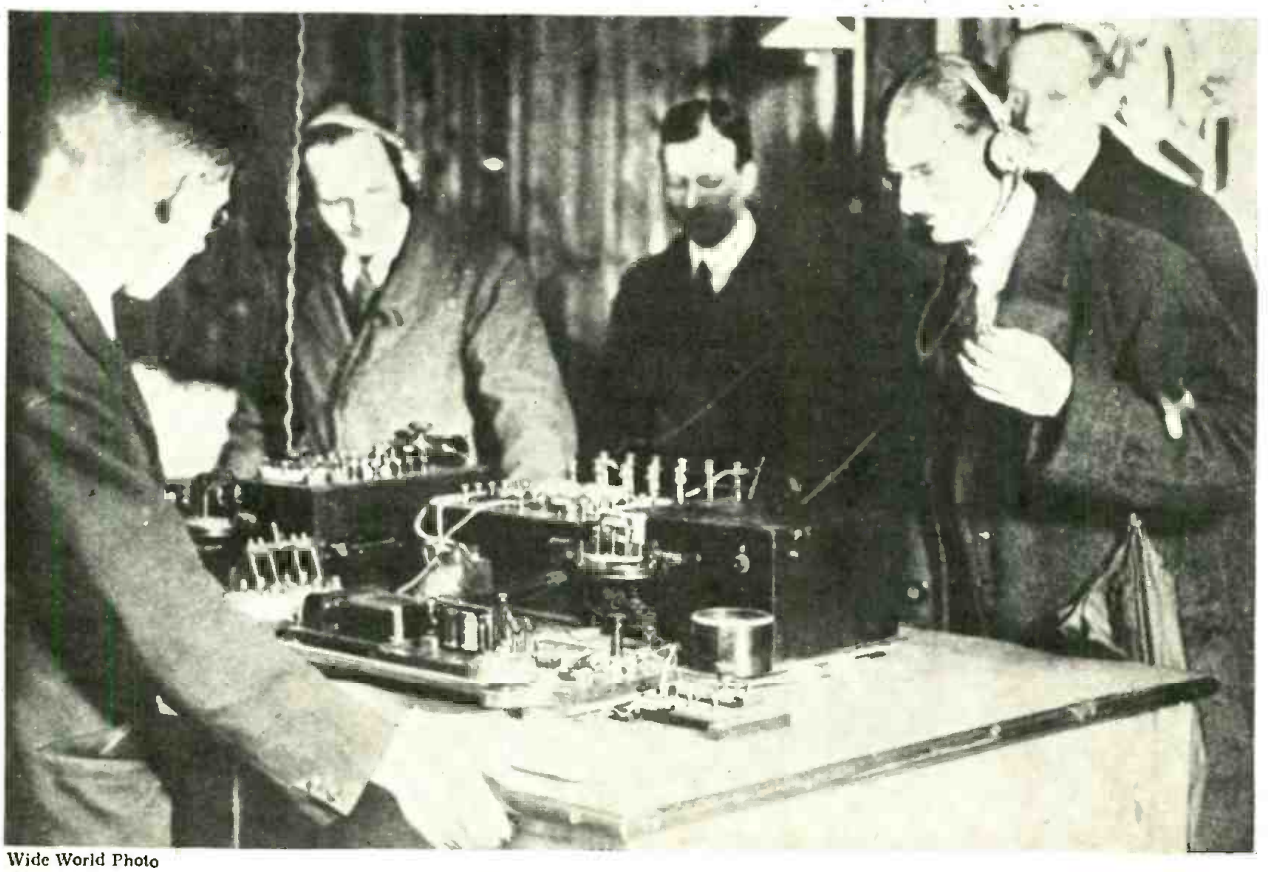
A special selector is used in connection with the receiving instrument and it is the function of this device to properly interpret the four-second dashes, so that it will automatically pick them out of the maze of signals that happen to be vibrating the ether and convert them into the impulses necessary to actuate the relay and, in turn, the electric bell which is located in the operator's cabin.



Kadel & Herbert

A KNOBLESS RECEIVER THAT TUNES ITSELF

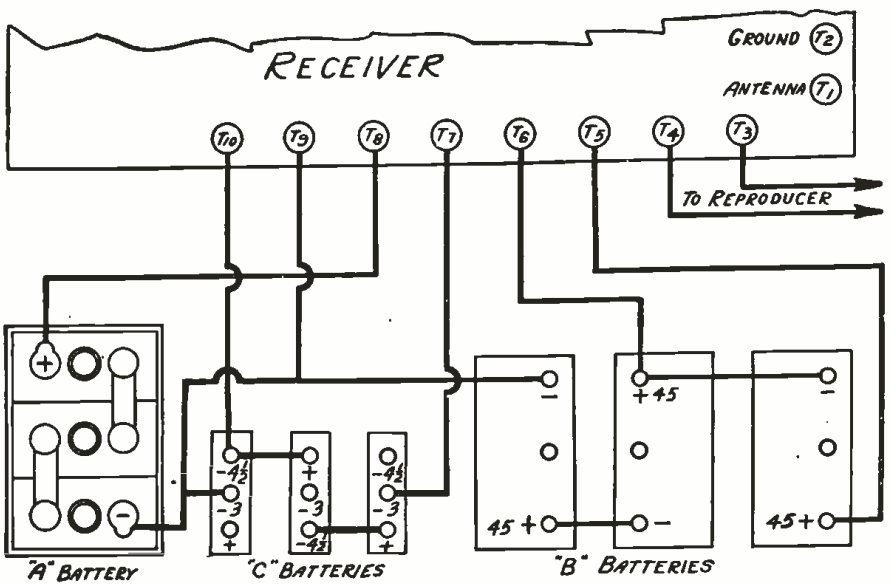
This picture shows the automatic receiver and special relays used to control the electrical current that rings the automatic alarm. The receiver will be seen at the left, and the delicate relays to the right. The alarm bells are between the two instruments.



Wide World Photo

A PRACTICAL DEMONSTRATION OF "HUMANLESS" RADIO

Here is a group of European engineers at an experimental demonstration of the automatic SOS equipment developed by the British Marconi Company. In almost the exact center of the picture one of the sensitive relays used to operate the bells may be seen uncovered.



A REVISED BATTERY HOOK-UP FOR THE RECEIVER

FIGURE 1: *If the "C" battery connections for the Lynch "Five" are carried out as shown in this diagram, there will be a considerable improvement in reproduction as compared with the hook-up given in the article in the November issue of* POPULAR RADIO.

OPERATING POINTERS FOR THE

LYNCH "FIVE"

Here are some hot tips, for the fan and experimenter alike, that will make the Lynch "Five" as phenomenal in operation as it was easy and inexpensive to build.

By S. GORDON TAYLOR

THE low cost and simplicity of construction of the Lynch "Five" receiver, as described in the November issue, will offer a strong inducement to many inexperienced radio fans to try their hands at assembly and construction. To these, and also to more experienced fans who have built this receiver because of its fine tone quality, this article on the operation of the receiver will be helpful. Some worthwhile pointers as to equipment are also incorporated in it.

The directions for putting the Lynch "Five" receiver into operation were given briefly in the November issue and there is no need for repeating them here. However, attention should be called to one change in the battery hook-up. Where the Ce-Co type F semi-power amplifier valve is used in the last low-frequency stage, the "C" bias voltage should be nine and the "C" bias applied to the first and second low-frequency stages should be 1½ instead of 4½ volts. The correct connections are shown in Figure 1.

If the Ce-Co type J-71 valve is to be used in the last stage, the battery connections as shown in the November issue are correct, although even in that case 1½ to 3 volts would be better for the first two low-frequency stages, instead of 4½ volts. If the J-71 valve is used, its greatest worth is obtained by applying 180 volts to its plate instead of 135, and this would call for increase in the "C" voltage to about 40 instead of the 27 volts shown originally.

An output filter should always be used where the plate voltage on the output valve is over 135. It is not necessary that the filter be incorporated in the receiver itself. One such as the National Tone Filter is sufficiently neat in appearance to be placed on the table next to the receiver, if desired, without marring the appearance of the installation.

For all ordinary purposes the type F power valve will be found adequate and it has the advantage of low current drain. With this and the other four valves specified in the original article the total current consumed from the "B" batteries is only 12 milliamperes per hour and the life of a set of standard "B" batteries, according to tables computed with Eveready batteries, will be many months.

Where the J-71 power valve is used, either a "B" power-pack or heavy duty "B" batteries should be used, because of the higher plate current requirements of this valve.

A combination which constitutes very nearly an ideal filament power source was used with one of the models of this receiver. It consists of a trickle charger and a glass-inclosed storage battery with a built-in charge indicator. The trickle charger used is unique in that it uses neither bulbs nor liquids for the rectifier; it provides a tapering charging rate and it includes a built-in relay switch. The rectifier included in the charger is the new "Drirex" cartridge. With this rectifier the trickle charger requires no attention whatsoever and the rectifier life is practically indefinite and is guaranteed for a minimum of 4,000 hours' service.

In operating the receiver the rheostat should never be turned more than four-fifths of the way "on," otherwise the voltage applied to the valve filaments will be excessive. About two-thirds "on" is a good normal operating position.

If there seems to be an excessive tendency toward oscillation, it will be well to reduce the voltage at the rear terminal, T6, shown in Figure 1, to 67½ volts. This applies a lower voltage to both the high-frequency and the detector valves and will provide just as good results as the full 90 volts in most cases—with lower "B" battery consumption. Tighter coupling in the antenna coupler will also help to stabilize the circuit, particularly where a very small antenna is used.

The best settings for the rotors of both coupling coil units should be found by experiment and then the rotors should be left in that position. Any considerable change in the adjustment of these will change the condenser dial settings for a given wavelength or station, and will therefore interfere with the accurate "logging" of the dial settings. The rotor of the antenna coupler should be adjusted as nearly parallel with the windings of the stator as practicable without sacrificing selectivity. The rotor of the detector coupler should be left in a position a little below that where the detector goes into oscillation. This latter will require some adjustment from time to time to serve as a sensitivity control, but for volume control it is quite as simple to detune slightly one of the tuned circuits.

From a photograph made for POPULAR RADIO

HOW TO TURN DOWN A METAL ROD

FIGURE 1: *Here the operator is shown turning down a rod by the use of the slide rest. "A" is the work to be turned, "B" is the cutting tool and "C" is the tool post which holds the cutting tool tightly clamped in the proper position.*

Your Laboratory Tools

ARTICLE NO. 4

The metal-turning lathe puts the ingenious home experimenter on equal terms with the manufacturer, as far as accuracy and quality in metal work goes. This article tells the experimenter how to use it.

By LOWELL MADDEN, JR.

ALTHOUGH metal-turning on a lathe may strike the novice as being very easy, there are a number of details that have to be mastered before proficiency or anything like accuracy may be attained.

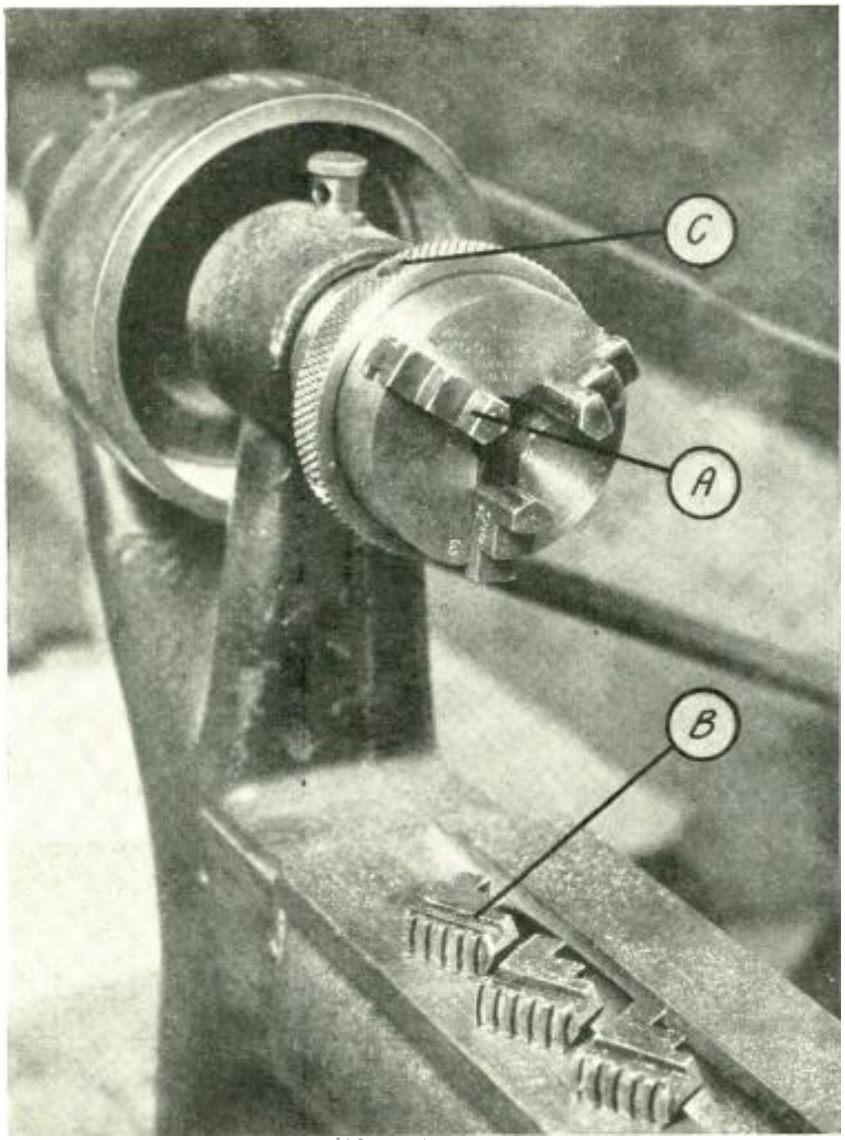
True, the principle of turning is simple; perhaps even the rankest dabbler could chew a piece of metal out on a lathe—but he would have much to learn and much experience to gain before he would gain skill enough to call himself even a third-rate machine hand.

This remark, however, should not tend to dishearten the beginner, providing he doesn't assume too much and is willing to take a few practical suggestions.

It is presumed that the reader knows that turning is accomplished on a lathe by the aid of a cutting tool coming in contact with metal revolving in the lathe.

Naturally enough, the lathe tool must always be harder than the metal being cut. One could not hope to cut down a file, for instance, because files are made out of extremely hard steel, and the ambitious turner of files would find that the edge of his lathe tool would be worn off as fast as he sharpened it. The lathe tools purchased on the market, and especially those provided for use with this particular Goodell-Pratt lathe, are sufficiently hard to cut any of the common metals except hardened steel. Cold rolled steel, which is comparatively soft, is easily machined.

Before a piece of work can be mounted for turning, the operator must



THE SCROLL CHUCK READY FOR WORK

FIGURE 2: *Here is a little scroll chuck mounted on the live spindle. The knurled ring, "C," is used to cause the chuck jaws, "A," to move in and out. At "B" the reader will see illustrated the outside jaws of the chuck, which may be inserted for the purpose of holding larger work.*

provide means for centering it in the lathe. It should be understood that bearing surfaces must be produced so that the work will revolve between centers without danger of chattering or moving out of position. Where accurate work is essential, good centers are extremely important.

Perhaps the first warning to impress upon the experimenter is the obvious possibility of making the wrong kind of a center hole.

We see this illustrated at A in Figure 6. This is the kind of a center that would result if the workman used an ordinary drill for the center hole. As the illustrations shows, the bearing surface will be very small; after making a few revolutions this surface will wear down and the piece revolving in the lathe will have a tendency to chatter and to work itself out of position when the cutting tool is brought in contact with it. Even the superficial student of metal working will see that it is impossible to turn the work accurately if this condition exists. It is bad not only for the work but for the dead center as well.

There is such a thing as a "centering drill." This is a special drill which produces a conically-shaped hole or bearing surface that corresponds exactly with the angle of the center, thereby providing a bearing surface similar to that illustrated at B in Figure 6. Such a bearing, well oiled and with the dead center pressed tightly into it, is necessary for accurate turning.

But how is the mechanic to find the exact center of a piece of rod, for instance?

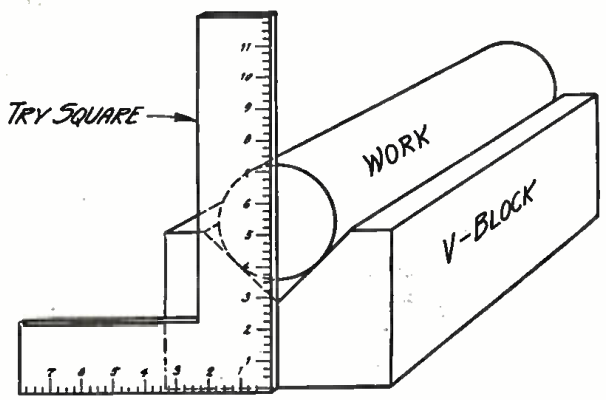
This must be done before the centering drill can be employed. Of course, when a heavy cut is being made along the entire length of a rod it is not so important that the exact center should be found, as the work will center itself after the cutting progresses.

For such a center, the kink illustrated in Figure 7 may be employed.

Here four lines are scratched on the end of the work by the use of a compass. The mechanic may then find the approximate center of the area enclosed by these scratches.

Another good method of locating the approximate center and a method more accurate than the one previously described is presented in Figure 9. Here what is known as a "bell center punch" is employed. The use of this is so obvious that no further description will be necessary.

A third method, and one that is perhaps as accurate as any, is shown at Figure 3; here what is known as a "V-block" is used. The rod is placed in the groove of this block and a square is brought into position so that it lines up with the exact bottom of the groove. A scratch is made on the end of the rod and the rod is then turned approximately 90 degrees and another scratch made. Almost the exact center will be found at the point where these scratches intersect.



FINDING THE CENTER WITH A V-BLOCK

FIGURE 3: *By scratching two lines at right angles to each other, almost the exact center of a round rod may be found.*

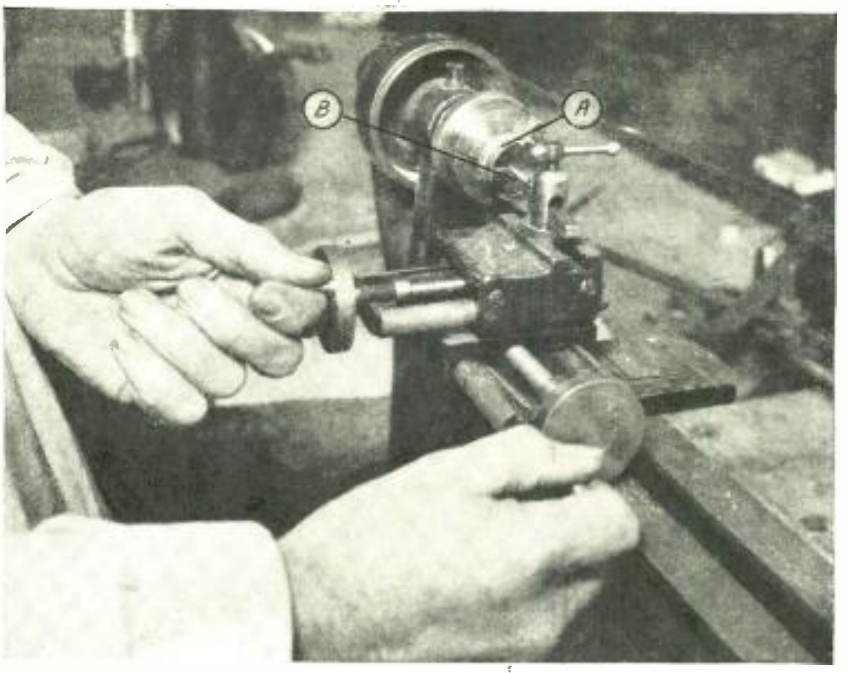
Figure 1 shows how the work is mounted between the lathe centers. First the slotted face-plate is screwed in place on the live spindle of the lathe. One of the two lathe dogs (which were described in the second article of this series) is placed over one of the ends of the rod. The projecting arm of the lathe dog is permitted to rest in one of the slots of the face-plate and the large center (that is, the live center) of the lathe is inserted in the live spindle. Naturally the opposite end of the rod is held in position by the dead center. A good dose of oil should be placed on the dead center bearing.

The next job in the work of arranging the set-up for turning is that of putting the slide rest in place. A clamping bolt which projects up through the center of the lathe bed and emerges in a slot in the bottom of the slide rest is used for this purpose. This slide rest is made up of three principal parts; one is held permanently to the lathe bed by the clamping bolt just mentioned. The position and movement of the other two parts are controlled by two feed screws; one moves the cutting tool parallel to the axis of the work revolving in the lathe and the other moves at right angles to it. Thus the tool may be moved up and down the work and into the work.

There is a slot provided on the top of the slide rest for the tool post. The tool post is that part of the slide rest which grips and holds the cutting tool in the proper position. Close examination of the Figure 1 will show that the tool post is also provided with a clamping screw. Means are also provided so that the angle of the cutting tool may be adjusted. (The importance of this adjustment will be discussed later.)

