Popular Radio

FEBRUARY · 1928 ★

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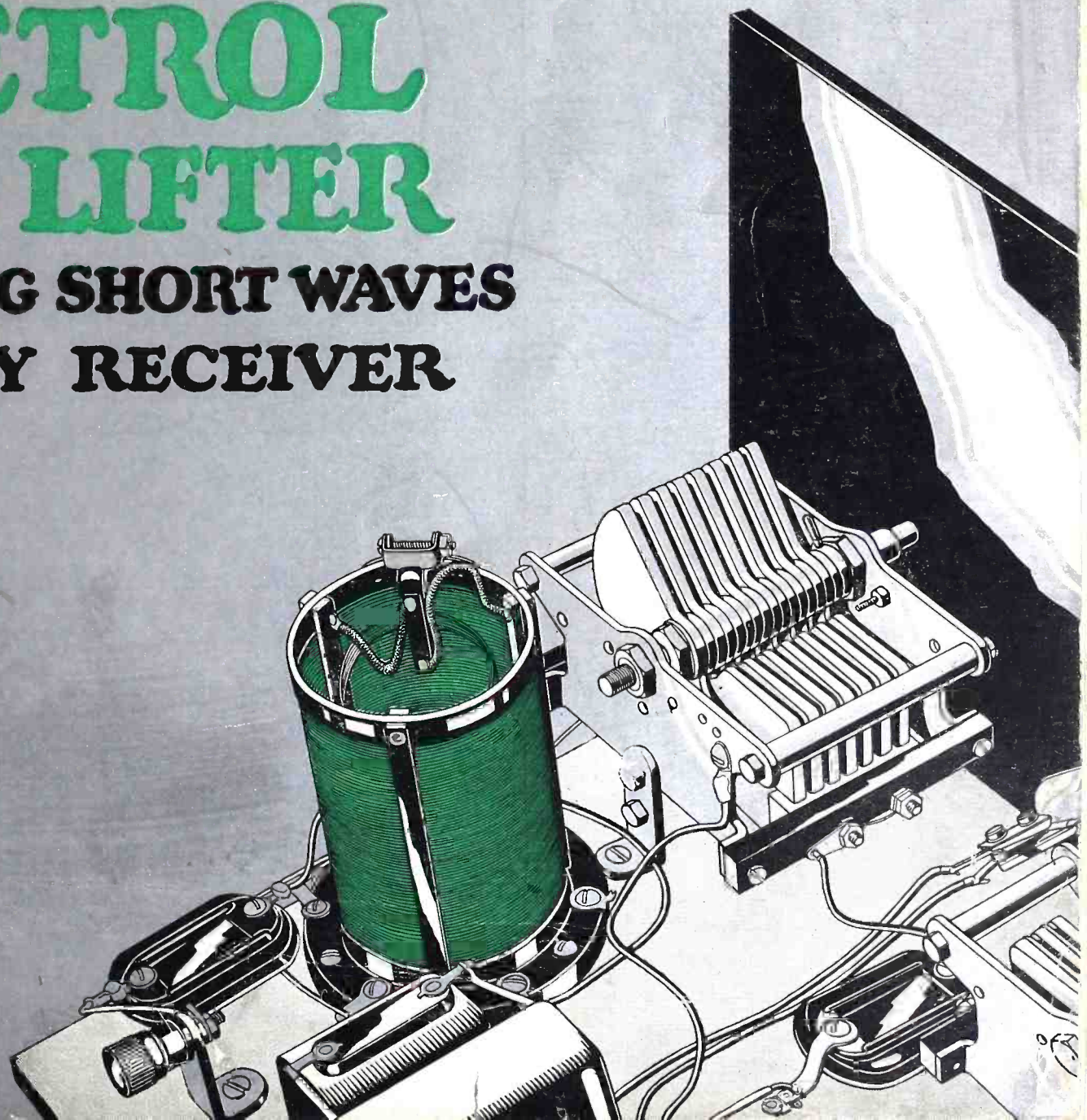
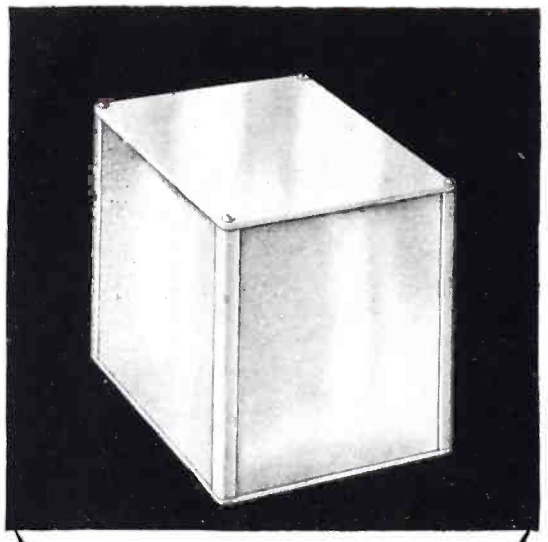


ALUMINUM

The mark of Quality in Radio



Junior Aluminum Box Shields

Four of these shields together with an aluminum sub-panel are used in the L. C. 28 Set.