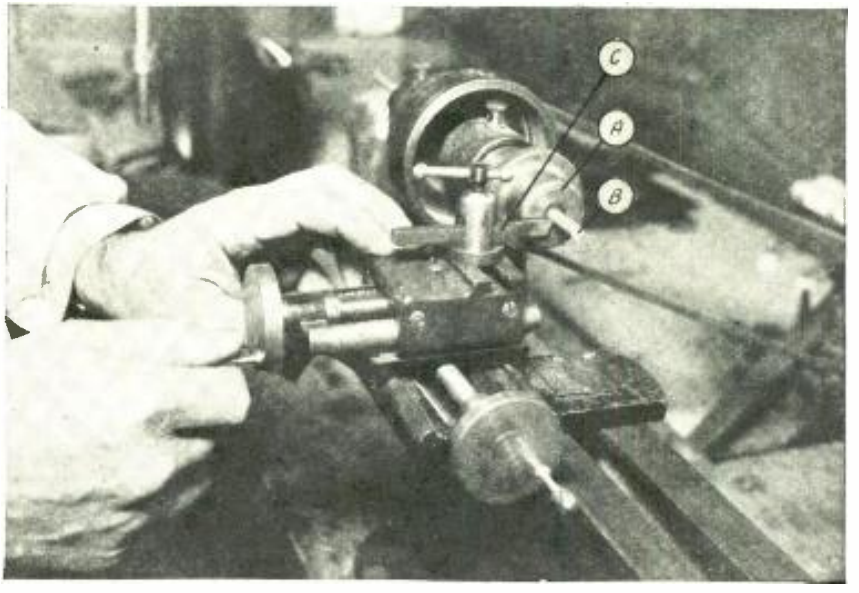
A good mechanic always examines a lathe tool before he uses it. First, he wants to know if it is shaped correctly, and secondly, he wants to assure himself that it is sharp. If it is not sharp he must know how to sharpen it. The first thing to learn in sharpening a tool is not to burn it. If it is left in contact with the grinding-wheel for too long a period it will turn blue and lose its hardness. A small receptacle of water

(*Continued on page 456*)



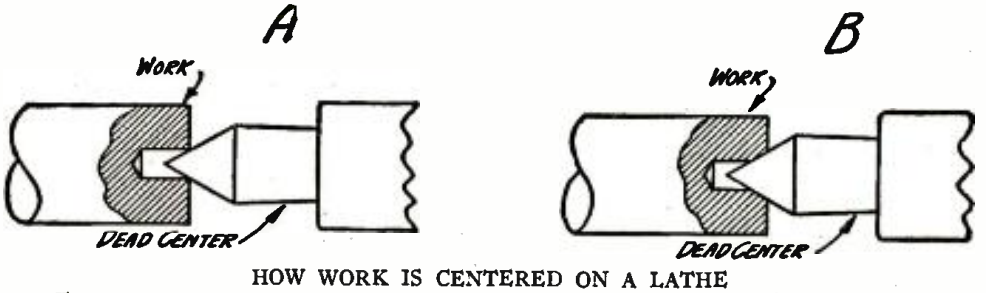
USING A SCROLL CHUCK FOR INSIDE TURNING

FIGURE 4: *Here the scroll chuck is used to grip a large brass tube, the inside of which is to be turned down. "A" is the work and "B" the cutting tool which, in this case, takes the form of a boring tool with the cutting edge at right angles to the body of the tool.*



MAKING USE OF THE COMPRESSION CHUCK

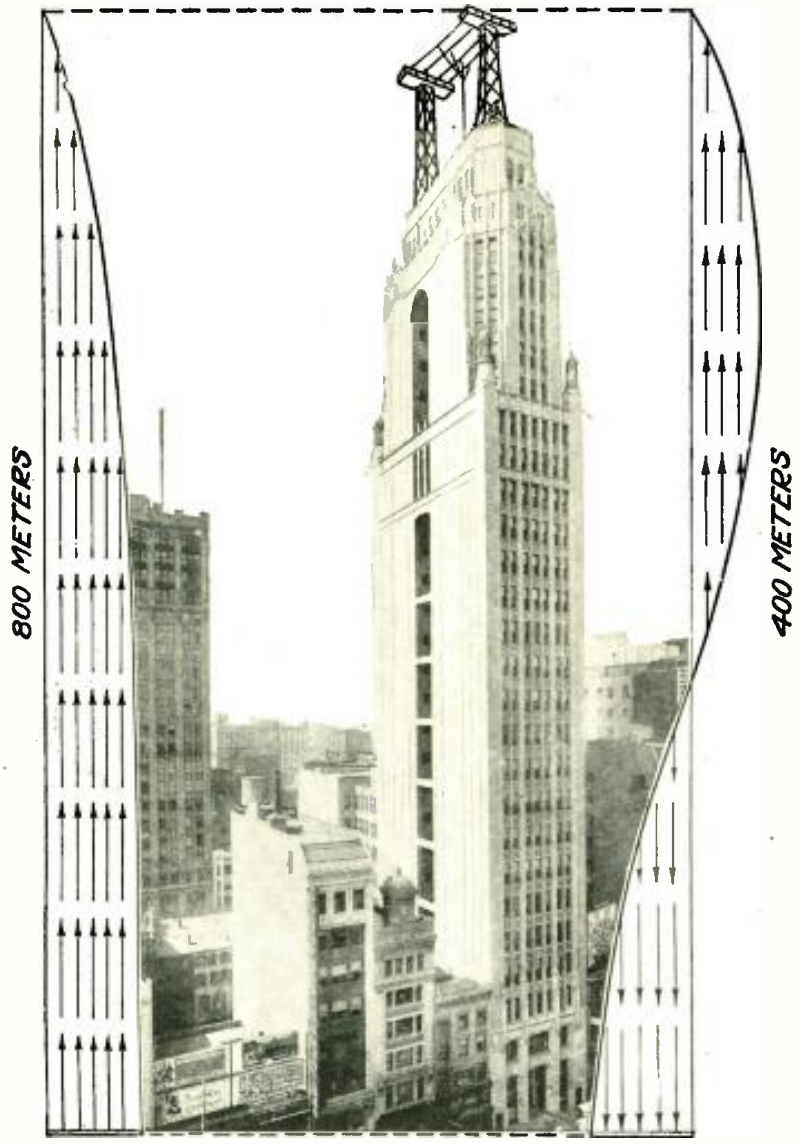
FIGURE 5: *Here the compression chuck is being used to cut off lengths of metal rod. The rod to be cut is illustrated as "B," while "A" is the compression chuck and "C" the cutting-off tool.*



HOW WORK IS CENTERED ON A LATHE

FIGURE 6: *At "A" the incorrect method of providing bearing surface is illustrated, while at "B" the proper method is shown.*

If You Live in a Building



HOW A SKYSCRAPER MAY REINFORCE OR IMPEDE RADIO WAVES

FIGURE 1: *A building such as the above one, that employs a steel supporting framework, acts as a secondary antenna for transmissions broadcast from its roof. If the wavelength of its natural frequency corresponds to the wavelength of the broadcasting antenna, the rein forced wave at the left is the result. If the two are out of phase, the result is poor transmission efficiency, as indicated on the right.*

Electrical energy radiated from broadcasting stations is absorbed by modern skyscraper construction—which directly affects radio reception. This article tells how experiments are locating and removing this particular problem of the listeners.

By R. W. KING

TO the broadcast listener in the city, one of the most vital factors in radio reception is the effect of tall steel buildings upon reception.

During the past few years, while the American Telephone and Telegraph Company was interested in broadcasting, its engineers made an extensive study of these problems* and many of their data are now in a form suitable for publication. These studies divide into two parts; first, the effect of tall buildings on the location of a transmitting station, and second, the effect of these buildings upon the individual receiving set.

The location which naturally suggests itself for a broadcasting station intended to serve the city is its center. A central location might be expected to deliver waves of the greatest strength to the greatest number of listeners.

The erection of a broadcasting station in the heart of a large city ordinarily means, however, that its antenna must stand on the top of a tall steel building. This has been done for a number of stations in various cities. Station WBAY was probably the first of this kind; it was originally erected on top of the twenty-four story long-distance telephone building at 24 Walker Street, New York City.

With this location it was found that with the limited wavelength range then open to broadcasting, radiation from the antenna was relatively poor. Careful measurements of the signal strength as received at a testing laboratory some 30 miles away (Cliffwood, N. J.) gave the results shown in Figure 4.

The wavelength upon which WBAY was operating as a broadcasting station was 400 meters. For the purpose of conducting the tests summarized in Figure 4, an experimental license was obtained, permitting operation over a rather wide range of wavelengths. As the curve shows, the signal strength radiated from WBAY was variable and dropped to a very low value at 400 meters. This was exactly the wavelength assigned to the station for broadcasting purposes. When it became possible to shift to a longer wavelength, radiation was, of course, greatly improved, as indicated by the curve.

The study made on this station was the first to disclose the fact that it is possible to have the supporting building too high for the efficient radiation of certain frequencies.

The electrical action of a tall steel building with respect to radio waves may be explained as follows:

City skyscrapers are immense steel cages or skeletons which are good conductors of electricity and form a suitable path for the flow of high-frequency electric currents. As electromagnetic waves are radiated from an ordinary antenna on the ground they advance outward and upward and touch the ground at their lower ends. At some

* See "Radio Transmission Measurements," by Bown, Friis and Englund, *Proceedings, Institute of Radio Engineers*, Vol. 11, 1923, and "Radio Broadcast Coverage of City Areas," by Espenschied, *Bell System Technical Journal*, Vol. 6, 1927.

With a Steel Framework—

distance from the station the wave fronts become practically vertical and the waves travel on, outward, with their feet on the ground and their heads somewhere above the clouds.

Now, when a station is situated on the top of a steel building the waves travel *down* the building as well as out horizontally. As they approach the ground, part of the wave energy is reflected back up the building and then interacts with later waves coming down.

The result is the formation of large oscillatory currents in the building structure; the distribution of these currents is determined by the height of the building and the wavelength of the radiated waves. If the dimensions of the building are such that one of its natural or free periods of oscillation corresponds closely to that of the wavelength one undertakes to transmit, it follows that the frame of the building, like any coupled resonant circuit, will draw heavily upon the power of the transmitter.

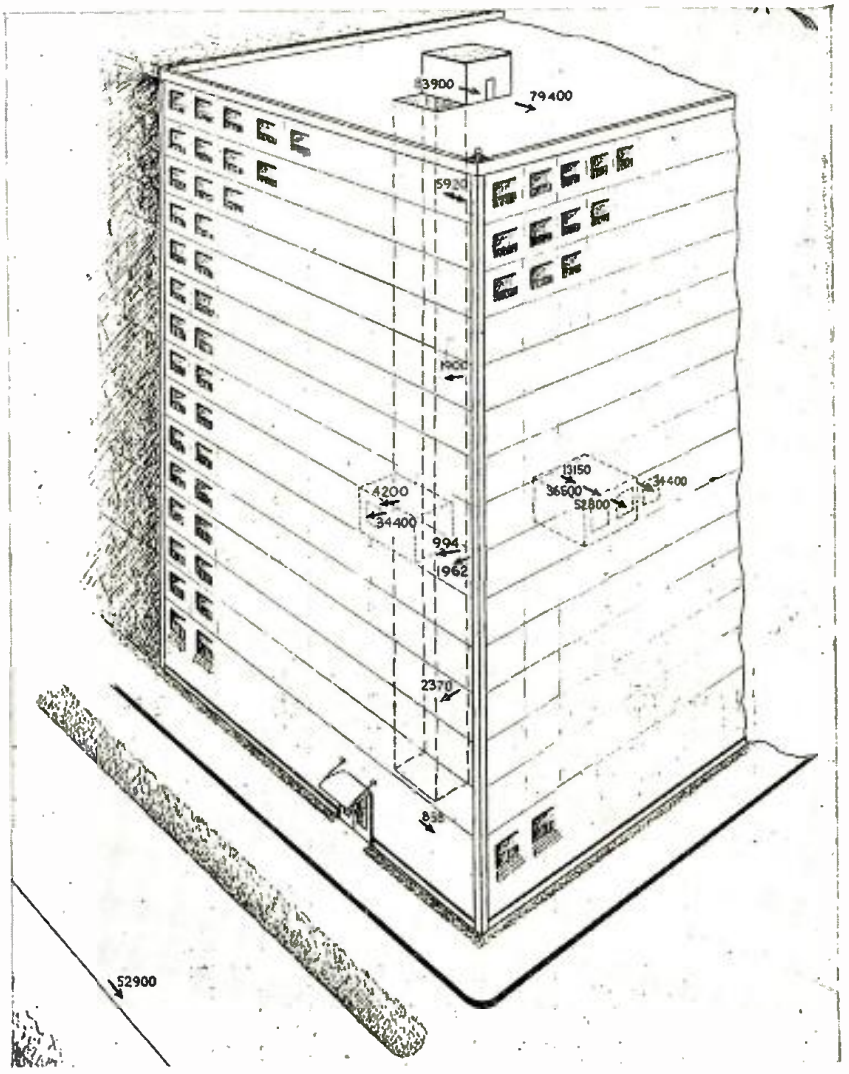
But, in addition to this, the building apparently acts as a secondary antenna, radiating a wave which may be more or less in or out of phase with the wave from the real antenna. If the two waves are out of phase, the net result at any distant point is, of course, a field strength less than that due to the single wave from the real antenna. On the other hand, if they are in phase, they augment each other and the real antenna shows up as being unusually efficient. Figure 1 illustrates this graphically.

Both of these conditions have been observed with signals sent from WBAY, as Figure 4 shows. In the neighborhood of 400 meters, the antenna was quite inefficient, while at about 800 meters it proved to be efficient.

As a result of the measurements made on WBAY, it was possible to predict the occurrence of a similar effect in the case of the antenna which the City of New York desired to erect on the Municipal Building. Temporary antennas were therefore erected and the signal strength from them was measured at the same testing laboratory at Cliffwood, N. J., using a small transmitting oscillator of 100 watts. The result of these measurements is given in Figure 5.

Radiation was found to be a minimum in the vicinity of 360 meters, which was very nearly the wavelength which was to have been assigned to the completed station. The station is now operating on 526 meters, which is seen to be well up on the radiation curve.

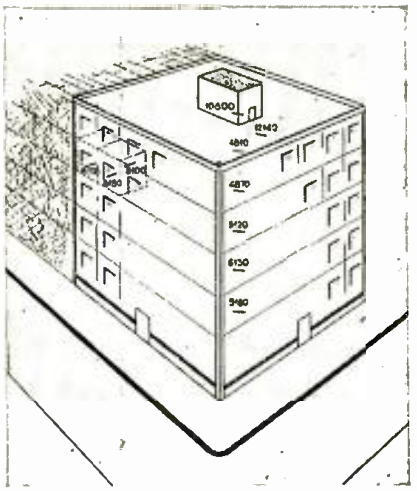
In both Figures 4 and 5 the signal intensity has been expressed in terms of microvolts per meter.



American Tel. & Tel.

HOW STEEL FRAMES ABSORB ELECTRICAL ENERGY

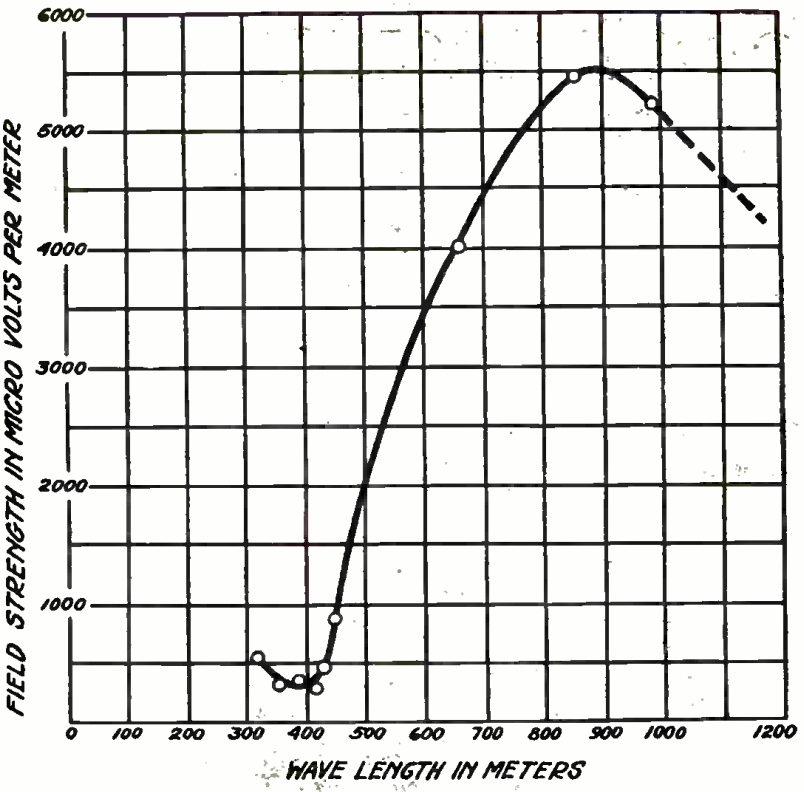
FIGURE 2: *An apartment house of this type that employs a heavy steel framework acts as an absorber of electrical energy from broadcasting stations, with the result that inside the building the field strength of a broadcasting station signals is only a small fraction of the field strength outside. The figures show the signal strength in microvolts per meter, as received in various parts of the building. Note how little energy reaches the inside rooms around the elevator shaft.*



RECEPTION IS BETTER WHERE NO STEEL FRAMEWORK IS USED

FIGURE 3: *This apartment house does not have a steel framework. Note that the reception inside is never less than one-half of that in the penthouse on the roof, while in Figure 1 the reception at some inside points is as low as 1 per cent of that on the outside.*

In the case of both the Walker Street telephone building and the Municipal Building, experiments were made with a number of different antenna arrangements and with different methods for exciting the antenna and obtaining the ground connection. None of the modifications, however, materially affected the frequency of minimum radiation. Measurements made upon lower build-



THIS GRAPH ILLUSTRATES HOW ONE STEEL BUILDING AFFECTED A BROADCASTING STATION

FIGURE 4: *At 400 meters WBAY'S field strength dropped to a minimum, due to absorption of energy by the steel framework of the building on which it was erected. At a higher wavelength the steel structure reinforced the wave energy and brought the field strength to a maximum.*

cated in Figure 6 of course discloses the distribution as measured in streets and open places. It does not disclose the signal intensity in the immediate vicinity of any indoor receiving set.

Perhaps the most difficult situation is that of the large apartment house, particularly where it is desired to receive by means of an indoor antenna. Two effects are here encountered:

First, the reduction in signal strength because of the shielding effect of the building; and;

Second, the existence of a relatively high noise level caused mainly by high-frequency interference from electrical systems within the building.

In general, it may be said that the chances of good reception in apartment houses are in favor of the man who pays the lowest rent. The four or five story walk-up apartment without elevator and without steel frame exerts no very serious influence upon radio reception within it. Measurements made upon a typical house of this type are given in Figure 3.

It will be noted that observations taken at the various landings of the stairway, which rises at about the center of the building, are only half as great as that taken out in the open on the roof of the building. Signal

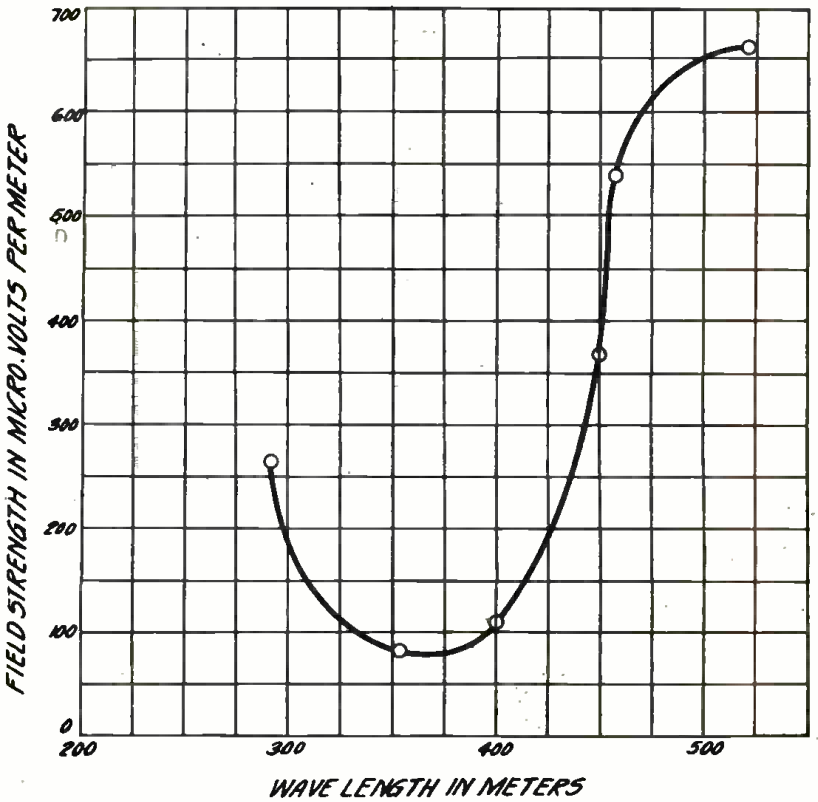
(*Continued on page 472*)

ings have shown that, for the usual broadcast wavelengths, heights of the order of two hundred feet are entirely satisfactory.

The alternative to locating a city broadcasting station within the heart of the city is to locate it well outside and provide it with such power that it can lay down a strong and fairly uniform field throughout the city itself.

Here again the presence of tall buildings asserts itself. These buildings are good absorbers of radio waves and therefore cast long shadows. The existence of such shadows has been recognized since the early days of broadcasting and has been described in other articles,* but to recall briefly the nature of the effect the reader is referred to Figure 6. The data represented in this figure were gathered by means of a portable radio transmitter on the one hand and a portable receiving and measuring set on the other. For the test shown, the transmitting station was located at College Point, Long Island, while the receiving set was carried on circuital tours around the transmitter. It will be noted that the tall structures of Manhattan Island throw a very decided shadow over into New Jersey.

The variation in field strength indi-

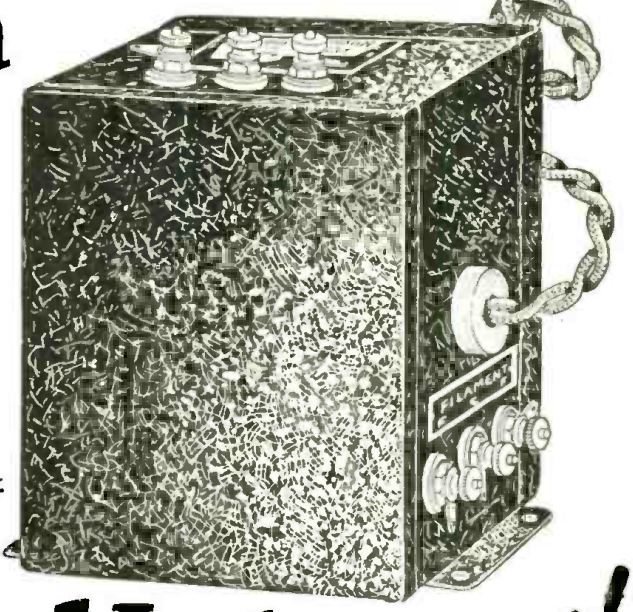


HOW A TRANSMITTER WAS "TUNED" TO A SKYSCRAPER

FIGURE 5: *This chart shows how the broadcasting station on the Municipal Building in New York City was out of phase with the steel structure at 350 meters and in phase at about 550 meters.*

* See POPULAR RADIO for September, 1925.

Build Your Own Power Amplifier



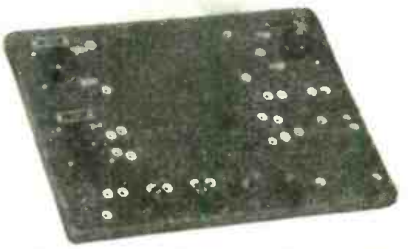
Transform your Receiver into a Real Musical Instrument!

R-210 Power Compact . $20

With a screw driver, a pair of pliers, and a soldering iron you can build a Thordarson Power Amplifier and B-supply in your own home that will equal the finest commercial amplifier on the market. Complete constructional booklet and simple diagram accompany every transformer.

Thordarson R-210 Power Compact

The Thordarson R-210 Power Compact is scientifically designed to give maximum electrical efficiency and to make home assembly of power amplifiers as simple as possible. The R-210 Power Compact is the foundation unit and contains the following apparatus: (1) A power supply transformer designed for UX-216-B rectifier; (2) Two filter chokes of 30 henries inductance and 65 M. A. current carrying capacity; (3) A 7½ volt supply center tapped for the filament of one UX-210 power tube. Wiring of the complete amplifier is simple—20 leads complete the assembly.



R-211 Metal Baseboard, including sockets, binding posts, mounting screws, and hook-up wire $5

New Metal Baseboard for R-210 Compact Amplifier

To further simplify home construction of the R-210 type amplifier, you can now buy this new crackled finished metal baseboard. All spring sockets and binding posts are mounted and included in the list price. All mounting holes are drilled. All holes for sub-panel wiring are carefully insulated. Location of all sub-panel wiring is marked under baseboard.

R-171 Power Compact . $15

R-171 Power Compact

This power compact is similar to the R-210 type, but is adapted for home construction of power amplifiers using the Raytheon BH rectifier and UX-171 power tube. Designed to meet the popular demand for a low priced yet highly efficient power amplifier. Delivers 320 volts either side of center to the Raytheon BH rectifier. The two choke coils are rated at 85 M. A. 30 henries. The filament winding of 5 volts center tapped is suited to one UX-171 power tube. Two 0.1 Buffer Condensers are also included in the case. Wiring the complete amplifier and B-supply is merely a matter of connecting 18 leads.

No. 2098 Power Supply Transformer . . $20

T-2098 Power Supply Transformer—T-2099 Double Choke Unit

Here is an extra heavy duty power amplifier supply that will satisfy the most exacting demands for excess power. An amplifier using this transformer and choke unit will deliver 425 volts at 130 M. A. drain, sufficient for the heaviest receiver using two UX-210 tubes in power push-pull. Transformer T-2098 delivers 550 volts each side of center tap and is designed to supply two UX-216-B rectifiers (full wave). The 7½ volt filament supply will easily handle two UX-210 power tubes. The double choke unit T-2099 consists of two 30 henries 130 M. A. choke coils mounted in a compound-filled case.

No. 2099 Double Choke Unit $14

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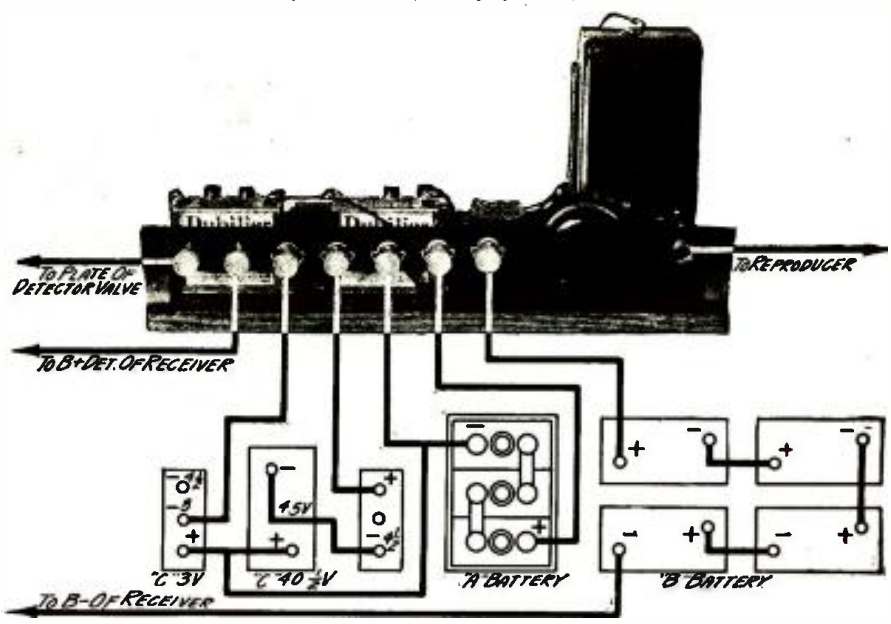
An Amazing Discovery in Resistance-Coupled Amplifiers

(Continued from page 420)



HOW TO HOOK UP THE AMPLIFIER

FIGURE 4: *With the amplifier hooked up to the batteries indicated in this diagram, amplification of surprising quality may be obtained.*

Next fasten the two single mountings, C and D, in position.

Then place the two condensers, M and N, against the single mountings and fasten with round-head brass screws.

Secure the amperite mounting with a flat-head brass screw.

Next place the low-frequency choke, O, with the terminals "away" from the binding-post strip and fasten down with two round-head brass screws.

Using the brass strap, Z, secure the large condenser P in position.

This completes the placing of the base-mounted instruments with the exception of the small coupling condensers, K and L, which should later be held by the wiring.

Mount the rheostat, U, the jack, Q, and the seven binding posts on the binding-post strip, X, and secure the strip on the baseboard with the small brackets, Y.

The wiring should be done exactly as shown in Figure 3. When the wiring is completed insert the plate-coupling resistances E and F, the grid-leaks, G and H, the filter resistors, I and J, and the amperite T in the proper mountings as shown in Figure 3. The instrument is then ready for installation.

How to Install the Amplifier

Connect the amplifier into the detector-output circuit of the receiver with which it is to be used and to the proper batteries as shown in Figure 4.

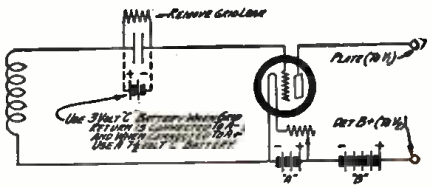
Insert a CX-340 valve in the detector socket and first low-frequency socket, R, of the amplifier, and a CX-371 in the last stage socket, S.

The CX-340 detector valve and the first amplifier need a high value of plate voltage, and the "B+" detector binding post of the receiver (normally connected to the 22 or 45-volt "B" battery terminal) should be connected to the highest amplifier voltage available, which will be that used on the last valve.

The detector valve will work best with "C" bias detection. If a grid-leak and condenser are used it is suggested that the grid-leak be removed and a "C" battery inserted across the grid condenser as shown in Figure 5. The bias should be three volts if the detector grid return is connected to "A—" and 7.5 volts if it is connected to "A+." If there is any uncertainty about the connection, try these two values.

The detector and first low-frequency valves can be burned very low. In fact, results will generally be satisfactory when the pointer of the 20-ohm rheostat just touches the first wires of the rheostat.

No difficulty at all was experienced in operating this new amplifier and the volume and quality have been found to be excellent. The amplifier can be highly recommended to all who are looking for better low-frequency amplification at small expense.



FOR BETTER RESULTS

FIGURE 5: *This diagram shows the changes to be made in the receiver with which the amplifier is to be used, if it is desired to get the best possible results by the use of "C" bias detection.*

The Hammarlund Hi-Q "Six"

(*Continued from page 436*)

attention other than the addition of water two or three times a year.

Regarding a Reproducer

A number of excellent loudspeakers are now on the market which are capable of reproducing the entire range of musical frequencies. Some of these, however, bring out the high notes while others give preference to the low or intermediate tones, which is the reason that some loudspeakers work better than others with a particular set. This, of course, as explained many times before in POPULAR RADIO, is due to the combination of the amplifier characteristics and the loudspeaker characteristics. The designers of the Hi-Q Six, therefore, recommend the use of the Farrand oval-tone reproducer, or its equivalent, in connection with this receiver.

Antenna Considerations

The set may be used with an outdoor or indoor antenna of almost any size. Most efficient operation will probably be obtained with an antenna of about 75 feet in length for both local and distance reception.

The Hi-Q Six has such a large value of amplification, however, that it may be connected to a standard light-socket antenna without the bother or fuss of putting up an outdoor antenna.

For this use the Dubilier Ducon unit may be screwed into any convenient lamp socket and a wire run from it to the antenna terminal on the set. Excellent reproduction and plenty of volume will be obtained, and in nearly all cases distance reception has been found to be satisfactory with this antenna. The use of this device, of course, eliminates a lot of unsightly wiring both inside and outside of the house. The battery hook-up in Figure 1 shows the proper installation for this unit.

If the set builder requires more information regarding recommendations as to power apparatus, loudspeakers. antennas, "B" batteries and storage batteries or voltmeters, in connection with the new set, he may obtain a complete construction and operation manual from the manufacturers.

In tests in the POPULAR RADIO LABORATORY the new receiver has come forth with flying colors, both for its simplicity in tuning and the excellent quality of reproduction that may be obtained with it. And the appearance of the receiver when mounted in a console. as pictured at the head of this article, will fit in with the best home furniture.

In the January number, POPULAR RADIO will publish an article telling how to build and install the official Hi-Q power-pack, that will supply "B" and "C" voltages for the Hi-Q receiver.

MR. RADIO EMPLOYER!

Do You Need Some Good Men?

Radio employers who wish to make additions or replacements within their organizations should call on our Free Employment Service for assistance. Men usually available at any point in the United States or Canada on 48 hours' notice. There is absolutely no charge for this service, either to the employer or to the employee.

We can supply men qualified for work in manufacturing plants, research and designing laboratories, or broadcast stations; licensed men for commercial land and sea operating jobs; Radio-trained salesmen for the manufacturer, jobber, or retailer; men who are competent at Radio service, installation, construction, and repair.

If you need a trained Radio man for any kind of work, or if you expect to need one in the near future, see if we can't help you. Write, describing the position and the sort of man you desire. You'll be informed promptly if we have the man you need available. Address correspondence to M. B. Taylor, Manager, Employment Department, National Radio Institute, Washington, D. C. A free monthly bulletin, listing men available and their qualifications, is published by this department. Your request will bring it to you regularly. Please refer to "RADIO."

(We conduct the oldest and largest Radio home-study school in the world, and our students and graduates are to be found in almost every Radio organization of importance. Our course of practical training is recognized by the U. S. Government, which allows our graduates the customary points of credit toward any Radio license they may wish to take out. See announcement on opposite page.)

Want More Money?

You Can Increase Your Earning Power By Learning More About Radio

If you're making a penny less than $50 a week, you're not getting what you ought to get out of Radio.

Thoroughly trained men—men whose knowledge of Radio is completely rounded out on every point—earn all the way up to $250 a week.

Radio is a new industry with plenty of fine positions unfilled. There are countless opportunities in Radio for a man to earn a splendid salary. But these are not opportunities as far as you are concerned, unless you're fully qualified for them.

The only way to qualify is through knowledge — training — *practical,* complete training, that fits you to get and to hold a better position in the Radio field.

See If This Free Book Can Do You Any Good

I publish a 64-page book, printed in two colors and filled with facts and photos relative to Radio and its opportunities.

I don't say this book will help you, but it *does help* such a large percentage of those who read it that I can afford to send it to all who ask for it—free. You may get only a single idea out of this book that will be of any value to you. Or every line of it may give you a message.

At any rate, fill in the coupon below and look it over. It costs you nothing but a two-cent stamp, and you place yourself under no obligation. I won't even send a salesman to call on you. And there's always a chance that that two-cent stamp may make quite a difference in your future.

A message to men now in the Radio business. And another to men who would like to be in.

I have helped all sorts of men to advance themselves in Radio. Lots of them, men who knew absolutely nothing about Radio when they first wrote me. Some who didn't know the difference between an ampere and a battle axe.

Others, graduate electrical engineers who wanted special work in Radio. Licensed sea operators who were way behind on the "BCL stuff." "Hams" by the score.

Last, but not least, the service and repairman or salesman who wanted to advance or go into the Radio business on his own. And the man already in on his own, who wanted to look forward to a more solid and permanent Radio future.

My Free Book—see coupon below—tells about my helpful methods, and cites the experiences of a hundred men—giving photos and addresses.

What My Radio Training Is

Under my practical system, a man can study at home in his spare minutes and get a thorough, clear, practical and expert knowledge of Radio in from 4 to 12 months. The time required depends on his previous knowledge, his ability, and the time he can spare for study. He keeps right on with the job he has—no necessity for his leaving home or living on expense.

Then, as soon as he's ready for a better position, I'll help him to get it and to make a success of his work. (See announcement on opposite page.)

This proposition is open to anybody who is not satisfied with his job, his prospects, or his Radio knowledge. Regardless of how much you know already (or if you don't know the first thing about Radio technically), I'll fit my methods to suit your needs.

If you want to enter into any correspondence about your own situation, anything you write will come directly to me and will be held strictly confidential.

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Please send me your free book about the bigger opportunities awaiting the thoroughly trained Radio man. At present I (am) (am not) in the Radio business.

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Your Laboratory Tools

(Continued from page 447)

placed near the grinding wheel should be used in cooling off the tool while sharpening it.

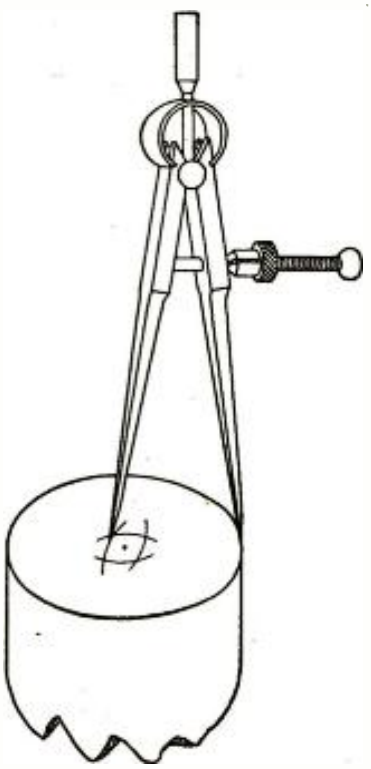
Figure 8 will help the reader to master the trick of grinding tools. "A" shows a very bad example; a tool ground in this way would last but a few seconds before the cutting point broke off. It could not fail to break off, as there is no support under it. "B" is an example of the opposite extreme. Here the non-cutting portion of the tool projects out so far that the real cutting edge at the top of the tool cannot be brought in contact with the work. If the reader buys a set of lathe tools already sharpened he will do well to maintain the original shape in resharpening them.

There is also what is known as "negative" and "positive" rake in cutting tools; examples of these are shown at C and D, Figure 8. Tools with positive rake cut more easily than tools with a negative rake. As a matter of fact, they cut too easily when used with soft metals such as brass and cast-iron. A tool with a positive rake has a tendency to bite into soft metal. The tendency to do this is so great at times as to make the tool actually jam and stall the lathe. A tool with a negative rake (example seen illustrated at D) may be used with safety on both brass and cast-iron.

To cut properly, a tool must be mounted in the tool post so that it comes in contact with the work just a tiny fraction of an inch below the center. We see this illustrated in Figure 10.

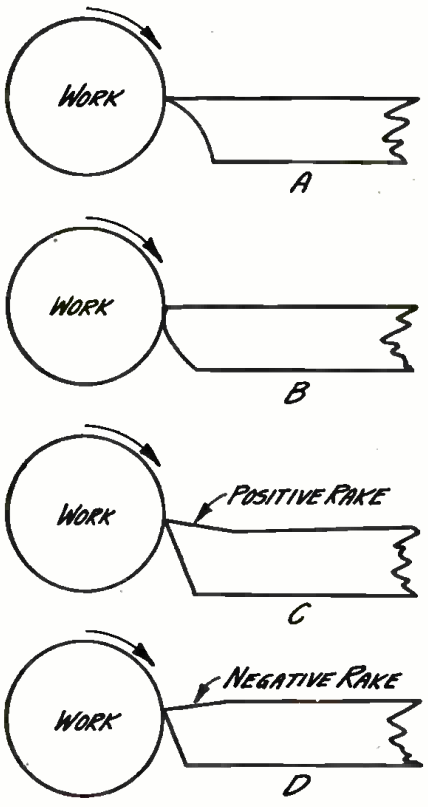
The experienced mechanic will usually succeed in mounting the tool properly, but the beginner must learn by experience, and if the tool does not cut fast and clean, he should have the patience to re-adjust it until he succeeds in obtaining the proper cut.

The manipulation of the feed handles of the slide rest is a thing that cannot be lectured upon with much success; only experience will give the operator expertness and confidence. One great mistake made by beginners is that of attempting to take too large cuts. This not only dulls the lathe tool, but it is an actual strain upon it and upon the bearing of the lathe, to say nothing of the possibility of overheating the driving motor. It must be remembered that a lathe tool is extremely hard and very brittle. Consequently, there is a limit to the strain that it will withstand. When steel is being turned it is good practice to mount the tool so that the cutting edge does not project too far out of the tool post. This reduces the leverage and consequently the possibility of breakage. A few drops of oil put on the end of the cutting tool will not come amiss when working with steel.



FINDING THE CENTER

FIGURE 7: *Here is a simple way of locating an approximate center on work that is to be mounted in the lathe. For all ordinary purposes this is sufficiently accurate.*



RIGHT AND WRONG

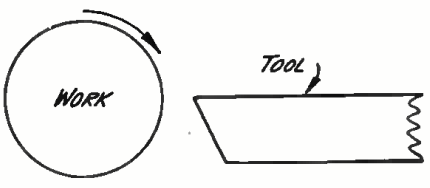
FIGURE 8: *At "A" and "B" two improperly ground tools are illustrated, while at "C" and "D" there is illustrated the difference between the positive and negative rake.*

Figure 2 illustrates at close range the scroll chuck that was mentioned in the second article of this series. When small pieces of metal are to be turned the centers of the lathe need not be pressed into service. There are but two factors that determine whether or not it is possible to turn down a metal rod with the aid of the scroll chuck. One of these factors is the diameter of the rod and the second factor is the distance that the rod will protrude out of the chuck. It is obvious that we could not hope to turn down the end of a small rod that protrudes very far beyond the chuck jaws. If such a job should be attempted, it would be found that the rod would spring when the lathe tool was brought in contact with it.

Naturally, this chuck will not accommodate a wide variety of shapes. It will hold round and hexagon rods very nicely, but different arrangements must be provided for odd shapes. The knurled ring shown at C in Figure 2 is used to tighten or loosen the jaws A. The inside jaws are illustrated in position while the outside jaws—that is, the jaws that are intended to grip the outside of the work—are illustrated at B. Naturally, if the operator finds that the capacity of the chuck when used with the inside jaws is not great enough to accommodate a piece of work, the outside jaws are put in place, each jaw always in its proper position. To make the correct placing of the jaws sure it will be found that the slots on the jaw and the jaw proper bear corresponding numbers.

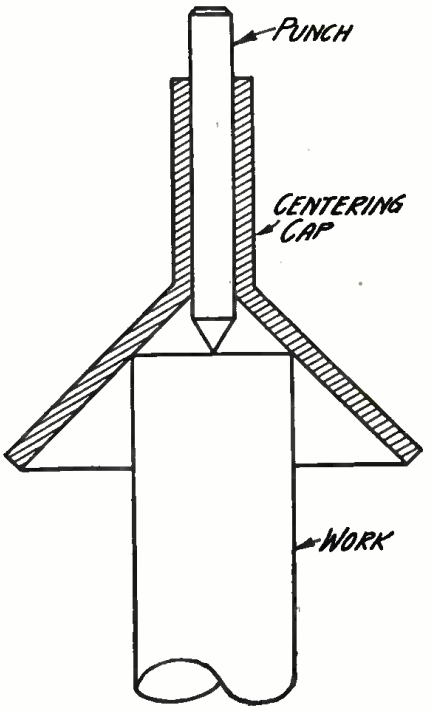
The use of the chuck in turning down the inside of a brass tube or collar is illustrated at Figure 4. The work is indicated at A and the cutting tool at B. The student of this series of articles will do well to study the position of the cutting tool. It is what is called an inside cutting tool and used only for work of this nature.

The use of the compression chuck is illustrated at Figure 5. This figure illustrates what is called a cutting-off operation and a cutting-off tool is shown mounted in the tool post. A is the chuck, B is the work and C is the cutting-off tool. In the case of a small rod



HOW THE CUTTING TOOL IS MOUNTED

FIGURE 10: *The cutting tool is brought to a position so that its cutting edge is just slightly below the center of the work.*



ANOTHER WAY OF FINDING THE CENTER

FIGURE 9: *Here a "bell center" punch is used for finding the center of work to be mounted in the lathe. This is a quick and fairly accurate method.*

projecting the same distance illustrated it would be impractical to attempt to turn the end, owing to the possibility of springing.

This compression chuck is extremely useful and convenient when a large number of pieces are to be cut from the long rod. In such work the rod may be fed through the hollow spindle of the lathe into the chuck and after each cutting-off operation it is only necessary to loosen the chuck and shove the rod through until the proper amount is again projecting.

In turning down work on a lathe, the question of proper speed is important. Experience has shown that soft metal can be cut best at high speed, while steel or any metal that offers severe resistance to the action of a cutting tool requires low speed. Consequently, when brass, soft iron or aluminum is being turned, the belt should be riding on the smallest of the three pulleys. When steel or an equally tough metal is being cut, the belt should be riding on the largest pulley.

Mechanics must always remember that the lower the speed the greater the amount of power delivered to the work. Reducing the speed for steel is simply a matter of providing the work with sufficient torque or turning power to overcome the resistance offered the cutter.

In the next installment of this series Mr. Madden will tell mechanically inclined thinkers how they may use a lathe for a wide variety of odd jobs—jobs that are ordinarily considered outside the range of this important tool. Special emphasis will be laid upon the application of the lathe in doing many of those jobs that cause radio fans so much trouble.

1,000,000-Watt Broadcasting

(*Continued from page 412*)

1921, one-half kilowatt was standard; in 1924, 5 kilowatts came to be regarded as a reasonable power; to-day the 50-kilowatt station has its recognized place, and perhaps by 1930 the 500- to 1,000-kilowatt station will be regarded as normal.

People have occasionally gotten the impression that high-power stations were not capable of high tone quality of modulation. This is far from being the case, however. Actually the tone quality of the highest power stations in the United States is second to none, and there is no technical reason why it should be in anywise inferior to lower powered broadcasting.

If stations of a power of from 500 to 1,000 kilowatts come into moderately general use, their performance will depend upon certain factors. If fading is eliminated they will have a service range of from 300 to 500 miles, which will give truly admirable coverage and economic justification for such stations. If fading is not eliminated, the range will still remain restricted to 100 or 150 miles, but they will give a greatly enhanced quality of service in the outer portions of the service zone, as compared to the 50-kilowatt stations now used.

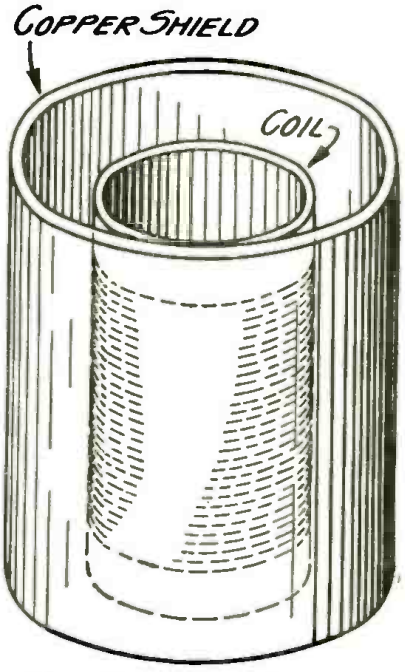
Another justification for the present trend toward higher transmitting powers is the inevitable presence of electrical disturbances in the neighborhood of human habitations. We cannot shut down every electric fan, every refrigerator, oil burner, motor, or other electrical device in the neighborhood. This might be too high a price to pay for a radio program, except perhaps to those of us who are members of a broadcasting association. As has been clearly pointed out by the National Electric Light Association recently, one of the desirable ways of meeting the problem of electrical disturbances of radio reception is by increasing the power of broadcasting stations.

We are now entering an era of real broadcasting service of a reliable nature. This is not an easy thing to accomplish in a country like the United States, where vast areas have to be covered. It is also difficult to work out any orderly plan with 700 stations in the field. We may congratulate ourselves that the number of stations is not 7,000, and we may perhaps consider how much luckier it would be if the number of stations were 70.

Archimedes once said: "Give me a fixed point for my lever and I will move the earth." And so, we may say of our newer field of broadcasting: "Give broadcasting the necessary transmitting power to reach all listeners clearly and it will move the souls of men."

The Harkness Counterfonic

(Continued from page 433)



A NOVEL SHIELDING METHOD

FIGURE 4: *The Counterfonic coils are placed concentrically within open-ended cylinders of heavy copper, giving an adequate shielding effect without changing the characteristics of the coil to any great extent. If the shields were closed at the ends, the electrical constants of the coil might be seriously affected.*

will give him an unexcelled quality of reproduction.

In the January number of POPULAR RADIO the full constructional details for the receiver will appear in an article written by Kenneth Harkness himself.

Below is a list of parts for the new receiver.

LIST OF PARTS FOR

The Counterfonic Six

TO BE FEATURED IN THE JANUARY NUMBER OF POPULAR RADIO—

3 Harkness Counterfonic RF transformers;
3 Copper shields;
1 Westinghouse Micarta front panel, completely drilled;
1 Westinghouse Micarta sub-panel, completely drilled, with 6 vacuum valve sockets attached;
3 Harkness tuned double-impedance couplers for the first, second and third stages;
1 Harkness output filter unit;
1 Harkness RF choke coil;
1 U. S. L. 3-gang variable condenser, .00035 mfd.;
1 S-M drum dial;
1 Carter midget rheostat, 10 ohms;
2 Saturn battery switches;
1 Carter fixed filament resistor, 4/5 ohm;
3 Aerovox fixed condensers, .0001, .00025 and .001 mfd.;
1 Lynch grid-leak, 2 megohms;
2 X-L neutralizing condensers, .0001 mfd.;
12 Eby binding posts;
3 Hammarlund equalizing condensers;
1 Aerovox by-pass condenser, 1 mfd.;
1 Pair of Harkness brackets, 9½ inches long.

IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

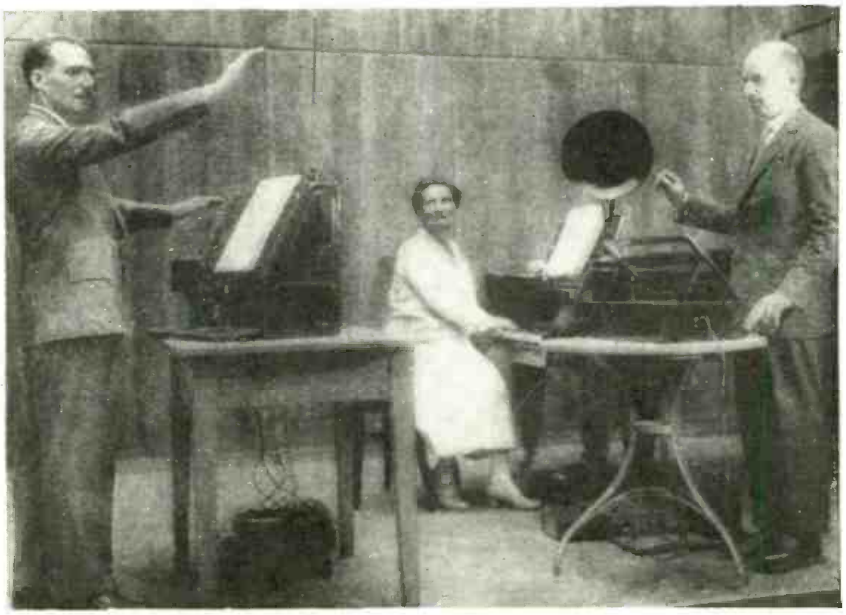
Radio Music By Hand

GERMAN musical circles have been somewhat excited this summer by a young Russian professor, Leo Theremin, of Leningrad, who waves his hands in the air above a box full of radio apparatus and proceeds to play tunes thereby. Were this the fifteenth century instead of the twentieth, Professor Theremin would probably have disappeared by now into the hands of the torturers appointed to deal with witchcraft. As it is, the torture is the lot of his hearers, if perchance his hand happens to slip.

German accounts of the innovation have not been especially lucid and Professor Theremin himself does not seem to have described in accessible publications the details of his method. Fortunately, Mr. Waldemar Kaempffert, the able scientific adviser of the New York *Times*, visited Professor Theremin's demonstration in Berlin and reports the details in the issue of the *Times* for October 2, 1927. The secret, Mr. Kaempffert discloses, is merely a controlled use of well-known body-capacity effects.

Professor Theremin's apparatus contains two radio oscillators, one of which can be varied in frequency by approaching or withdrawing the hand. The note produced by the apparatus is, of course, the heterodyne note of these two oscillators. By waving his hand in just the right fashion and at just the right distance from the projecting portion of his sensitive circuit, Professor Theremin can alter the frequency of this heterodyne note, causing it to take any desired frequency in the musical scale.

By means of another projection of the circuits, operated by his other hand, Professor Theremin can use similar body-capacity effects in order to alter the amplitude of the heterodyne im-



Underwood & Underwood

PLAYING THE HETERODYNE ORCHESTRA

Professor Leo Theremin, the young Russian radio expert who extracts music from radio circuits operated by body capacity effects, is at the reader's left, waving his hands near the two control antennas which alter the frequency and amplitude of the two internal oscillators. The heterodyne note of these oscillators provides a musical tone which can be varied at will, the music emerging from the loudspeaker on top of the accompanist's piano.

pulse and thus the loudness of the note. It is necessary, one imagines, to be rather competent and precise in the business of hand waving, but the skill required is presumably not much greater than that necessary to play other kinds of musical instruments.

Radio engineers have long been aware that musical tones of exceptional purity and wide variation of quality can be produced by means of vacuum valve circuits. The problem of arranging such circuits for actual musical use is one of ease of control, not of fundamental electrical principles. Whether Professor Theremin's device will prove to have solved this control problem sufficiently for practical musical use is perhaps a question, but if he has not done so presumably some one will. It is a safe prediction that music from tuned vacuum valve circuits will some day be an actuality.

An Acoustic Filter For Morse Code

A device both novel and ingenious for receiving dot-and-dash code in the midst of the most active interference was described last spring before the Radio Society of Great Britain by Mr. G. G. Blake, who has since printed a description of his apparatus in the *Wireless World*.* The essential idea is to select the signal note by acoustic resonance and to amplify it, allowing the miscellaneous sounds of the interference to disappear.

Every student of high school physics is familiar with the fact that hollow tubes or cylinders will respond by resonance to some particular tone, this tone being determined by the dimensions of the cylinder. By using a relatively long tube equipped with a plunger, it is possible to adjust this resonant tone over a somewhat wide range of musical frequencies. This is, of course, the familiar principle of the small tin whistles equipped with pistons, and of the slide trombone. Mr. Blake allows the output of his loudspeaker unit, containing not only his desired signal, but all the interference, to enter such a resonating tube. The resonator is then tuned, by sliding its piston in or out, until it reaches the frequency of the note which it is desired to receive. This note is then amplified automatically by the resonance.

At the end of the resonator, where it will be exposed to the air vibrations set up by the resonant note, Mr. Blake places a hot-wire microphone, substantially of standard type. This microphone picks up the tone given out by the resonator, converting this into an electric oscillation in quite the usual fashion. An amplifier of known character then strengthens this electric

*"Selective Morse Recorder," by G. G. Blake. The *Wireless World* (London), pages 213-215 (August 17, 1927) and 251-253 (August 24, 1927).

Underwood & Underwood

DEMONSTRATING THE RADIO FRYING PAN

At the New York Radio World's Fair, Mr. Bernays Johnson, at the reader's left, showed that it is possible to fry eggs or boil water in a frying pan held close to the top of a cake of ice and unprovided with any visible fire. High-frequency electric waves emitted by an oscillator below the table-top are absorbed by the metal of the pan and provide the heat. Holding the frying pan is Fire Commissioner Dorman of New York City.

oscillation so that it will operate a relay and, in turn, a standard inker for noting the Morse signals on a tape. Mr. Blake reports that he can receive radio code quite legibly through interference which would ordinarily make the code signals totally inaudible.

English papers have reported Mr. Blake's device as promising the conquest of static in broadcasting. Obviously, this is not the case. The resonator can be adjusted to respond only to one tone at a time, a limitation which is desirable in receiving code sent by interrupted continuous wave, but which makes the reception of speech or music quite impossible.

A Wave of Quicksilver

ONE of the chief limitations that still remain on the practical use of electric current is the difficulty of converting alternating current cheaply and easily into direct current. A new and interesting type of rectifier for this purpose has been developed by Dr. J. Hartmann, of Copenhagen, Denmark, and was described by him before the recent meeting of the British Association for the Advancement of Science, in Leeds, England.* The effective part of this rectifier is a jet of liquid quicksilver.

Such a jet of mercury or any other conducting liquid, when projected into an alternating magnetic field, takes on a wavy shape, the exact shape depending upon the dimensions of the jet and the frequency of the field. Dr. Hartmann arranges such a jet inside a container provided, on its two sides, with contact plates against which the wavy jet can impinge. By properly adjusting the dimensions and placing of these contact plates, the jet may be made to be in contact with one plate during one-half of the current wave and in contact with the opposite plate during the reverse half. This provides a mechanism by which rectification can be produced without the use of moving parts, except the moving jet of mercury.

Practical utility will depend, one imagines, upon success in producing stable operation of the jet. Presumably

*Dr. Hartmann's paper is noted in *Nature* (London), volume 120, pages 416-417 (September 17, 1927).

this will not be without difficulty, but the success already attained implies that the difficulties permit of ultimate solution.

Tricks With Radio Power

At the recent Radio World's Fair in New York City, Mr. Bernays Johnson, already well known as one of radio's foremost masters of the spectacular, received a new title. By grace of newspaperdom, he is now "Radio Wizard." In the presence of admiring audiences. metal plates floated in the air at Mr. Johnson's behest. Water was boiled on top of a cake of ice and eggs were cooked in a similar situation. Lamps were lighted in empty air or when held in Mr. Johnson's hand, apparently unconnected with supplies of power. Even the end of an iron rod was melted electrically while the other end reposed, apparently not uncomfortably, between Mr. Johnson's lips.

To the experienced electrical experimenter these marvels are immediately obvious as due to the properties of high-frequency electric currents of the type made famous years ago by Mr. Nikola Tesla. The water boiled or the eggs cooked atop a cake of ice were heated, of course, by a metal plate, absorbing high-frequency electric radiation from an oscillator underneath the table. These waves traversed the ice-cake without great absorption and without heating it. The levitation of metal plates, perhaps the most startling of Mr. Johnson's tricks, is due to the generation in such plates of eddy currents opposed in phase to the arriving high-frequency radiation and thus repelled by it, as is required by the well-known theories of electromagnetism.

It is probable that the possibilities of these spectacular high-frequency waves for public amusement have by no means been exhausted. The suggestion is offered to radio fans possessed of a Tesla oscillator and a yearning toward vaudeville.

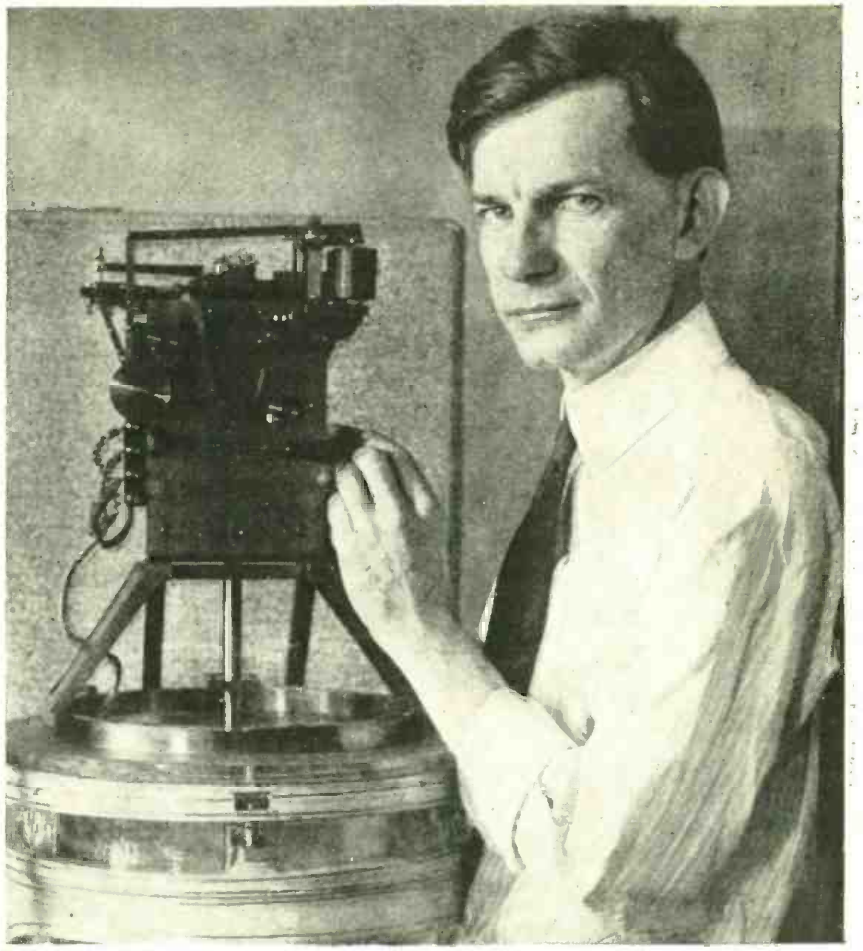
The Winds and Radio Time

MORE and more evident is the importance of radio in providing the world with that remarkable convenience called Standard Time. If President Coolidge summons his cabinet to meet at a designated hour or minute, it is

Underwood & Underwood

A MODERN MIRACLE OF LEVITATION

A metal plate that seems unaffected by gravity, flying upward at the word of command instead of falling to the earth, reproduces a marvel claimed by many self-styled magicians of antiquity, but realized only in these days of radio waves. The secret, as demonstrated by Mr. Bernays Johnson at the New York Radio World's Fair, is merely the producing of eddy currents inside the metal plate and the repulsion of these by the alternating field of a concealed oscillator circuit.



Underwood & Underwood

TWO DICTATORS OF RADIO TIME

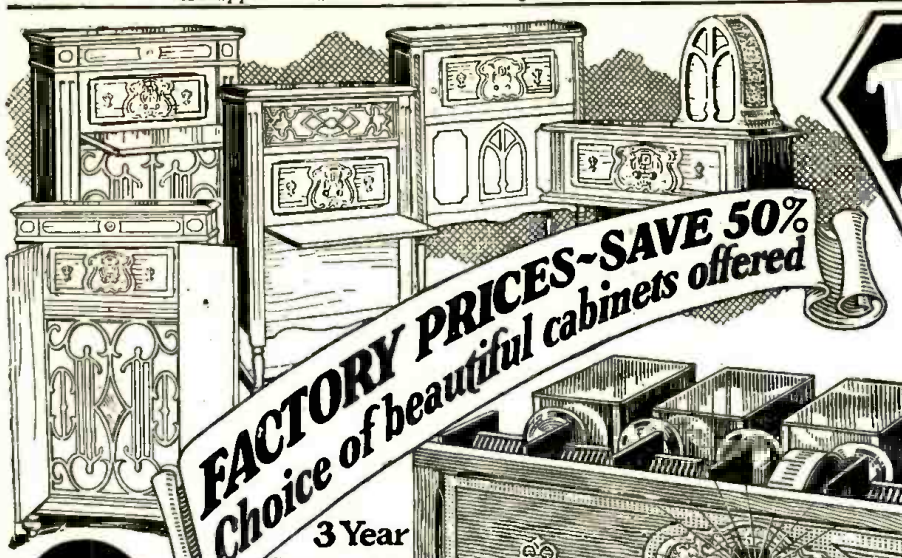
Mr. Paul Sollenberger, of the United States Naval Observatory, in Washington, D. C., is one of the dictators. The other one is the precision clock which he is adjusting, a timepiece which runs inside a vacuum maintained in a glass case and which is operated by an electrically-driven pendulum. This clock, newly installed at the Observatory, is expected to run with an error of less than one hundredth of a second a day. The Observatory's clocks, corrected daily by observations of the stars, provide the standard for the time signals throughout the United States. Recent studies of the similar radio time signals arriving from Europe show slight variations with the direction of the wind, presumably due to effects of the weather on radio transmission.

not at all difficult for every one of them to arrive within a few moments of the appointed time. This would have been totally impossible for Julius Cæsar, or even for Napoleon Bonaparte, as countrywide agreement upon a time standard did not then exist. That it exists now is due to the astronomers and to the telegraph; the duty of the telegraph gradually has been passing, however, to radio broadcasting.

The development of the radio methods of exchanging time signals has not only become a great international convenience, but it has disclosed certain small variations of these signals, already much noticed in scientific news, which are now the subject of very active scientific investigation. In a recent report* on some of the work of the United States Coast and Geodetic Survey, Mr. Paul Sollenberger, of the United States Naval Observatory, describes recent developments of the time service maintained by that institution and mentions a most interesting correlation which has been discovered by Mr. J. E. Willis, of the Observatory, between the variations of the Washington-London time signals and the directions of the winds at the stations.

The variations between the times in London and in Washington are far too small to have great practical importance. They amount to only small fractions of a second. They are too large, however, to be blamed upon accidental error, either of the astronomers or of the apparatus. It is probable that they correspond to slight variations in the time required for the passage of radio waves between the two stations. A correlation with atmospheric conditions is, therefore, not unexpected. It is to be hoped that research will throw light on the relationship.

*"The United States Naval Observatory Time Service," by Paul Sollenberger. In "Geodetic Operations in the United States, January 1, 1924, to December 31, 1926," by William Bowie, published as Special Publication Number 134 of the United States Coast and Geodetic Survey, Washington, D. C., 1927, pages 24-25.



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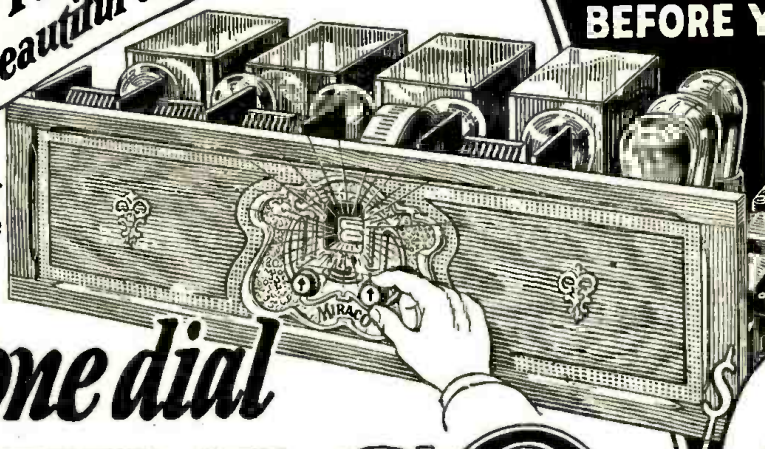

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Miraco's work equally fine on "AC" electric house current or with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons—enjoy programs Coast to Coast, Canada to Mexico, loud and clear—with the magnificent cathedral tone quality of costliest sets. Don't confuse Miraco's with cheap, "squawky" radios. Miraco's have finest parts, latest approved shielding, metal chassis, etc.—as used in many $200 sets.

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Miraco is best set I've ever heard. It's just the set I've always wanted and I've had so many sets I got just a little hard-boiled about believing there were any sets perfect. I sure got my wish. I've had just 104 stations. There's about a station to each number on dial. I get KFI (Cal.) every night. Had PWX last night and got 6KW tonight good and loud.—FRANCIS ARMBRUSTER, Cleveland, Ohio.
P.S. You pack your sets wonderful.

HE KNOWS SETS—READ THIS
I have built radios since they first made their appearance and it has been my pleasure to build, repair and sell them. For quality, selectivity and sensitivity it is my firm belief that the Miraco cannot be excelled. I have proven beyond any shadow of doubt that it will outperform any other radios. I bring in the farthest distance with little or no effort. The Miraco also gives me tone quality.—URBAIN BARIL, Jr., Fall River, Mass.

MIRACO EXCELS EXPENSIVE RADIOS
The Miraco set and loud speaker beat anything around here, regardless of price. Have tried them out against a $200 outfit. Have logged 140 stations, coast to coast.—E. J. CARRIERE, Bathgate, N. D.

HEARS CUBA, CANADA, MEXICO
A friend visited here that has close to $300 in a radio—but no better tone and no plainer than the Miraco. Have gotten 118 stations. We get Mexico City, Winnipeg, Canada and Havana, Cuba—all of these so plain.—MRS. CLEM CORRELL, Morristown, Ind.

CUTS THRU NEW YORK LOCALS
I can get distance thru the locals when they are all on early in the evening.—J. F. LOGAN, Rockaway Beach, New York.

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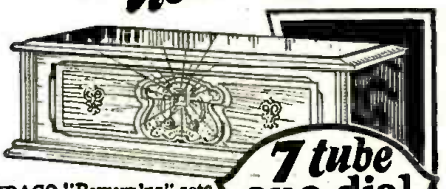

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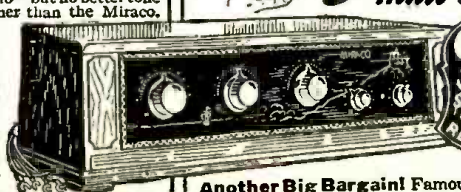

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ADDRESS

What's New in Radio

(Continued from page 438)

all well and good, providing he is willing to pay the price. But if one desires the most actual radio value for his money, he will do well to forget about great high-boy consoles and content himself with a smaller receiver which has all of its value in those things which go to make fine tone quality, sensitivity, selectivity and the other highly desirable features of the very best radio reception.

The Freed-Eisemann NR-9 receiver is just such a receiver. It is a six-valve set with three stages of tuned-high-frequency amplification, a detector and two stages of transformer-coupled, low-frequency amplification. It provides fine sensitivity and tone quality, is simple to operate and the volume of reproduction when turned up full is more than required for home use. Yet with all these good characteristics, the outside dimensions of the cabinet are only 20 inches in length by 10½ inches in depth by 10 inches in height. It is finished in dark-brown mahogany, with a front panel of the same material and color. The lines are graceful, and an effective contrasting note is obtained by the antique bronze escutcheon plate on the front panel. This plate bears all of the tuning and control knobs, as well as a pilot light window and a small window behind which the calibrated scale moves.

One reason for the great sensitivity of the NR-9 receiver lies in the inductively tuned antenna coupling. Instead of using the usual coil and condenser for this purpose, the variometer method of tuning is employed. The extreme efficiency of this system is generally recognized, but has not found extensive popularity because of difficulties encountered in designing a multi-stage amplifier of this type. Lack of selectivity has been a particular stumbling block. In the NR-9 receiver careful design has made the use of the inductive tuning entirely practicable for the antenna coupling and plenty of selectivity is obtained through the fact that three tuned circuits of the more usual type follow this inductively coupled circuit.

The low-frequency amplifier employs two stages of transformer coupling. The transformers used are sturdy products which provide uniform amplification of all tone frequencies. This is particularly true when a UX-171 type power amplifier valve is used in the last stage, because this valve is capable of handling the large volume of this receiver without overloading. A UX- or CX-112 type valve can be used and is quite satisfactory if the full volume of the receiver is not used—and in the home there will seldom be occasion to use full volume. A good reproducer should be used with the receiver; a reproducer marketed by the same manufacturer is recommended.

Either an indoor or outdoor antenna may be used. For local reception the former will in practically every case prove entirely satisfactory. For reception of distant stations an outdoor antenna is required, and it should be somewhere between 50 and 75 feet in length.

Standard UX- or CX-201-a type valves are employed in all stages except the last low-frequency stage, where either a UX-112 or the UX-171 type valve is required. Standard battery equipment is also used, or any good "A" or "B" power-packs. The Freed-Eisemann "B" and "C" power-pack is expressly designed for use with this receiver and will provide results at least equal to those from "B" and "C" batteries, without the necessity for replacement or attention. All connections between the receiver and the batteries are made by means of a cable made up of colored and coded wires. This comes with the receiver and leaves no opportunity for wrong connections.

Three knobs on the front panel control the tuning and operation of the receiver. The lower right-hand knob operates a combination battery switch and volume control rheostat. A pilot light shows when the receiver is "on" and "off."

The wavelength tuning is accomplished by means of the large center knob. This operates the three sharply tuned high-frequency circuits simultaneously. The tuning scale which moves behind the small window that is located just above this knob is calibrated both in degrees and directly in wavelengths. The broadly tuned antenna circuit is controlled by the left-hand knob, which surmounts a small lever switch that serves as an auxiliary antenna tuning device. This knob serves to regulate the sensitivity of the receiver and is a decided aid when it is desired to tune in weak, distant stations.

Maker: Freed-Eisemann Radio Corp.

A By-Pass Condenser That Saves Space

Name of instrument: Cartridge type by-pass condenser.

Description: This is one of the newer types of by-pass condensers that has found increasing popularity with builders of receivers. They occupy less sub-panel space for a given capacity than do condensers of the block type. The condenser proper is of the "wound" type and is made in a round roll. An edge of each of the two strips of foil which form the "plates" of this condenser is allowed to project beyond the edge of the paper strip which forms the dielectric. These edges project at opposite ends of the roll and the metal end-caps of the finished condenser are electrically soldered direct to the projecting edges, thus forming perfect contact. The metal end-caps then become the opposite terminals of the condenser.

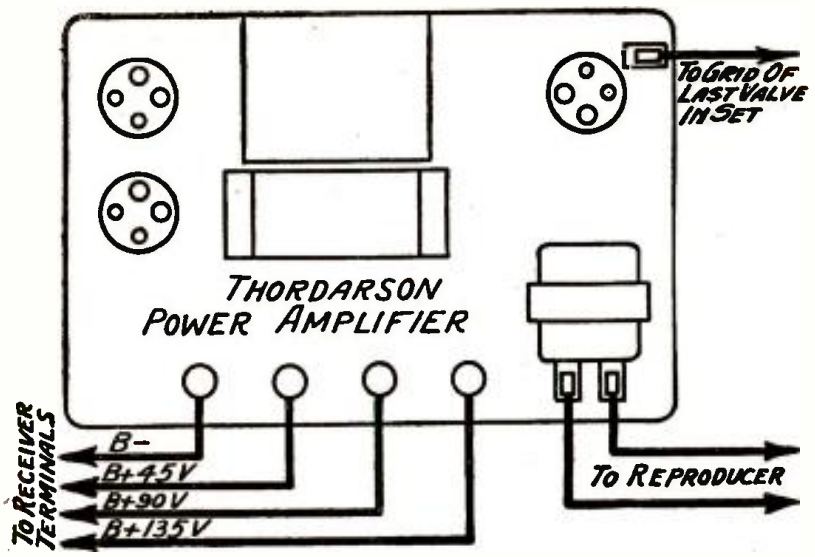
Usage: For any purpose where by-pass condensers of capacities from .1 mfd. to 2 mfds. are required.

Outstanding features: Compact. Easily mounted. Non-inductively wound.

Maker: Brown & Caine, Inc.

The Thordarson Power-Pack Amplifier

(Continued from page 428)



HOW TO HOOK UP THE UNIT

FIGURE 3: *This diagram gives the exact connections to the Crosley receiver, including the lead to the grid of the last valve, and the connections to reproducer.*

When the wiring has been completed and carefully checked, the unit is ready to be installed.

How to Install the Unit

The Thordarson unit may be used in connection with any receiver, to supply B" voltages and a 210 power stage for the low-frequency amplifier. For the purposes of clearness, it is described here as used with the Crosley Bandbox, No. 601, a six-valve receiver of standard design. The installation of the unit in other standard receivers would not differ greatly from the procedure outlined here.

In setting up the Thordarson power amplifier with the Crosley receiver, first disconnect all the "B" batteries from the set cable. Then remove the "B" batteries from the radio table and place the new unit in their place. Next, connect up the cable wires to the four binding posts, I1, I2, I3 and I4, as indicated in Figure 3, and connect the reproducer to the two Fahnestock clips, J2 and J3, on the output transformer, C.

There is still one other connection to be made to the grid of the last valve in the Crosley set. To do this a simple plug can be made out of an old vacuum valve. Break the glass on a burned-out standard valve and clip off three of the wires left in the shell. The wire that connects to the grid terminal, however, should be left and a long extension wire soldered to it. Figure 4 shows the proper prong to connect this wire to. This plug should then be inserted in the last valve socket in the Crosley set. This socket is the one in the extreme right-hand front corner. The extension wire connected to this plug should then be run over and attached to the Fahnestock clip, J1, on the socket, D3.

Next turn the receiver "on" in the regular manner and insert the plug on the lamp cord from the power compact, A, into a convenient AC lighting socket and turn the socket switch "on." Of course, a 216-b type rectifier valve should first be inserted in socket D1 in the unit, and an 874 voltage regulator valve in socket D2, and a 210 type power valve in socket D3.

The set is now ready to operate and no further adjustments are necessary.

Always remember, in putting the set into operation, first to turn "on" the switch on the Bandbox receiver and then turn "on" the power to the amplifier unit. In turning "off" the receiver, turn "off" the amplifier unit first and then turn "off" the switch on the receiver.

A surprising improvement in tone quality and volume will immediately be apparent, and the satisfaction in listening to the accompanying reception will be increased hundreds of per cent.

Radio dealers and service specialists will find that installations of this kind made for their customers will be extremely popular and profitable to themselves as well as to the users of the new amplifying apparatus.

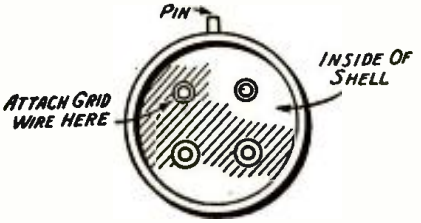


FIGURE 4: *The lead from the power valve of the Thordarson unit to the last valve socket of the receiver should be attached to the grid prong of a plug made out of an old valve base as shown in this diagram.*

What's New in Radio

(*Continued from page 440*)

the receiver, and from this point on this knob serves as the volume control. When turned all the way to the right, maximum volume is obtained; this may be shaded down to any desired degree by simply turning this knob to the left. When turned all the way to the left, the receiver is turned "off."

All wavelength tuning of the three high-frequency stages and the detector stage is accomplished simultaneously with the lower right-hand knob. It also drives the drum which is located behind the illuminated escutcheon plate and which is calibrated directly in wavelengths. The drum lamp is operated by the same switch that turns the receiver "on" and "off," and it therefore serves as a pilot light.

The tuning condensers of the four tuned circuits are located in a shielded compartment just inside of the front panel. All other parts and instruments are located or mounted on a composition sub-panel, which in turn is mounted on a metal frame that serves both as a rigid foundation for the chassis and also as a partial shield. This metal framework, and the metal case which incloses the condenser assembly, constitutes a complete cover for everything except the valves, which are mounted on top of the composition sub-panel.

The high-frequency portion of the receiver is well stabilized by a method not disclosed by the manufacturer. The coupling transformers of the "binocular" type minimize undesirable interstage coupling and direct pick-up. Thus all of the signal energy coming into the receiver must come by way of the antenna and is therefore subjected to the full tuning action of the four tuned circuits. This is one of the reasons for the high degree of selectivity obtained in this receiver.

In the low-frequency amplifier two transformers of good characteristics are employed, with the result that the overall tone quality is of a high order. There is also ample volume for all ordinary purposes.

The receiver is designed for the use of standard UX-201-a type valves in all sockets except the last low-frequency stage, where either a UX-112 type or a UX-171 type valve may be used. Separate "B" and "C" connection wires are provided in the battery cable for this stage to permit the use of "B" and "C" voltages to correspond with the type of valve used in this stage.

Inside of the receiver, at the rear, binding posts are provided for the connections to antenna and ground. There is also a pair of tip jacks for connecting the reproducer. All battery connections are made by means of a battery cable, the receiver end of which is permanently connected directly to the circuit inside of the receiver. Each of the wires in the cable is distinctly marked so there can be no error in making the connections to the batteries.

While operating the receiver in New York City no difficulty was found in bringing in, without any trace of interference, distant stations which operate within 20 kilocycles of powerful local stations. This is entirely adequate selectivity even for city use. The sensitivity of the receiver was also found to be above average.

Maker: Pfanstiehl Radio Co.

Peppy Batteries always . . . . *if the Christmas list includes a General Electric battery charger!*

Tungar (the name of the General Electric Battery Charger)—put that on your list. For Dad, or Jack . . . or maybe, just for yourself. Every radio set should have its Tungar to keep batteries always pepped up.

The two-ampere Tungar has been a particular favorite because it gives both trickle and boost charging rates.

But different sets really require different chargers. Your radio dealer will tell you which is best for your set. Now that Tungar prices are lower than ever before, be sure you settle your battery charging problems for all time. And do as much for all the other radio fans on your Christmas list.

Tungar causes no radio interference. It cannot blow out tubes.

An overnight charge costs about a dime.

It is a G-E product developed in the Research Laboratories of General Electric.

The 2-or 5-ampere Tungars charge 2-, 4-, and 6-volt "A" batteries, 24- to 96-volt "B" batteries, in series; and auto batteries, too. No extra attachments needed.

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Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

New low prices
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2-AMP. TUNGAR $14

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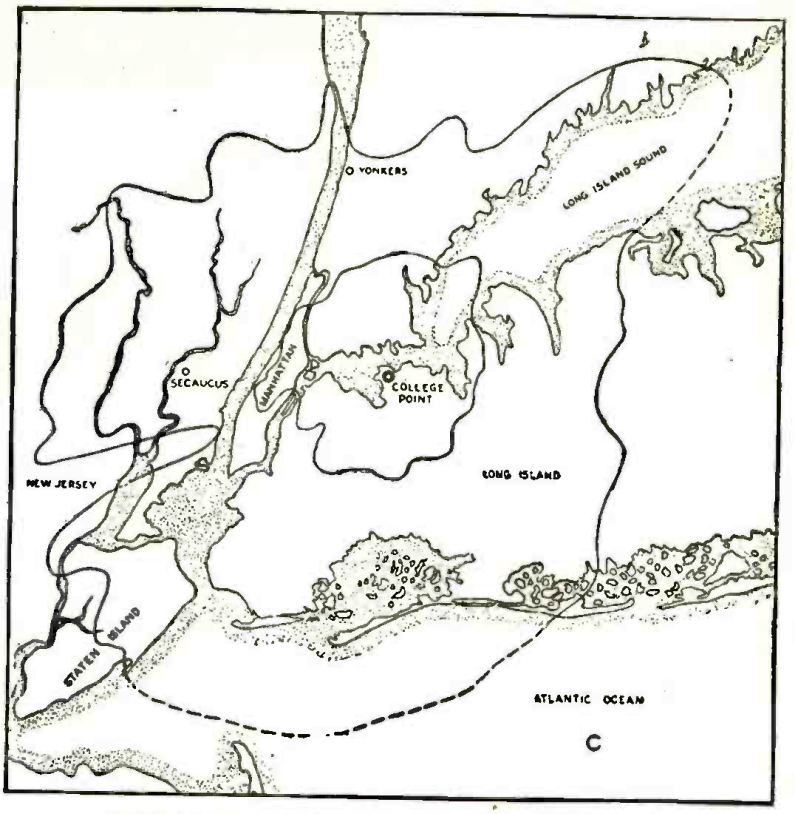
GENERAL ELECTRIC

If You Live in a Building With Steel Framework—

(Continued from page 450)



RADIO "SHADOWS" CAST BY TALL BUILDINGS

FIGURE 6: *The light black lines connect places where the signal strength of the experimental station at College Point was equal. The deep indentation of the line in New Jersey shows that the tall buildings of lower Manhattan absorbed much of the energy of the broadcasting station, so that receivers in this part of New Jersey had much poorer reception than other places equally distant from the transmitting station.*

strength for typical rooms which have windows opening directly outward are also given on the diagram.

In the case of a typical modern steel apartment house, the interior signal strength may be reduced to but a few per cent of that outside the building. Measurements illustrating this fact are given in Figure 2.

For example, the field strength on the ground floor at the foot of the elevator shaft was found to be but 1/100 of that of the open roof. In such a building the presence of a window in the room has a very noticeable effect. For outside rooms, the field strength near the window was found to be about eight times as great as that along the farther wall. It is almost as though the broadcast waves blew in at the window like a breeze that puffs out curtains and draperies before it. But, of course, to obtain the broadcast breeze it is not necessary to have the window open.

Such severe shielding effects as those indicated in Figure 2 obviously suggest the desirability of an outdoor antenna, with means for connecting it to the radio set by wire circuits, preferably by shielded circuits, in order to protect against local interference.

A New Leaf for the New Year

The new year always brings new resolutions, and POPULAR RADIO'S promise to its readers for 1928 is a bigger magazine, with more articles, more varied subjects, and a snappier, crisper presentation of facts than ever before. Let the January number prove this to you—the biggest issue of the magazine ever published in its appeal to all types of radio enthusiasts.

The New Science of Soldering

(*Continued from page 434*)

metals other than tin or lead. Such a condition of the alloy will react by raising the melting point, detract from the strength of the solder bond and generally result in difficulty in working the alloy. Solder may be procured in a variety of different forms, but the home constructor of radio apparatus has most generally adopted the wire or ribbon form. This type is made in two ways—either solid or tubular. The tubular type has within its walls a rosin flux. Thus it offers the constructor a unique labor-saving combination of the two essentials for wire connecting—solder and flux.

Just why is solder used? Many radio fans look on it merely as a sort of metal glue for binding together similar dissimilar metals. If this were all that it did, bolting, riveting or welding would accomplish the same result. But whenever we weld, rivet or otherwise mechanically join two metals, oxygen may penetrate to the surfaces of their contact, coating the metals with a film of metallic oxides that offers undesirable electrical resistance.

The more delicate the current to be controlled, the greater is the necessity for oxygen exclusion from vital connections in conductors. Furthermore, all metals under the influence of temperature-change react with an accompanying expansion and contraction. This is more pronounced in some metals than in others. Let us suppose that in the formation of a mechanical connection two different metals are employed, one displaying a greater co-efficient of expansion than the other. As the radio receiver may be exposed to varying temperatures, this mechanical connection will be constantly in motion until a connection is loosened.

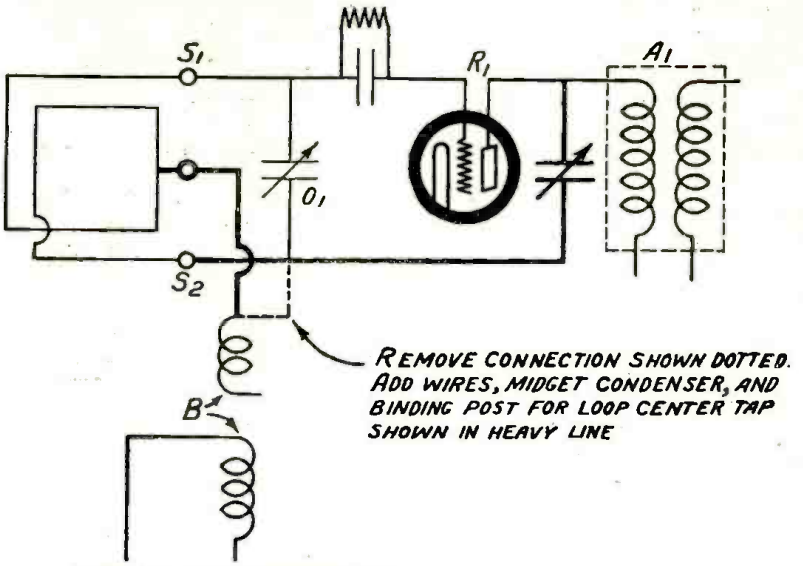
In the alloy solder we have a material that furnishes us with a means of defeating all these undermining factors of good radio reception. It is a tenacious, flexible bonding medium that will readily yield to the various strains and stresses, as well as form an impenetrable barrier against the encroachment of atmospheric oxygen.

To illustrate better the seriousness of an unsoldered joint in radio-receiver construction, consider the fact that ten such joints increase the resistance in the conductors four times in less than three months. On the other hand, the same joints, if properly soldered, will lower the resistance in the joints so protected to approximately 60 per cent of the resistance offered by the conductor itself.

So for your next set make it a point to solder-bond every connection you possibly can, for this will mean increased range and more volume.

Operating the Magnaformer

(Continued from page 424)



HOW TO ADD REGENERATION IN THE LOOP CIRCUIT

FIGURE 2: *This simple drawing shows the added wiring and the small, midget condenser, as well as a center binding post for the loop, in heavy black lines. The only wire that should be removed is that shown in dotted lines. The midget condenser will then control regeneration in an efficient and simple manner. This addition will help in extreme long-distance reception.*

ity are to be attained. But the Magnaformer 9-8 receiver does not require this external bolstering up of efficiency. The receiver is designed to provide all the selectivity and sensitivity that will ever be required.

It is realized, however, that there are many experimenters who are interested in trying all the tricks, and for them a diagram is shown, in Figure 2, covering the changes needed to add this regenerative feature.

The only changes involved are easily made. They consist of the addition of one more small jack for the third loop connection in the receiver, and the installation of a .00005 mfd. midget variable condenser. The original connections for the loop are shown in Figure 1. In Figure 2 is shown the revised connections in heavy lines. The tuning condenser is left connected across the entire loop as before, but the connection from the pick-up coil should be changed over to the middle loop terminal. The midget condenser which controls regeneration is then connected between the plate of the detector valve and the end terminal of the loop which before connected to the pick-up coil.

The third jack for the loop can be mounted at any convenient point on the sub-panel, but close to the other two jacks. The midget condenser may be mounted either on the front panel or, to avoid spoiling the symmetrical appearance of the panel, it can be mounted on a little shelf fastened on the inside of the left-hand end of the cabinet, just below the top. This latter arrangement is recommended because it will not alter the external appearance of the receiver, yet the regeneration control will be readily accessible.

For those who desire additional information on the construction and operation of the Magnaformer receiver, complete, full-size blueprints, with constructional and operating data, may be obtained from the manufacturer.

SUPER RECEPTION COMES INTO ITS OWN—

—with the new Victoreen 8-valve superheterodyne receiver. The January number of POPULAR RADIO will give complete constructional details for this new set, that embodies all the 1928 innovations in design and construction, both in the intermediate and low-frequency amplifiers. Superheterodyne fans cannot fail to be interested in this receiver.

A Real Romance of Radio

"THIS is station KFKX, Hastings, Nebraska. The next selection will be a violin duet by William and Edward Zimmer, father and son."

Marvelous as radio is, it is no more marvelous than the tale that lies behind the harmony of those two violins—a tale of real life, written in bitter and happy experiences of twenty years.

William Zimmer, a violinist educated in Berlin, fell in love with a sixteen-year-old girl in New York City and, after a whirlwind courtship, he married her. Their cup of joy seemed full when their baby came. The boy, who was named Edward, was about nine months old when Zimmer went on the road with a musical comedy company.

But he failed to return.

In time Mrs. Zimmer got a divorce and married a wealthy cotton broker named Mack.

The family moved to St. Louis, and Edward, who had shown real talent on the violin, made his *début* over the radio. He and his mother had often heard his father playing over the radio at Hastings, Nebraska.

Adverse business conditions developed and the Mack fortune was swept away. The mother realized that Edward's musical education must come to an end unless, in some way, the boy's father would help. And she devised a unique plan.

Under the name of "Edward Mack," she sent the son to Hastings to take violin lessons of his father.

Edward protested against the idea at first; he didn't care to know a father who had deserted him as a baby. But finally, to please his mother, he went.

The father tells the rest of the story:

"He had been taking music lessons of me for several weeks, and, of course, I had not recognized him. I hadn't even seen him since he was nine months old. I had worried about him and wondered about him; and I wasn't so proud of the way I had acted years before.

"Then, one day, as I was giving him his lesson, I noticed tears in his eyes.

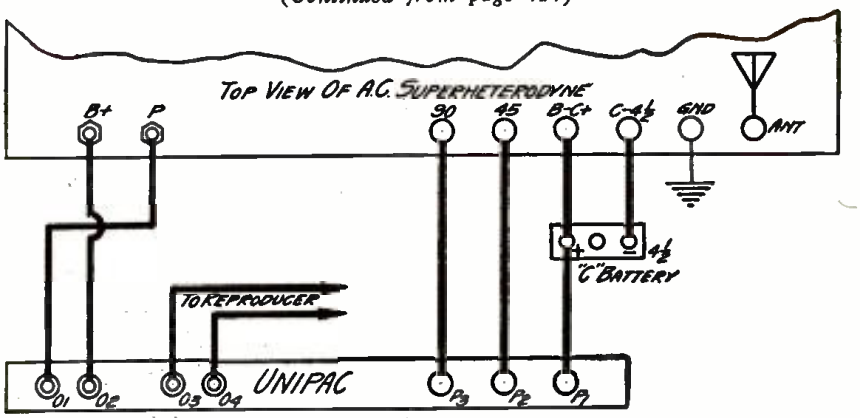
"'You are homesick for your folks,' I said. He had told me they were coming to Hastings in a short time. I threw my arm across his shoulder to comfort him, and then he broke down and told me the whole story. I was never so happy in my life!

"I then had told my present wife all about my first marriage and she insisted that Edward come into our home. He is a wonderful violinist. He plays in the orchestra I direct and I give him the solo parts, for he is a much better musician than I am. At the close of the season I shall take him to New York with me to study. I am in a position to help him now and it is my turn to do something."

—BERTHA STREETER

The New AC Superheterodyne

(Continued from page 414)



THE CONNECTION DIAGRAM

FIGURE 5: *This diagram gives the hook-up between the superheterodyne intermediate-frequency pack and the LC-28 Unipac, that contains the complete low-frequency power amplifier. One small 4½ volt "C" battery is required*

The wiring of the heater circuit, including the twisted pair of wires that run from the transformer to the heater terminals located on top of the AC valves, is not shown completely on the picture-wiring diagram, but is given in a separate diagram shown in Figure 6. This wire should be of twisted lamp cord of sufficient conductivity to carry 7 or 8 amperes. All of the heater terminals are connected in parallel, with the lamp cord twisted in the span between each valve.

When the wiring, as shown in Figure 4, is complete, the circuit shown in the schematic diagram in Figure 1, has been carried out, and the receiver is ready to be used.

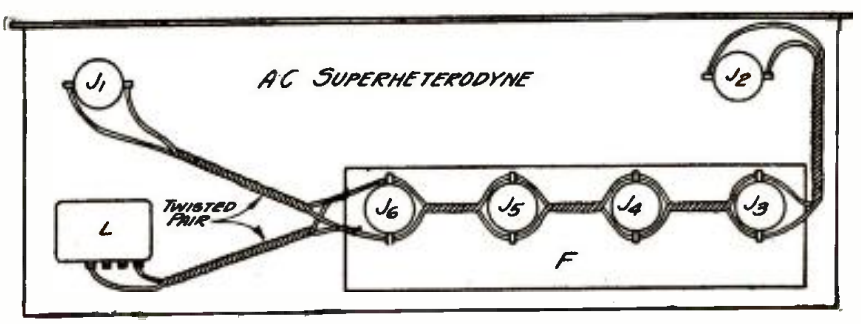
How to Install the Set

The superheterodyne high-frequency pack that has just been completed may be slipped into the cabinet or console chosen for it, according to the builder's taste, and the LC-28 Unipac, that was fully described in the November, 1927, issue of POPULAR RADIO, should be set up underneath it in the radio table or the lower part of the console. The LC-28 Unipac will furnish complete "B" voltages for the high-frequency pack and will furnish two stages of low-frequency amplification with a power-operated last stage.

Six Sovereign AC valves should be inserted in the sockets, J1, J2, J3, J4, J5 and J6, with the AC harness attached. The heater terminals of these AC valves are in the form of 6-32 machine screws, and ordinary nuts and lock washers may be used to fasten on the heater wires. It is best to solder copper terminals or soldering lugs onto the wires, in the correct positions, and then screw them down tight on the heater terminals of the valves.

Next place a Magnatron AC-226 type AC valve in socket I in the Unipac. Place a 210 type power valve in socket H of the Unipac. Place an 874 type glow valve in socket G. Then place two 216-b type rectifier valves in sockets F1 and F2. Refer to the article on the LC-28 Unipac in the November, 1927, issue of POPULAR RADIO for the designations for the sockets.

The two units may now be connected together in the manner shown in Figure 5. This gives the hook-up between the AC superheterodyne and the LC-28 Unipac, including the connections to the antenna and ground, and to the reproducer. It is recommended that a Farrand Eliptical cone or a Western Electric cone reproducer be used with this receiver on account of the response curve of the amplifier in combination



HOW TO CONNECT THE HEATER CIRCUIT

FIGURE 6: *In this diagram the arrangement of the heater cables is shown clearly. All of the AC valve heaters are connected in parallel, and get their current supply from the two outside terminals of the heater transformer, L*

with the response curve of these particular loudspeakers. These combinations work out well, giving excellent response for the entire audible range.

The combination is now ready for operation and the switch, O, on the superheterodyne may be turned "on," causing the heaters of the six AC valves to warm up.

Then the switch at the lamp socket feeding the LC-28 Unipac may be turned "on" and the amplifier will commence to function.

The sensitivity control, E, on the superheterodyne should be turned about half way. Then the two dials, N and P, may also be set about half way, and the two drum dials, K1 and K2, revolved in unison until a signal is picked up.

Both the volume and the quality may then be adjusted to the operator's taste by the three controls, E, N and P. There will be no other adjustments to be made either in the set or in the Unipac and all that will be necessary to do to tune in other stations will be to revolve the two dials, A1 and A2, and to make the adjustments on the three middle controls as indicated by their designations on the front panel; one for sensitivity, one for gain and one for filament adjustment.

It should be remembered in turning the set "on" or "off" that the filament switch on the set should be turned "on" first and then the Unipac should be turned "on." The Unipac should be turned "off" first and then the switch on the superheterodyne should be turned "off."

The sensitivity of the new receiver and its excellent tone quality, together with its ease of control, and the complete absence of worry or bother in upkeep of batteries or charging, should make the receiver a popular one with broadcast listeners, and especially those who want an ultra-sensitive superheterodyne of the most modern design.

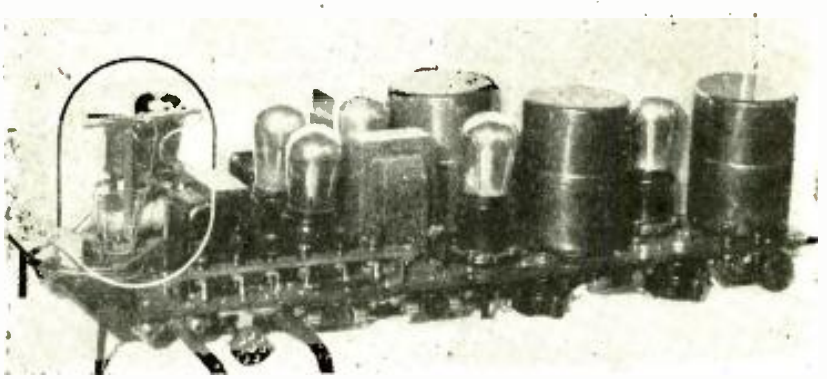
The Octa-monic Circuit

(*Continued from page 427*)

The Octa-monic, as shown in Figure 2, is subject to some limitation in regard to sensitivity, as the signal strength of the incoming carrier wave must be sufficient to operate the grid to a point where unequal amplification occurs and harmonics are generated. This means that extremely weak signals will not operate the harmonic valve and accordingly will not be heard. Some method of amplification must be employed ahead of the harmonic generator to insure the pick-up of weak signals. Such an amplifying system does not have to possess any particular selectivity, since selectivity is obtained by the harmonic principle. Amplification alone is the only consideration for this part of the high-frequency circuit.

Tuning with a Push Button

(Continued from page 422)



A SELF-TUNING RECEIVER

FIGURE 2: *The automatic tuning receiver perfected by Mr. Burns is shown here without the cabinet, so as to give an idea of the layout of the instruments. The tuner valve and relay which actuates the tuning motor are in the circle at the left.*

eration, such as either releasing or pressing a push button, we may have a remote control device, but not an automatic tuner. Third, when the tuning unit is in resonance with received signals, it must be possible to start the movement again, so that the tuner will go on to signals of another frequency, by simply pressing the button. A self-tuner, therefore, includes three units: first, a motor unit which can be set in operation by the simple act of pressing a button and which will operate the moving part of the tuning unit; second, a relay actuated by voltage or plate current variations at resonance and which will stop the motor and hold the tuning unit as soon as it reaches a point of resonance. The relay and motor mechanism should act in a very small fraction of a second, so that the tuning unit will not be carried beyond the point of resonance before the stopping mechanism acts. There must also be a reset unit to start the motor unit again in action. The relay and reset units can be combined in one, as will be shown.

I shall describe the self-tuner as applied to capacity tuning, though it would apply as well to inductance tuning.

The motor unit which we used turns the condenser plates at the rate of one revolution per minute. No gearing is necessary, as the shaft of the motor unit has a speed of 1 r.p.m. The motor unit shaft is connected directly to the condenser shaft. The motor is synchronous and the minute gearing, in a ratio of 3,600 to 1, which is a part of the motor unit, is completely enclosed in the same housing with the motor armature.

To make clear the operation of the relay in our self-tuner, it will be necessary to review the action in the plate circuit of an amplifier valve. The variations in grid voltage produced by received signals cause variations of plate current above and below a constant mean value. This constant mean value is the DC component. If the valve is operated on the straight portion of its characteristic curve, the plate current increases just as much above the mean value as it decreases below that value, and the positive and negative amplitudes are equal, so the average value of the plate current remains constant. This is shown at A in Figure 1. If, however, the action takes place near the lower bend of the curve, the increase above the average value is greater than the decrease below that value, the positive amplitude is greater than the negative amplitude, so that while impulses are coming in there is an increase in the average value of the plate current. This is shown at B in Figure 1. Whether the valve operates on the straight portion or the bend of the curve depends on the plate and grid voltages, so that it is a simple matter to adjust the action of the valve to the desired part of the curve. The plate current surge can be made to operate a relay and stop the action of the motor unit. The relay can be adjusted so that it will operate only on a surge of a certain value, say 1 milliampere, above the average value.

It would be possible to adjust the grid voltage of the last low-frequency valve of the receiver so as to cause it to act at the lower bend of its curve, and use the plate current surge to operate a relay. This would not be desirable, however, since it would mean distortion in the output. An amplifier valve should work on the straight portion of its curve. We may solve this difficulty by connecting another valve, after the manner of a vacuum valve voltmeter, across the secondary of the last low-frequency transformer. This we shall call the tuner valve. As the tuner valve is not in the receiving cir-

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To use the new power tubes with Na-Ald Connectoralds, just insert the tube in the Connectorald, attach the leads of the connectorald to the extra "B" and "C" batteries, and put the tube and Connectorald into the set.

Na-Ald Connectorald are supplied for every desired combination. These devices are especially designed to give most efficient operation for particular conditions. Like tubes, they are delicate apparatus, and must be carefully handled.

NA-ALD SILENCER SOCKET, with its many patented features, is unequalled. Its contact is a constant pressure triple phosphor bronze of N shape, presenting a parallel face to the entire length of the tube prong. This pressure is firm, removing corrosion from tube prongs and making positive, low resistance contact.

Insert a tube in one of these sockets, noting that it brightens the full length of the tube prong, although it goes in readily and is removed easily from the socket.

Examine a cross section and you will see that a firm, constant pressure is exerted all along this brightened surface. Being sure of perfect contact, regardless of how much used or how irregular the tube prongs are—the contact shapes itself in a resilient bow, like an automobile spring.

The socket is moulded so that no amount of abuse, twisting, or tugging can injure these flexible contact springs that allow the tube to move upward, downward, laterally and pivotly. Because of this resiliency, all possible vibrations are instantly absorbed and not transmitted to the tube.

Once again, the contact counts in making for perfect reception, in that Na-Ald Silencer Sockets can fit neatly and snugly to panels and with four small holes in the panel provide extension tabs for soldering leads. The soldering tabs are the same piece of metal that contacts with the tube prong, this direct connector avoiding loose or noisy connections.

For above panel, the binding post connections can be used or the solder tabs can be brought out below the base. Na-Ald Silencer Socket is made round, so that it can be turned for the most convenient wiring. This also lends itself to mounting on metal panels, holes being punched with clearance for the solder tabs on a round hole of 1" diameter which can be punched and the base bolted to the panel, the round collar protruding.

Na-Ald Silencer Sockets do not depend upon screws to hold the contacts in the button, but are held by a retainer ring so moulded that it becomes an integral part of the socket.

Twisting or pulling cannot injure the socket or contacts. Stops prevent lateral twisting, and an arc-shaped stop retains the proper shape of the contact when pulled upward.

Na-Ald Silencer Sockets are Alden Processed Synthetic mouldings, double cured for the highest electrical insulating qualities, as well as the greatest mechanical strength.

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cuit, we can place its action at the lower bend of its curve without introducing distortion in the receiver output. Figure 3 shows the relation of the tuner valve to the last low-frequency stage.

It is possible to bias the last low-frequency valve and the tuner valve so that the one will act on the bend of its curve and the other on the straight portion. Let E_{b_1} be the voltage of battery B_1, E_{b_2} the voltage of battery B_2, E_s the voltage impressed on the transformer secondary by the two batteries, E_{g_1} the voltage impressed on the grid of the amplifier valve, and E_{g_2} the voltage impressed on the grid of the tuner valve. E_s is common to the two circuits. We have, therefore, the following relations:

$$E_{b_1} = E_{g_1} + E_s$$
$$E_{b_2} = E_{g_2} + E_s$$

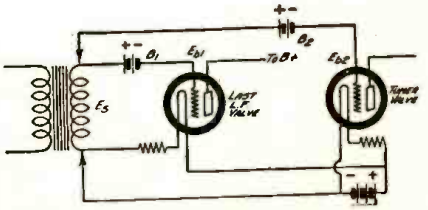
Eliminating E_s, we get

$$E_{b_1} - E_{b_2} = E_{g_1} - E_{g_2}$$

By adjusting the values of E_{b_1} and E_{b_2}, we can make the difference between E_{g_1} and E_{g_2} whatever we choose. Practically, we can connect a milliammeter in the plate circuit of each valve and adjust the grid voltages so that we get a surge in the plate circuit of the tuner valve and no surge in the plate circuit of the amplifier.

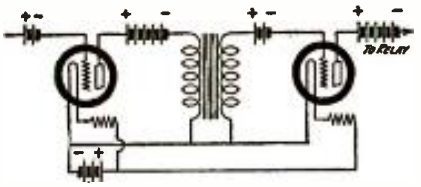
Since the grid current of a valve with a negative bias is practically zero, the tuner valve takes no energy from the receiving circuit. The only effect of the tuner valve on the receiving circuit is that of grid voltage. The grid voltage of the amplifier is not that of its own grid battery, but depends on the voltages of the two batteries, as we have shown. This does not matter, however, since by adjusting the two batteries we can make the grid voltage of the amplifier whatever we choose. We can, therefore, secure our plate current surge without introducing distortion in the output of the receiver. We have the distortion in the output of the tuner valve—which is where we want it.

We can now amplify the output of the tuner valve with another valve and secure a greater plate current surge. This last valve we shall call the tuner



THE TUNER VALVE CIRCUIT

FIGURE 3: *The tuner valve is connected in parallel with the last low-frequency valve; this arrangement prevents distortion in the amplifier output.*



THE HOOK-UP FOR THE TUNER VALVE AND TUNER AMPLIFIER

FIGURE 4: *At the left is the tuner valve, connected in the receiver circuit as shown in Figure 3. At the right is the tuner amplifier; its output is connected to the relay, which controls the motor.*

amplifier. There are various methods of connecting the tuner valve and the tuner amplifier. In the receiver shown in Figure 2 a form of inductance coupling is used. This is shown in Figure 4. Using a CX-340 valve as a tuner amplifier, we get a plate current surge of from 1 to 3 milliamperes. By the method described advantage may be taken of both voltage oscillations and plate current surges. The voltage oscillations across the transformer secondary act on the grid of the tuner valve and the plate current surges occur in the tuner circuit, where they do not affect the quality of the receiver output.

In the relay we used 60,000 turns of No. 42 enameled wire, approximately 15,000 ohms, with a core and housing of Norway iron. The armature operates on a surge of about 0.8 milliampere. A surge of this value, or greater, breaks the motor circuit. Since the motor current is approximately 40 milliamperes, there is very little arcing at the contacts. The small amount of arcing that would occur can be practically eliminated by the use of a condenser. A simple form of detent holds the relay armature in position to keep the motor circuit open.

The reset device is simply an electromagnet mounted directly above the relay and connected to the "A" battery of the tuner valve and a push button. The push button may be at the end of a cord as long as desired. When this button is pressed, the magnet lifts the detent, the relay armature closes the motor circuit, and the motor begins to turn the condenser plates at one revolution per minute. When the tuning unit again comes to resonance with signals, the relay breaks the motor circuit. The action is practically instantaneous, since the motor is dead beat. If another station is desired, the button is pressed again and the receiver is tuned to resonance with the next station on the scale that is broadcasting. We have a design for an indicator which can be attached to the set, if desired, and which will indicate at a distance the frequency to which the circuit is tuned.

It can be seen that the automatic tuning control described here does not require the building of a new receiver, but may be added to any receiver with a few easily obtainable parts.

WITH THE INVENTORS

CONDUCTED BY WILLIAM G. H. FINCH

THIS *department will keep you in touch with the latest inventions of interest on which patent rights have been granted, and which are significant contributions to radio art.*

A Novel Means for Sound Reproduction

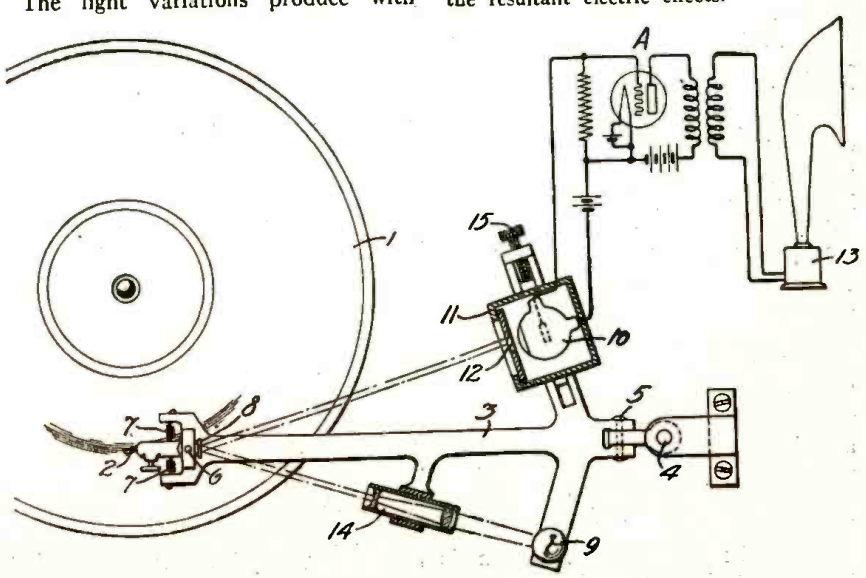
EDWARD B. CRAFT, of Hackensack, N. J., has patented a novel means for reproducing sound. Briefly described, and illustrated in Figure 1, the invention comprises the translation of the sound undulations in a record into variations in light, the translation of the light variations into electrical variations, and the reproduction of sound from the electrical variations after they have been amplified to any desired extent and distributed to any desired point or points.

The light variations may be produced by deflecting a beam of light by a mirror actuated by the usual reproducer needle when the needle passes over the sound record, or vice versa. As the mirror and its actuating mechanism may be made to have extremely small mass, the light variations may represent, to a high degree of accuracy, the recorded undulations.

The light variations produce with high accuracy equivalent electrical variations, and these, in turn, may readily be amplified with negligible distortion to the desired volume and distributed as desired. At the point or points where the sound is to be produced, the usual loudspeaking telephone apparatus may be employed.

Claim 1 reads:

In a sound reproducer, a record having a record groove containing undulations representing sound, an oscillation member mounted so as to be free to oscillate about an axis, means to produce relative movement between said record and said member to bring successive portions of the sound record into operative relation with said member, and to cause oscillations of said member in accordance with the recorded sound undulations, a light-sensitive, electro-responsive element, means to throw a beam of light from said oscillation member to said element, and to vary the illumination of said element by said beam in accordance with the actuation of the member by the sound undulations, means to make the variations in illumination of said element independent of the position of said axis with respect to said record, and means to produce sound from the resultant electric effects.

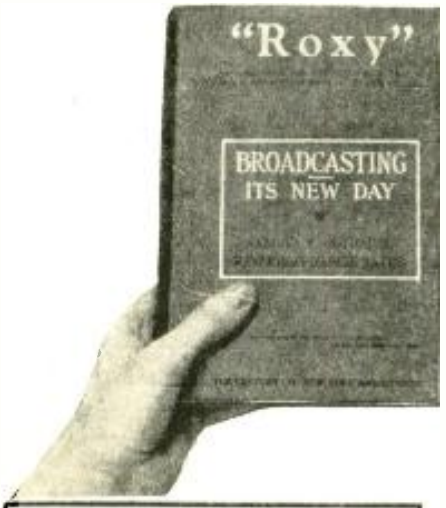


A NOVEL SOUND REPRODUCER

FIGURE 1: *The sound undulations in the record are translated into variations in light and then into electrical variations. These latter are passed through an amplifier and then into the loudspeaker.*

Do You Want A Free Copy of Roxy's Amazing New Radio Book?

Radio's greatest impresario, collaborating with Raymond F. Yates, Editor of POPULAR RADIO, gives his startling private views and predicts revolutionary changes in broadcasting.



CONTENTS

Broadcasting, Its New Day

By

S. L. ROTHAFEL (ROXY)

and

RAYMOND F. YATES

Hundreds of thousands of fans who listen to Roxy's weekly concerts have often wondered what he really thought of the big problems of broadcasting and the radio art in general. Now, for the first time, Roxy gives his answer to the big radio questions of the day in the most fascinating, edifying and readable book that has ever been published. In his extremely likable way, Roxy gives his impressions of broadcasting. He not only criticizes, but he suggests startling improvements and needed reforms in the presentation of programs. Roxy tells you what he thinks of radio as it effects the impresario, politics, religion, education and commerce. And he answers, once and for all time, that great question: "Where is broadcasting going, and how will it get there?" You will be surprised and amazed by Roxy's original thoughts on what is today the world's greatest form of entertainment.

The latter portion of the book is given over to a startling prediction of the technical future of the radio art; telling in a simple, readable way of the improvements in short-wave transmission, television, telephotography, receiving sets, tel-mechanics, and the transmission of power through the ether of space. The book is really a liberal education in radio, and treats not only its human side, but its technical side as well.

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Thousands of people have been willing to pay $2.00 for this book. Now, for the first time, it is available to the readers of POPULAR RADIO who enter their subscription for a period of one year at $3.00 per annum. The book contains 316 pages and is liberally illustrated with heretofore unpublished photographs and simplified diagrams depicting the marvelous technical advancement that has taken place during the past five years. No intelligent person will want to remain ignorant of the great questions that BROADCASTING, ITS NEW DAY, answers.

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A Simple and Efficient Wavemeter

PAUL T. PLATT, of Norfolk Downs, Mass., describes several improvements in wavemeters, which are intended to be used to help an operator to tune his broadcast receiver to any predetermined wavelength, in patent No. 1,582,780.

The wavemeter that he describes is relatively simple in construction, but is highly efficient in operation, thus making it possible to tune a non-oscillating receiving set with very great accuracy to any desired wavelength within the range of the wavemeter.

The main object of the invention is to provide a radio wavemeter, employing a single three-electrode vacuum tube, which is entirely silent itself, in operation, but which oscillates at audio frequencies, and causes to be radiated a radio-frequency wave. This wave is modulated by an audio-frequency wave that may be picked up on a non-oscillating receiver, and that produces a tone that is pure in character and that is very easy to tune in sharply.

Figure 2 shows a device that embodies the invention. It comprises an oscillating three-electrode vacuum tube and means to tune the associated circuit to any desired wavelength within the range of the instrument. The associated circuit is of such a design that a radio-frequency wave is produced and radiated.

Audio-frequency oscillations are produced by reason of the fact that the circuit action causes the grid of the vacuum tube to choke periodically. This blocking action causes periodic interruptions in the radio-frequency oscillations, which are inaudible in themselves, and divides them into groups of oscillations that occur at much lower and audible frequencies. This causes to be radiated a radio-frequency signal of low power, modulated by an audio frequency, which may be picked up on a non-oscillating receiving set.

Figure 2 is a wiring diagram that illustrates the principle of the invention.

Figure 3 shows a part of a calibration sheet.

In the diagram, 1, 2 and 3 indicate the filament, grid and plate, respectively, of a three-electrode vacuum tube. The filament is connected to the low voltage or "A" battery, 4, through a filament circuit, 5, the latter having the usual rheostat, 7.

The high-voltage or "B" battery is indicated at 8. This is connected to the plate through the plate circuit, 9, as usual. The grid circuit is shown at 10.

The theory of operation is as follows. A large, double, plate-winding, specially interconnected, is close-coupled in fixed relation to the tuned grid inductance. With the filament circuit closed and a moderately high "B" battery potential applied to the plate, there is a tendency

SM

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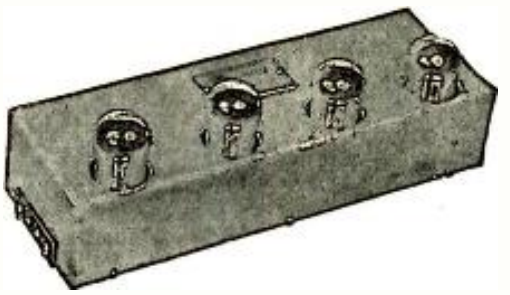


WITH a greater degree of selectivity, with a greater amplification factor—the 440 Jewelers Time Signal Amplifier offers possibilities never before realized in long wave amplifier construction. It is more accurate—with a finer degree of calibration — than any long wave amplifier that may be built from standard parts today. It's so good that it simply can't be beaten—with any combination of individual parts or anything else. It is housed in a copper and brass catacomb which completely and individually shields the three radio frequency and detector stages. The 440 Time Signal Amplifier is tremendously popular already, for thousands have been sold this season, simply because it's the best long wave amplifier ever developed. It is tuned exactly to 112 K. C., the 2677 meter wavelength of the Naval Observatory station at Arlington (NAA). Price $35.00.

We Could Charge More—But a *Better* Transformer Can't Be Made

That's a cold statement about the S-M 220 audio transformer, but it takes steel and copper to make the best transformer. The size and weight of the S-M core—the countless turns of wire—these are the things that produce real transformer quality. And where will you find a heavier or higher grade silicon steel core—where will you find more copper than in the S-M 220? The 220 has from 25 to 50 per cent more steel and copper in its construction than any other transformer on the market. We could charge from 25 to 50 per cent more for them than we do, but at no price can you get a better transformer. Do you wonder why it's sold on an unconditional guarantee to give you better tone quality than any other audio amplifying unit available? The 220 audio is $8.00, and the 221 output is $7.50. Of unapproachable quality, they are *priced* low, but not merely made to sell at a low price.

We can't make the 220's cheaper, but if you desire a transformer somewhat lower in price, taking up a little less room, and with a little less core and wire, the new 240 audio and 241 output transformers are larger than practically all other transformers, and are far superior to items at twice their price. They have the same general characteristics as the famous 220's and 221's, but provide slightly less accentuation of frequencies below 80 cycles. They have the same 5000 cycle cut-off for which 220's are famous, eliminating many of the objectionable whistles and heterodyne squeals. The 240 audio sells for $6.00 and the 241 output is $5.00. Hard to beat at any price, it is impossible to equal them at their prices.

S-M audios have outsold all other transformers. They are specified for more prominent circuits than all others. The reason is obvious.

They are better.

That's all.

THE LC-28 UNIPAC

The LC-28 Unipac is Mr. Cockaday's own selection—the ideal low frequency amplifier and power supply for the LC-28 receiver; and the two together provide a perfectly coordinated tone and power combination.

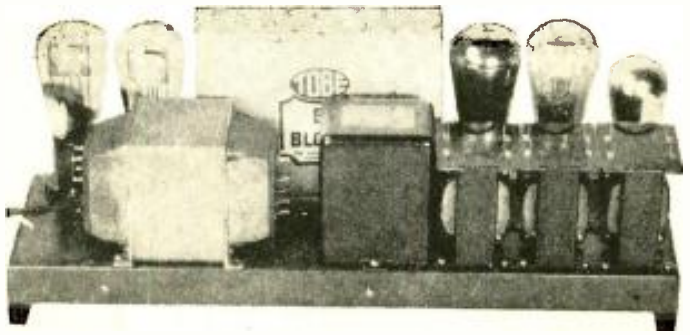
The LC-28 Unipac is a two-stage light socket operated power amplifier using one CX-326 A. C. tube in the first stage, and a CX-310 super power amplifier in the second stage. A combination of the new, specially developed, S-M audio and 241 output transformers gives perfect tone and uniform amplification to all frequencies from below 100 to above 5000 cycles where used for phonograph or radio amplification. The CX-310 tube, with a full 425 volts on its plate, results in beautiful rounded tone with ample volume, while the power supply, furnishing all ABC power to the Unipac amplifier, also supplies B potential to any receiver at 45 and 90 volts, with automatic glow tube voltage regulation.

Like all other S-M Unipacs (push-pull 171 or 210 types) the LC-28 is housed in a beautiful brown crystal-finished steel case which protects all parts and safely encloses all tubes and high voltages—for over 475 volts is delivered by the full wave rectifier using two CX-316B or CX-381 tubes.

Though especially designed for Mr. Cockaday's new set, the LC-28 Unipac will operate as an entire two-stage power audio amplifier and B power supply with any receiver at all. Used to replace the entire audio system of older receivers, it will also eliminate all B batteries and provide a quality of reproduction which is a positive revelation in tonal beauty.

The LC-28 Unipac may be procured from any good dealer as a kit ready to assemble, priced at $81.25, or individual parts may be procured if desired.

There are many other Unipac models—they may be built in many different ways for any sort of power and audio combinations and as phonograph amplifiers. Ask us to send you the complete Unipac literature.



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Name.....

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to violent radio-frequency oscillations.

However, the grid condenser is bridged by a very high resistance grid-leak, of such high resistance that the grid of the vacuum tube chokes periodically, thus dividing the high-frequency pulsations that are generated, into groups which occur at audio frequency. This results in the radiation of an audio-frequency signal, which is tuned to the desired wavelength by the variable condenser shunting the grid inductance.

The frequency of the audio wave may be varied, within moderate limits, by the adjustment of the filament rheostat. Audio-frequency variations, of this sort, have no effect on the wavelength calibrations.

On a given rheostat setting, there will be very little variation in audio frequency at the opposite ends of the wavelength scale of the wavemeter. This is due to the constants and the arrangement of the grid and plate circuits, which are such that audio pulsations are freely produced throughout the wavelength range of the instrument.

The frequency of the received audible note corresponds to the frequency of the grid blocking action in the wavemeter. This action changes an inaudible oscillation of, say, 1,000,000 cycles, to an audible one of approximately 100 cycles, or higher as desired.

In Figure 2, the large, double, plate winding is shown at 11 and the tuned grid inductance with which this plate winding is close coupled is indicated at 12.

The variable condenser by which the tuning is effected is indicated at 13. This condenser is operated by any usual control.

The usual grid condenser in the grid circuit is shown at 21 and 14 is the high resistance grid-leak which bridges this condenser.

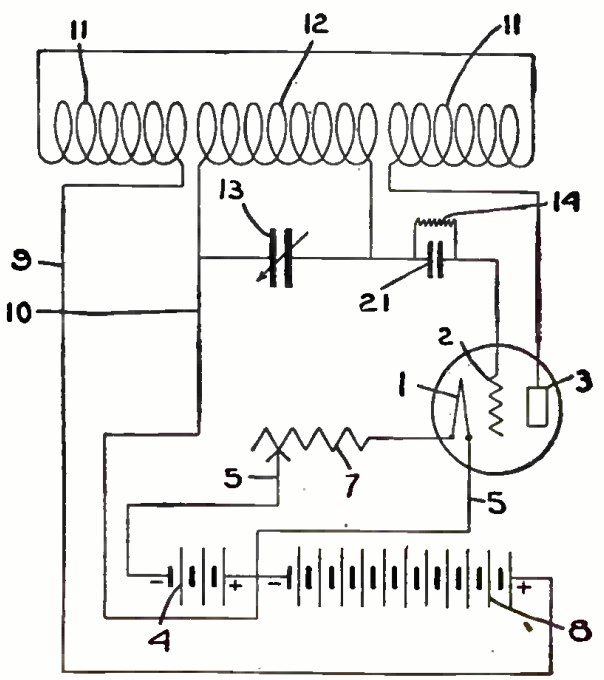
One use for which this wavemeter is intended to be used is to assist a person to tune his receiving set exactly to any predetermined wavelength.

In order to use the wavemeter it is necessary to have it calibrated and to employ a calibration curve. The calibration of the instrument consists in determining the wavelength values corresponding to the various settings of the variable condenser. This information must be obtained from a standard source before the wavemeter can be used.

Figure 3 illustrates a partial list of hypothetical calibration adjustments. The figures under the columns labeled "Dial" indicate the reading by dial divisions for the variable condenser; the figures in the column labeled "Meters" indicate the corresponding wavelength.

According to this calibration, if the variable condenser is set at 37 the vacuum tube produces radio-frequency oscillations tuned to a 300-meter wavelength; if the variable condenser is set at 38, the wavelength of the emitted signal will be 306 meters. A setting of the variable condenser at 39 will cause an audio radiation tuned to 312 meters.

Assuming that the operator desires to set his receiving set for the reception of a broadcast on a 306-meter wavelength, he should adjust the variable condenser of the wavemeter to indicate "38." When the filament circuit is closed through the rheostat the vacuum tube of the wavemeter will cause radio oscillations to be radiated tuned to 306-meter wavelength.



THE CIRCUIT DIAGRAM OF THE WAVEMETER

FIGURE 2: *This simple and efficient wavemeter may be used to tune a receiving set to a predetermined wavelength or to find the wavelength of any received signal.*

DIAL	METERS
31	267
32	272
33	278
34	283
35	289
36	295
37	300
38	306
39	312
40	319
41	325

A CALIBRATION SHEET

FIGURE 3: *The wavemeter must be carefully calibrated before it is ready for use.*

The grid-choking action of the tube produces a radio-frequency wave tuned to 306 meters which is modulated by audio frequency and may be readily picked up by the non-oscillating receiver.

The wavemeter should be placed from 1 to 10 feet away, according to the sensitivity of the receiver.

After the wavemeter has been adjusted for any particular wavelength and set in operation, the operator should tune his receiving set to the wavemeter. This is done by adjusting the controls of the receiving set until the wavemeter signal comes in clear and strong, and at maximum intensity.

The operator then knows that his set is tuned exactly for the reception of radio transmission on a wavelength of 306 meters. The wavemeter is then shut off and the receiving set is in condition to receive any broadcast which may be coming in on the 306-meter wavelength.

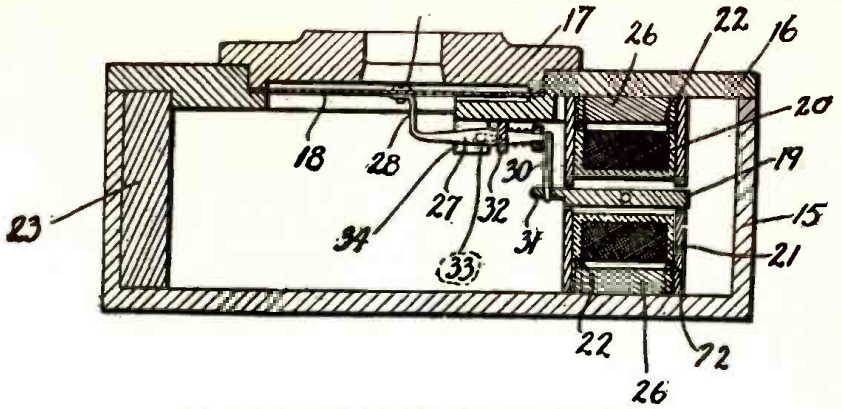
The wavemeter may also be used to ascertain the wavelength of any broadcast which has been picked up by the receiving set.

In this case, the wavemeter should be put in operation and its variable condenser rotated until the audio-frequency wave generated by the wavemeter is distinctly heard, together with the broadcast, after which a reading is taken of the wavemeter's condenser setting.

This method will give accuracy to within a meter or two. If greater accuracy is desired, the filament rheostat of the wavemeter may be adjusted so that straight radio-frequency oscillations are produced, after which a zero beat adjustment on the broadcast station's carrier wave can be made.

Claim 1 reads:

A radio wavemeter, said wavemeter comprising a single oscillating vacuum tube with filament, grid and plate circuits therefore, a two-section winding in the plate circuit, said sections being connected at their outer ends, a tuned inductance in the grid circuit situated between the inner ends of the two sections of the winding in the plate circuit, a grid condenser in the grid circuit and a high-resistance grid-leak bridging said grid condenser, whereby a periodic grid-choking action is produced which causes the radio-frequency oscillations to be broken into groups occurring at audio frequency over a wavelength band of at least 188 to 555 meters.



AN IMPROVED TYPE OF LOUDSPEAKER CONSTRUCTION

FIGURE 4: *Instead of a rigid connection between the diaphragm, 18, and the loudspeaker armature, 19, the inventor uses the lever system shown, which has a semi-rigid pivot. The purpose of this arrangement is to prevent unnecessary wear on the system.*

New Developments in Loudspeaker Construction

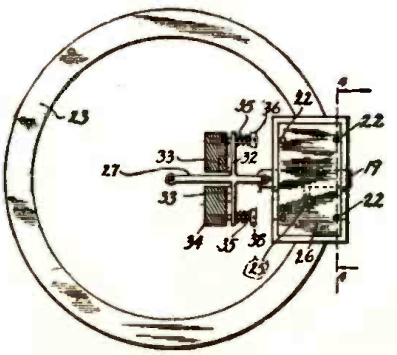
SEVERAL improvements in the construction of loudspeakers that are used with radio receivers are given in patent No. 1,571,452 which was recently issued to John J. Low. These improvements are illustrated in Figures 4 and 5.

In radio loudspeakers there are generally two factors that hurt their commercial success.

The first of these is the fact that countercurrents are set up in the solenoid because of the magnetic lines of force that emanate from the permanent magnet and that traverse the solenoid winding. These countercurrents affect the armature to the extent that they produce that familiar and objectionable roaring sound at the diaphragm which so injures the clarity of the sound that is produced.

The second factor is the rigid connection between the diaphragm and armature which generally causes an early disintegration of the mica diaphragm, and which also prevents the control of the volume of sound that is produced.

The purpose of this invention is to provide a loudspeaker construction that will eliminate these undesirable features.



A TOP VIEW OF THE LOW LOUDSPEAKER

FIGURE 5: *The pole faces of the permanent magnet, 23, are shaped in such a manner that the lines of force between them do not cut the winding of the electro-magnet.*

A Novel Crystal Detector

T. E. ARUNDEL, of Omaha, Nebraska, was recently granted patent No. 1,569,446 for a new type of crystal detector.

This invention aims to provide a detector that is of a permanent nature, but in which the crystal may be replaced.

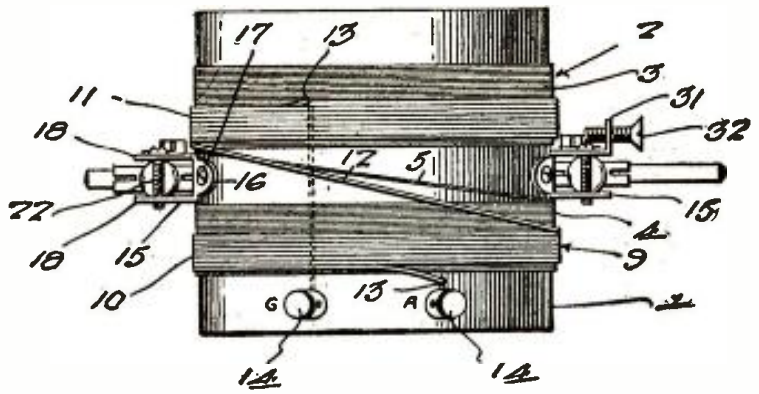
At the same time it is hoped to obtain by means of this detector a clearness and intensity of reception which will be even greater than is given by the most efficient crystal receivers at present.

Another feature of this invention is a provision for a variable or adjustable contact surface that comprises an infinitesimal number of contact or detector points that are so relatively positioned that only a slight adjustment between the surfaces is necessary to renew or change the relation between the contacts. In this way a few loud or clear points of contact are insured at all adjustments.

A further object of the invention is to provide a detector that has complemental surfaces which are adapted to be brought into proper contacting positions. These surfaces may have abrasions or roughened surfaces arranged promiscuously upon them so that variable and unpredetermined contacts may be made during the relative movements of the surfaces. This will always insure new combinations of contacts.

In addition, a provision is made for a means of renewing or increasing these contact surfaces so that, when they wear or grind down, they may be renewed. This is accomplished by a relative adjustment of the surfaces that are incident to the abrading action.

This invention also provides a substance of an abrasive or granular nature that is pocketed between the relatively movable surfaces of the detector. This is adapted to cut and abrade the surfaces irregularly so as to cause the irregular projections or depressions that are essential to the formation of the contact points in the detector



A THREE-CIRCUIT TUNING COIL

FIGURE 6: *The secondary is divided by the "tickler" shaft into sections 3 and 4; sections 10 and 11 of the primary are wound over the former.*

An Improved Type of Inductance Coil

IMPROVEMENTS in inductance coils are the basis for patent No. 1,567,600 which was recently granted to Patrick J. Kelly, of Philadelphia, and which is illustrated in Figures 6 and 7.

An interesting feature of the invention is a provision for an inductance that has a plurality of coils that are arranged for cooperation. They are constructed in predetermined proportions that are adapted to be interposed in the antenna, plate, grid and filament circuits of a tube receiver.

The coils cooperate to transform and amplify the signals that are received in the antenna circuit, thus increasing the distance reception range of the set and increasing the amplification of the signals in the circuit.

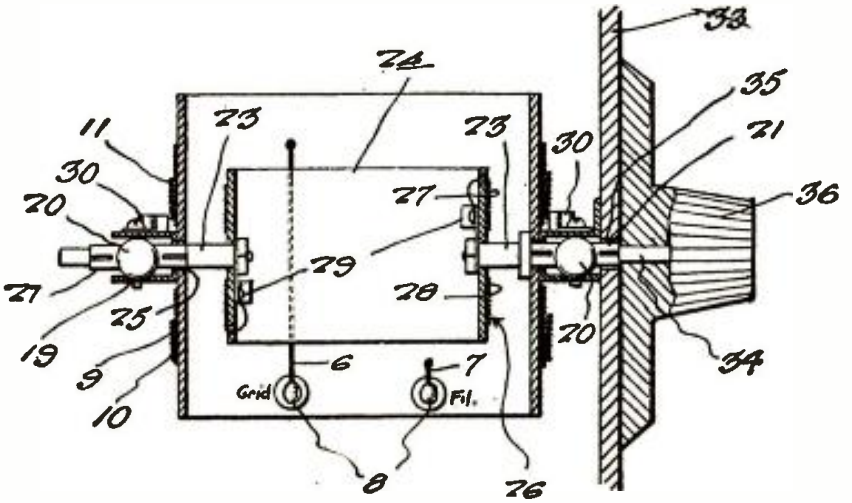
Another object of the invention is to provide an inductance coil that comprises a stationary tube upon which is wound a secondary winding. The winding is arranged in spaced sections of equal inductive value on the tube. Superposed on the secondary is a primary that is formed of spaced coil sections of predetermined inductance value equal in each section, and that has a predetermined relation with the sections of the secondary (as shown in Figure 6).

The primary is arranged in a special relation to the secondary coil section as it is connected in the antenna circuit and the secondary is connected in the filament and grid circuits of the radio receiver while a movable coil member is rotatably mounted within the tube, on an axis extending between the sections of the secondary coil.

This movable coil is also formed in spaced sections of equal inductive value and it is adapted for connection in the plate circuit of the receiving set, in order to produce a cooperation with the stationary primary and secondary coils so that signals received in the primary circuit will be transformed and amplified in the secondary coil and in the movable coil. In this way a maximum range of reception in the set and amplification in the receiving circuit may be obtained.

Claim 1 reads:

An inductance coil for radio receiving apparatus comprising a secondary stationary inductance, formed in a pair of separated sections mounted in axial alignment, a primary winding formed in a pair of sections superposed on the sections of the secondary winding in concentric relation, and a movable inductance coil of smaller size than the first mentioned coil rotatable on an axis extending between sections of the coil.



A CROSS SECTION OF THE TUNING COIL

FIGURE 7: *The position of the rotatable "tickler" or plate coil is shown here. Its winding is also divided into two equal sections, 27 and 28.*

A Reliable Short-Wave Transmitter

PATENT No. 1,585,244, issued to William H. Hoffman, of Madison, Wis., describes an invention which has to do with the generation of high-frequency oscillations for radio transmission. It is directed more particularly to an improved vacuum-tube oscillator which is especially well adapted for use in generating extremely high frequencies, or, what amounts to the same thing, for use as a short-wave transmitter oscillator.

Probably the greatest problem which has had to be contended with in the efforts which have been made to develop short-wave transmission, is that of maintaining a sufficiently high degree of stability. When such extremely high frequencies are generated, slight disturbances, which would not have any noticeable effect at lower frequencies, are often serious enough to vary the frequency to such an extent as to make reception very difficult, if not impossible.

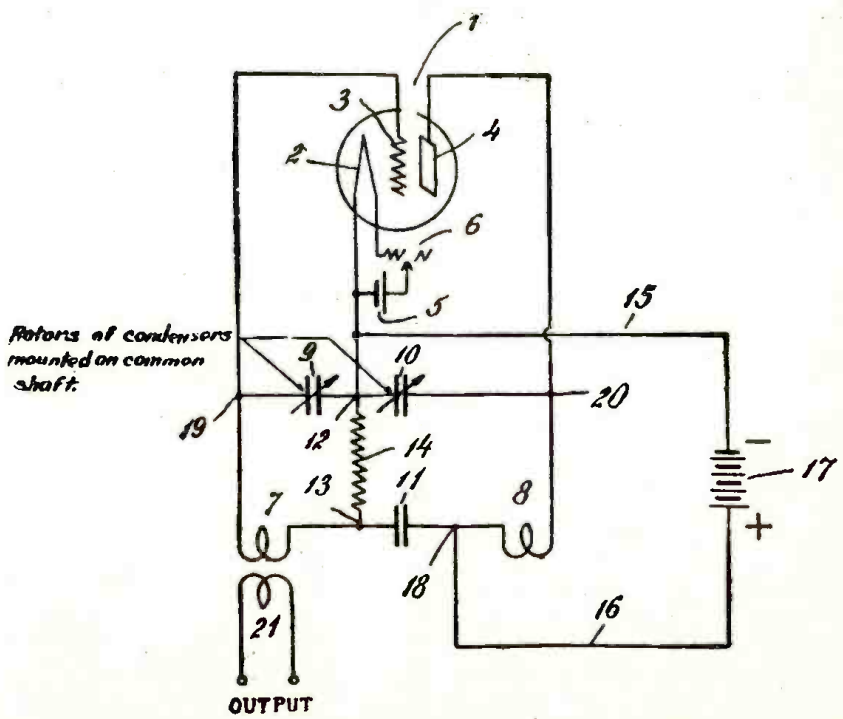
Tireless efforts have been made by those interested in the development of short-wave transmission toward overcoming this lack of stability, but it does not appear that a great deal of progress has so far been made in that direction.

The present invention is the result of careful analysis of the probable causes of instability carried on concurrently with cut and try experiments. The experiments were started at about 600 meters and the wavelengths gradually reduced until 3 meters was reached. Observations were made at each step and any tendency toward instability noted and efforts made to analyze the causes of such instability. The ultimate outcome was that when the wavelength of 3 meters was reached a circuit had been developed which was just as reliable and stable at that wavelength as at the longer waves.

In the high-frequency generator thus developed there is a high-frequency oscillatory circuit consisting of inductances and capacities, to different points of which the respective electrodes of the vacuum tubes are connected. The high-frequency oscillatory circuit contains capacity and inductance elements which are so proportioned, with respect to each other, that it constitutes an arrangement equivalent to a high-frequency bridge.

Across two equipotential points of this bridge there is connected a high-resistance element, forming a leakage path for the grid; the direct current supply for the plate circuit is also connected across the same or equivalent points. By virtue of this arrangement the direct current source and leads are kept out of the high-frequency circuit and it appears that the extraordinary stability of the generator is largely due to this fact.

Tuning is preferably effected by means of a pair of variable condensers, the rotatable plates of which are mounted on a common shaft so that their capacities may be increased and decreased simultaneously. These condensers each form one arm of a high-frequency bridge. They are usually so designed that they have substantially equal capacities for each setting, although this is not essential; it is only necessary that they be so proportioned that the bridge is at least approximately balanced for all settings of the condensers.



THE CIRCUIT DIAGRAM OF THE TRANSMITTER

FIGURE 8: *This short-wave transmitter, developed by Mr. William H. Hoffman, is said to be able to transmit on a wavelength as low as three meters with as much stability and reliability as on the longer wavelengths.*

The circuit diagram, shown in Figure 8, illustrates the exact arrangement with which these unusual results were obtained but it should be realized that some little modification is possible without detriment to the efficiency and stability of the system.

In Figure 8, 1 is a three-electrode vacuum tube comprising a cathode or filament, 2, a control electrode or grid, 3, and an anode or plate, 4. A filament heating battery, 5, together with a filament control resistance, 6, are provided. For low-power purposes the tube may be of the type commonly used in radio receiving apparatus (UV-201-a, for example).

It has been commonly supposed that, in order to generate such high frequencies, as that corresponding, for example, with a five-meter wavelength, it was necessary to use a tube in which the lead-in wires for the plate, grid and filament were widely separated. It has been found, however, that with the circuit here shown it is not necessary to provide a tube of special construction, but that, on the contrary, an ordinary tube of the type referred to above will give equally good results. No doubt with increasing frequencies it would be desirable, if not necessary, to provide a tube in which the lead-in wires are more widely separated so as to reduce the capacity between them.

The oscillatory circuit, which is the main factor in determining the frequency at which the generator will operate, comprises two inductance coils, 7 and 8, two variable condensers, 9 and 10, and a fixed condenser, 11, of large capacity. Condensers 9 and 10 are variable and their movable plates are mounted on a common shaft, so that their capacities may be varied simultaneously and equally or proportionately.

The high-frequency oscillatory circuit forms a bridge, the four arms of which contain respectively, inductance 7, inductance 8, condenser 9 and condenser 10. The fixed condenser, 11, is also included in that arm of the bridge including inductance 8. The arrangement is preferably such that the two arms of the bridge containing the inductances 7 and 8, respectively, are of equal reactance.

If the condenser, 11, is large, the reactance due to it is very small at the high frequency dealt with, so that even if the two inductances, 7 and 8, are equal there is practically no unbalance due to condenser 11. This condenser may be of the order of .003 microfarads for a transmitter designed to operate in the neighborhood of 5 meters or less.

Assuming that the bridge is balanced, the points 12 and 13 are of equal or substantially equal potential.

A high resistance, 14, of the order of, say, 5,000 ohms is connected across equipotential points. The leads, 15

and 16, from the direct-current supply, 17, are connected respectively to the points, 12 and 18, the latter of which is substantially of the same potential as points 12 and 13, due to the small reactance from condenser 11.

The condenser, 11, functions as a blocking condenser to prevent the positive high potential of the source, 17, from being impressed upon the grid.

The grid and the plate leads are connected to points 19 and 20, respectively, of the oscillatory circuit. These points are necessarily always of opposite polarity.

As the filament, 2, is connected to the point, 12, which is midway between the potentials of points 19 and 20, it is obvious that the circuits meet the well-known definition of a vacuum-tube oscillation generator.

When working at such short wavelengths as those referred to, it is obvious that the capacities of condensers 9 and 10 and the inductances of coils 7 and 8 will be extremely small. In practice, the inductances, 7 and 8, may each consist of a half-turn of No. 8 copper wire, the radius of the turn being about two inches.

Coil 7 is shown inductively associated with a secondary coil, 21, the terminals of which may be connected to an antenna or other output circuit. Coil 21 may likewise consist of a half-turn of radius.

Condensers 9 and 10 may be of unequal capacity, provided inductances 7 and 8 are likewise unequal, so that the bridge is maintained at an approximate balance for all settings.

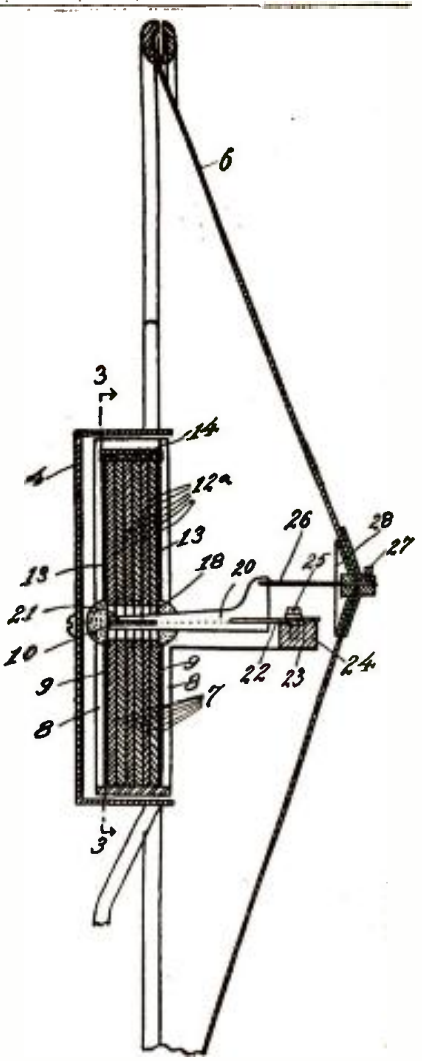
If the bridge circuit is so balanced that the high-frequency potentials at points 12 and 18 are exactly equal, it is apparent that no high-frequency current flows through the direct-current source, 17, and therefore that any disturbances occuring in the direct-circuit source or leads 15 and 16 have no effect on the frequency generated.

Although the invention is of special importance for short-wave transmission, its operation is equally good at longer waves.

An Improvement in Loudspeaker Construction

PATENT number 1,583,490, illustrated in Figure 9, has been issued to Charles W. Peterson of Ann Arbor, Mich., for improvements in the mechanical features of cone-type loudspeakers.

The main improvement is in the link system that transmits the motion of this armature of the diaphragm. The ends of the armature are still held between the yokes or side arms of the two magnets, but the center of the armature is connected to one arm of a pivoted lever. This lever in turn transmits the motion of the armature to the diaphragm at the proper lever arm distance from the fulcrum point.



AN IMPROVED LOUDSPEAKER

FIGURE 9: *A new link system that transmits the motion of the armature to the diaphragm with reduced motion and increased force is the main feature of this new cone speaker.*

In the type shown in Figure 9, the long lever arm is connected to the armature, and a short lever arm, at right angles to the first, is connected to the center of a cone diaphragm, giving a motion of less amplitude and greater force to the diaphragm than that of the armature itself.

This reduction of motion and increase of force is very desirable in connection with cone-type diaphragms. Having the two lever arms at right angles, as shown, permits a more compact and efficient construction than if the two were in line.

In case the two lever arms are equal, the diaphragm will vibrate with the same amplitude as the armature, the same as when the two are connected by a straight rod link.

Another feature is the provision of a simple way to simultaneously adjust the armature into its central position in the air gap, and a simple and efficient fulcrum for the lever. This object is accomplished by the use of a resilient spring fulcrum, a screw and a depression in the mounting surface so arranged that while tightening the screw the air gap is adjusted.

Radio "Spooks" All Over the House!

(Continued from page 416)

THE VOICE FROM BENEATH

The installation of the reproducer on the under side of a chair is easily done with a small wooden block to which to fasten the reproducer clamp.

from WEAF, was guilty each morning of awakening the guest at an hour at which he was, in all probability, unaccustomed to arising.

In the cellar the visitor is shown a speaker unit attached to the floor of the living-room. Visitors to the house even feel the tingle of music through the soles of their shoes.

While the applications outlined above are ingenious, the means of carrying them out is comparatively simple, although it involves a little work and a lot of wires, to say nothing of a lot of opposition on the part of the housewife.

All the terminals of the various units used terminate at a special switch near the receiver itself. This is so concealed that the operator, without arousing the least suspicion on the part of the guest, can make the various changes that are necessary.

Needless to say, this fun cannot be had without a power valve of the 210 type. At least twenty milliamperes must be flowing through the speaker unit to bring about the desired results.

MAKING THE SHINGLES SING

The last word in radio mystification is this installation, by which the whole roof can be made to broadcast setting-up exercises to the next-door neighbors.

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"Everyman's Guide to Radio" contains 1300 beautifully engraved illustrations in 1200 pages of text.

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For the "Broadcatcher" as Well as the Experienced Radio Enthusiast

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- Accessories and Radio
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POPULAR RADIO'S "Calls Heard" Department is ready to serve all American amateurs by forwarding their calls heard (QSL) cards to their proper destination in foreign countries. These cards are delivered through agents in those countries who have or can obtain knowledge of the present address of foreign amteurs. POPULAR RADIO is also doing the foreign amateur the service of forwarding his QSL cards to the proper destination in this country. In addition, the magazine will publish a monthly list in the "Transoceanic Calls Heard" column. Address your cards to the foreign amateurs by call number and enclose them in envelopes to—

The Calls Heard Editor
POPULAR RADIO
119 West 57th Street, New York

THE following stations in the United States were received and logged at the amateur station of Dr. L. Bailleul (EF-8EZ), at 119, Boulevard de Belfort, Roubaix (Nord), France, using a Schnell circuit with detector and one stage of low frequency:

1ADM, 1ADS, 1AFF, 1ALR, 1BHM, 1CMP, 1CNZ, 1SZ, 1VS, 1XV, 2AGN, 2AMF, 2ATS, 2AWQ, 2AZK, 2BCU, 2CI, 2CRB, 2CUQ, 3AUW, 3BLP, 3BUV, 3BVA, 3CJN, 3IU, 3QE, 4DX, 4UX, 5DI, 6AM, 6TA, 7DF, 8DRJ, 8JQ, 8LI, 8QB, 8SF, 9BPB.

AMATEUR station F-8SM, operated by J. M. Sacazes, Toulouse, France, reports the reception of the following stations in the United States, using a low-loss tuner with one stage of low frequency:

1BHW, 1CMP, 1CKP, 1MV, 1ON, 2BOW, 2GX, 2TF, 3AHL, 3BWT, 8LT, 9ADK, 9ARW.

AMATEUR station EF-8NOX, Paris, France, reports the reception of the following stations in the United States, receiving with a Schnell circuit:

1AHG, 1CPB, 1NK, 1ZL, 2AWX, 2NM, 2TP, 3QV, 5ATF, 5OA, 8AHC.

THE following stations are reported as received and logged at the amateur station, F-8XIX, Avignon, France, with a Bourne circuit and one stage of low requency:

1DI, 1GA, 1IC, 1RN, 2BBB, 4AAH, 4IO, 8IJV, 9BJP, 9ELI.

AMATEUR station F-8YOR, operated by Professor M. Reyt, Orleans, France, reports the reception of the following stations in the United States, using a low-loss three-circuit tuner and one stage of low frequency:

3BMS, 4TU, 5GL, 8ALF, 9AOR, 9ARN, 9AXB, 9BGE, 9BHT, 9BPM, 9BVH, 9CHN, 9CVN, 9EF, 9MH, 9XI.

THE following stations in the United States were received and logged at the amateur station of A. Chaye-Dalmar (F-8GM), Saint-Brieuc (Cotes-du-Nord), France, with a Bourne circuit and one stage of low frequency:

1AHI, 1CJC, 1CJH, 1GA, 2AQW, 2AWX, 3AGU, 3AZT, 5KC, 8ABG, 8ALY, 8AXA, 8BAD, 8BEN.

THE following stations in the United States were received and logged at the amateur station of M. Meidieu (EF-8ARO), at Belfort, France, using a detector and one stage of low frequency:

1ADM, 1AQT, 1ARC, 1AVL, 1CNZ, 1VW, 2ADL, 2AYJ, 2AZK, 2CRB, 2CUQ, 2CYX, 2GX, 2HC, 2IZ, 2JN, 2TR, 2PZ, 3ACW, 3AEF, 3AFU, 3AKS, 3QE, 3SZ, 4DX, 4LK, 4RN, 4RR, 8ALY, 8BTH, 8DHX, 8JQ, 9ARA, 9DIJ.

THE following stations in the United States were received and logged at the amateur station of Herbert A. Paltschik, Wickersdorf, Germany, using a detector and one stage of low frequency:

1AFF, 1AG, 1AGA, 1AHV, 1AKM. 1ALR, 1AUR, 1AYL, 1BDI, 1BFW, 1BHW, 1CKP, 1CNF, 1IC, 1LX, 1MK, 1NO, 1RN, 1XM, 1ZD, 2AAN, 2AGN, 2AMF, 2AMJ, 2APD, 2AVB, 2AZK, 2BC, 2BCM, 2BGZ, 2CDR, 2CRB, 2CUG, 2CXL, 2CYX, 2DOW, 2GX, 2HC, 2TP, 2UB, 2UO, 2VD, 2WR, 2XAJ, 2ZA, 3ADD, 3AHL, 3BCO, 4GY, 4IZ, 4LK, 4WC, 8HB, 9ADG.

THE following stations in the United States were received and logged at the amateur station of Paul Tabey (F-8KU), Lyon, France, using a Schnell circuit with detector and one stage of low frequency:

1BDX, 2AMJ, 2ASE, 2BQD, 3AFW, 3IU, 3IZ, 3QE, 3SZ, 8CFR, 9BQE.

THE following stations in the United States were received and logged at the amateur station of R. and A. Aronssohn (F-8FT), Colombes, France, using a Schnell circuit with detector and one stage of low frequency and an indoor aerial:

1AFF, 1AJM, 1BKV, 1CAW, 1CCZ, 1CJH, 1LW, 1ON, 1XF, 1XM, 1ZL, 1ZZ, 2PZ, 6AGR, 6CLN, 6HJ, 8ADM.

STATION EF-8UDI, operated by A. Yvon, Paris, France, reports the reception of the following stations in the United States, receiving with a Bourne detector and one stage of low frequency:

1ACH, 1ASU, 1BUX, 1BYV, 1CAU, 1CPB, 1LU, 1ZL, 1ZZ, 2ASC, 2AGW, 2AHM, 2ASL, 2CNG, 2JN, 5OA, 8ADG.

GEORGES SOLET, operator of the amateur station TUN2, Bizerta, Tunis, reports receiving the following stations in the United States, receiving with a Bourne circuit and one stage of low frequency:

1AAO, 1ADM, 1AHI, 1AJM, 1BYV, 1CMX, 1FL, 1IC, 1RF, 1UW, 2AHM, 2GP, 5AFB, 8ALY, 8AXA, 8BEN, 8GZ, 9EF.

The amateur station of Pierre Louis (F-8BF), Dijon, France, reports the reception of the following stations in the United States, using a detector and one stage of low frequency:

1AKZ, 1ALR, 1GH, 2EB, 3PF, 9BN.

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GET THESE RESULTS with the new AmerTran Push-Pull Power Amplifier. It is a completely assembled two-stage unit embodying a first stage AmerTran De Luxe followed by AmerTran Input and Output Transformers for Power Tubes. The metal box has four sockets, two for power tubes, and a four prong and a five prong socket in the first stage for either a standard amplifying tube or the UX-201 A type, or a UY-227 (C-327) A. C. tube. Using the latter tube, the amplifier can be entirely A. C. operated.

This amplifier can be connected to the detector of any good receiver, replacing the audio amplifier. When operated from a power source supplying sufficient voltage, the reproduction will be as perfect as the speaker is capable of making it. In addition, distortion, and the hum from raw A. C. on the power tubes are eliminated. The energy output to the speaker, especially at the lower musical frequencies also is increased.

It is recommended that this amplifier be operated from the AmerTran A. B. C. Hi-Power Box, but it can be used with any good power supply system or batteries. Tone realism and volume will be finest, with the largest available power tubes in the power stage. Therefore, UX-210 or CX-310 tubes will normally be supplied. If the 171 type of tube is preferred, the amplifier will be equipped with the AmerTran Type 271 Output Transformer.

AmerTran Push-Pull Amplifier as a complete unit is licensed under patents owned or controlled by the Radio Corporation of America and must be sold complete with tubes. When ordering, please state choice of tube for the first stage (either UX-201A or UY-227, or Cunningham equivalent) and either two (UX-210, CX-310) or two (UX-171, CX-371) power tubes for the power stage. Price on application.

Send for further information.
Inquiries on this new unit will be handled promptly.

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$55. At this price the Crosley Bandbox is Radio's most astonishing success, *not* because the price is low, *but* because the set is magic!

The ability of the new Bandbox is amazing. Its simple operation is easily understood and its wonderful performance is at the command of any hand that can turn the dial.

Millions are making up their minds today to buy a radio.

Millions will replace obsolete sets with new, up-to-date receivers this fall.

Experienced radio owners will look first for 3 fundamental points and to every set they consider will address these questions:

1. Is it selective?
2. Is it sensitive?
3. Is it easy to operate?

Satisfied on these points they will look for:

1. Single dial control.
2. Illuminated dial.
3. Volume control.
4. Single cable leads.
5. Console installation adaptability.
6. Reasonable price.

Millions will look at the Crosley Bandbox. This amazing little set is now displayed by more than 16,000 dealers.

One dealer, alone, expects to sell a million dollars' worth of Bandboxes this season.

Crosley dealers from Maine to California have this wonderful receiver hooked up for immediate demonstration and will explain its matchless performance in a manner somewhat like this:

The Crosley Bandbox is a 6-tube receiver.

The circuit of this set is of the excellence you would expect from a group of skilled engineers suddenly given the pick of the world's radio patents to work with.

Crosley has always given the radio world its biggest value for its dollar. Contemplate the perfection possible when the doors of the research and development laboratories of The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone & Telegraph Co., and the Hazeltine and Latour Corporations were thrown open.

Licensed under their patents!

MUSICONE TILT-TABLE $27.50

Tremendous! Wonderful! Significant!

Simply it means that millions will possess the best radio performance possible at the low prices for which Crosley is already famous.

The Crosley Bandbox is totally and completely shielded. Every element is absolutely separated from every other element by solid shielding. Coils are covered with copper. This could have been done cheaper but efficiency would have been sacrificed. Condensers are housed in cadmium-plated steel. All wiring is separated and shielded from all other parts of the receiver. Solid, sturdy, substantial, the entire set is assembled on a heavy metal chassis.

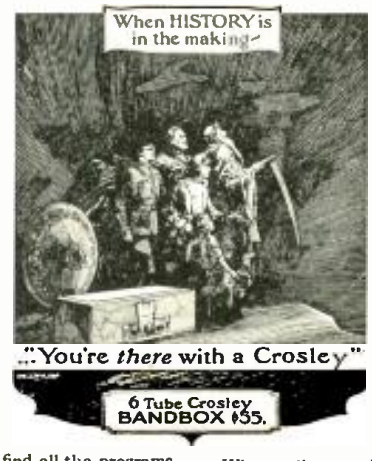
The tuned radio frequency amplification stages have been absolutely balanced through use of the Neutrodyne principle. The set is a genuine Neutrodyne!

To the initiated this means much. To the layman it manifests itself only as a radio receiver that does not squeal or howl when you are trying to get a station.

The foregoing answers for the Crosley Bandbox the three fundamental questions set forth in the fourth paragraph, which the experienced radio owner is asking of every set he sees this fall.

The shielding makes the Bandbox highly selective—the circuit, acutely sensitive and the design, extremely easy to operate.

The Bandbox is operated with a single station selector (one dial).



In most localities and in most owners' hands the single station selector will find all the programs anyone could possibly wish. But there are some owners who demand greater ability like the possessors of 90 horse power motor cars who may never step on it but like to be conscious it's there. For such have the Acuminators been designed. Far away stations of weak power but perhaps good music are captured by the use of these little auxiliary tuners. Their function is best likened to a pair of field glasses. As the lens bring the distant scene to nearby aspect, so do the acuminators bring the remote station signals up to room filling volume. Ordinary one dial radios can never perform like this. Hair line tracking of the condensers together is difficult—but the Acuminators, little secondary adjustments *exclusive* to Crosley give the Bandbox a substantial command of the air and *all* that is in it.

The dial of the Bandbox is illuminated. A detail! A refinement added but not as an excuse to raise the price. For shadowy corners and dim eyesight it recommends itself.

Volume Control is necessary on good radio today. Nearby and high powered stations send terrific impulses into the receiver. Detuning has been a favorite method of softening this loud reception but with stations closer and closer together on the dial detuning, particularly in large cities, creates an overlapping of programs. The ear like the eye is only good for one thing at a time. Under the towers of the heaviest stations the volume control of the Bandbox cuts the loudest blast down to a veritable whisper. No distortion whatsoever!

A single cable leads all outside and power connections from the Bandbox. In this brown fabric covered cable lies each lead covered with colored rubber for protection, accuracy and easy assembly. Tidy housewives appreciate it.

The adaptability of the Bandbox to installation in all types of cabinets is a feature. The metal case of the Bandbox lifts off the chassis. This leaves the closely grouped dial, switch and volume control shafts to be stuck through holes in the panel of any sort of cabinet. The escutcheon is quickly screwed over them and the console installation is not only complete but has no earmarks of a makeshift.

Much has influenced the $55 price of the Bandbox.

First, an ideal and an idea.

Then, a working out of the idea.

And now, the constant possession of the ideal.

Back before radio became the entertainment force it is today Powel Crosley, Jr., held an ideal that the things which give people pleasure should be made to sell at low prices so that millions may enjoy them.

When radio was a bundle of hair pins turned with the knobs from typewriter carriages, he had the idea that if he could make radios in sufficient quantities, he could supply millions with a means of enjoying this new source of pleasure at moderate prices.

Every radio year has been a year of mass production experience to Crosley. This year saw an investment of over half a million dollars in equipment that a fine radio might be made at such speed and in such quantities that a price of nearly half a hundred dollars could be maintained.

Throughout the country millions examine the Bandbox today. They see it the achievement of an organization who began its developments when radio as we know it today began. Its success has been tremendous if clamorous demands from dealers are any indication. Skeptics, the unbiased and the radio wise have pronounced it GREAT. Even at any price it would be a sensation, for its performance ranks with the most expensive and fanciest radio receivers on the market.

An AC model Bandbox takes its power from the electric light.

Former power supply with its constant annoyance and expense is entirely eliminated.

POWER CONVERTER

The new R.C.A. AC tubes provide clear, smooth and loud reception comparable in every way to the most efficient wet storage battery power.

Alternating current ripple is smoothed out in the compact little power converter which is sold with the AC Bandbox. This device needs no attention—is half the size of an ordinary storage "A" battery and matches the Bandbox in finish and color.

The AC Bandbox with
The Power Converter is $110

This gives you a complete, direct AC radio adaptable to any type of installation you may choose—bookcase, console, desk, cabinet, arm chair or tuck it away on the corner of the table—for $110.00.

THE CROSLEY MUSICONES ARE AS OUTSTANDING IN THEIR FIELD AS THE BANDBOX IS IN ITS

Back in early 1925 radio's audibility above the single telephone ear unit depended upon a horn. Unnatural and harsh it laid a handicap on a fast developing industry. Only at great cost could its limitation be surmounted. Suddenly Crosley offered the radio world a cone speaker at $17.50. Instantly the demand exceeded the supply. Promptly loud speaker sales were gauged by the leadership of the Musicone.

Today that position is still maintained. The cause is plain. Mechanical refinement and improvements of the Musicone since its inception have been constant and considerable.

Price of the Musicone has shown a steady downward trend from $17.50 in 1925 down to $9.75 at the present time.

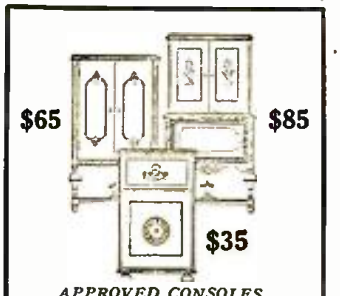
Only a national acceptance could make this possible and only a remarkable value could create such a national acceptance.

Today the Musicone is a perfect reproducer thru—

1. A new metallurgical discovery giving many times the vibrating capacity of the actuating unit as formerly.
2. Bakelite coil cores impervious to moisture.
3. Secretly coated wire that does not permit deterioration in damp climates.

Crosley owners find a perfect affinity between the Bandbox and the Musicone aside from their physical appearance.

The Musicone is sold in two sizes:
The Ultra Musicone (12-inch) .. $ 9.75
The super Musicone, as illustrated (16-inch) $12.75



APPROVED CONSOLES

"I want the public to have as great a value in consoles this year as I have given them in the Bandbox" said Powel Crosley, Jr.

Prominent furniture manufacturers thru their long experience promised beautiful cabinets at moderate prices. Designs submitted were admired, praised, tested, approved! The Musicones were built in. Crosley dealers now sell them. Purchasers may know they are best suited for Crosley radio by looking for the "approved label" in each one. Crosley dealers get these cabinets only from The H. T. Roberts Co., located at 1340 S. Michigan Ave., Chicago. Sales representative for The Showers Brothers Co., Bloomington, Ind., and The Wolf Manufacturing Industries, Kokomo, Ind.

Write Dept. 16 for descriptive literature

CROSLEY RADIO

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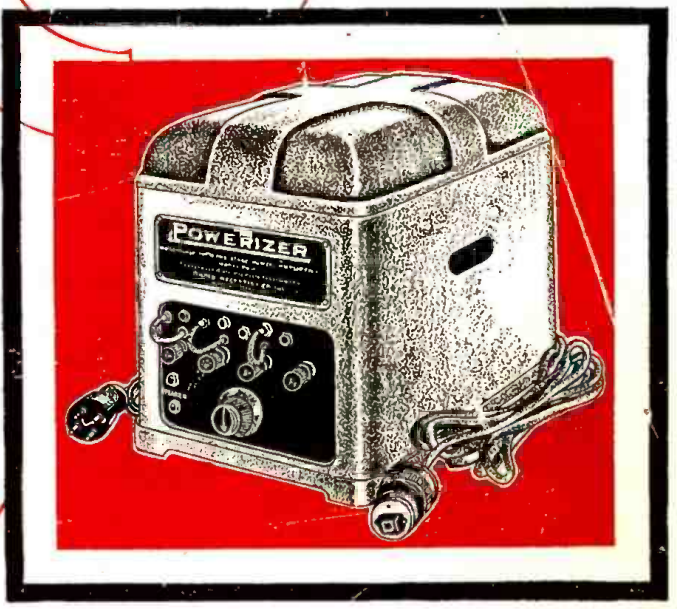
Montana, Wyoming, Colorado, New Mexico and West prices slightly higher.

POWERIZER



Model for Atwater Kent and other standard sets, $60
Radiola "20" model.....$59

makes your set an A. C. Electric

with the newest A. C. Radiotrons which require no batteries!

Cymbals crash...the great bass booms...the baritone sax sighs and moans...dance music with jungle deep intonations...music such as you've never heard from your radio before...With the Powerizer, all those elusive low notes are captured—and reproduced with a rich mellowness.

Equip your set with a Powerizer and the finest tone quality in Radio is yours—for there is installed in your set the same system of A. C. Radiotron electrification that is used in the finest $500 and $800 A. C. Receivers.

The Rolls-Royce of tone tubes is used—the UX-210 ...The Powerizer comes equipped with harness and adaptors—NO REWIRING IS REQUIRED—write for details how to make your set a 1928 A. C. Electric Receiver.

RADIO RECEPTOR CO., INC.
106 Seventh Avenue, New York

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