FOR greater selectivity, finer appearance, longer life, lighter weight, use Aluminum Box Shields in the set you build—and look for Aluminum Shielding in the set you buy.

Designers agree on the superiority of Aluminum for shielding. It has become an established factor in radio design—recognized alike by advanced amateur set builders and engineers responsible for commercial production.

Aluminum Company of America's Junior box shields, designed especially for amateur sets, are made of heavy Alcoa Aluminum with satin-dip finish, size 4½ in. x 4½ in. x 5 in. high. (Made also in standard size, 5 in. x 9 in. x 6 in. high.) They require no soldering.

Four of these Junior Aluminum box shields together with an Aluminum sub-panel are called for in Cockaday's L. C. 28 Receiver, which is being featured in this magazine.

If your dealer cannot supply you with Aluminum Box Shields send us his name and we will see that he is put in position to service you promptly. Be sure to send, also, for a copy of the new edition of "Aluminum for Radio." It is free.

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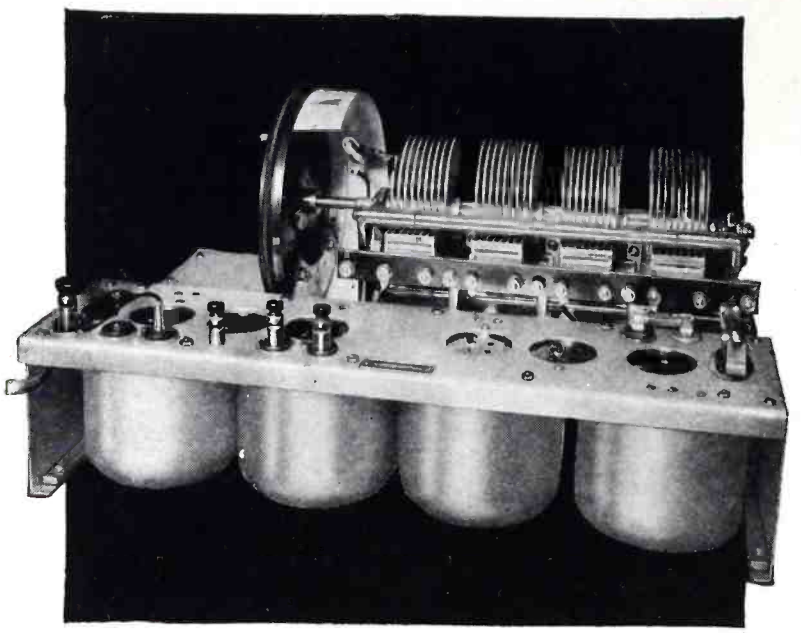
ALUMINUM SHIELDING *for Improved Reception*



Aluminum Shields and Other Parts
Zenith Radio Corporation

RADIO Engineers are using more and more Alcoa Aluminum because of the efficiency with which this *one* metal meets the widely differing conditions encountered in radio design.

In many modern sets you find Alcoa Aluminum Shielding used because of its great effectiveness at radio frequencies. You find condenser blades made of Alcoa special Aluminum sheet because of its narrow limits of tolerance, its uniformity and its lightness. You find Alcoa Aluminum foil preferred for fixed condensers. Countless screw machine radio parts of Alcoa Aluminum are being used.

Sand castings and die castings of Alcoa Aluminum make the finest chasses, sub-panels and loud speaker frames, both because of the combined lightness and strength of Aluminum and because of its permanence and finish. Aluminum, decorated in a variety of rare wood grain effects, is ideal for front panels.

Look for Aluminum in the receiving set you buy. It has come to be recognized as the mark of quality in radio. Your copy of our new booklet, "Aluminum for Radio," will be sent free on request.

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ALUMINUM

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AMERTRAN *Now Offers*

Complete Light-Socket Power with Fidelity of Reproduction

The AmerTran ABC Hi-Power Box. List price $95, east of the Rockies. Rectifying tube extra.

No batteries, liquids or chargers. No attention or adjustment necessary. Uniform, dependable power from the house current.

You know already the well-earned reputation of AmerTran parts. Now investigate these latest achievements, and by comparison judge their merit. Certainly you will select them for long life, and quiet, reliable operation.

BEFORE you think of another set, think what these new AmerTran products will do for the one you have. The ABC Hi-Power Box will deliver smooth power to plate and filament from the light socket, supplying sufficient voltage and current for push-pull 210 tubes and all other AC tubes required in a modern receiver. There is no fussing—no weak reception due to run-down batteries. This complete unit contains AmerTran-designed equipment, with a power transformer having separate windings to provide AC filament current at 7½ volts for two 210 power tubes, a similar winding for the 281 rectifying tube, a third winding at 2½ volts—providing heater current for three or four UY-227 AC tubes, and a fourth winding providing current at 1½ volts for four or five UX-226 raw AC tubes. These capacities are ample for practically every set, with a generous margin of safety.

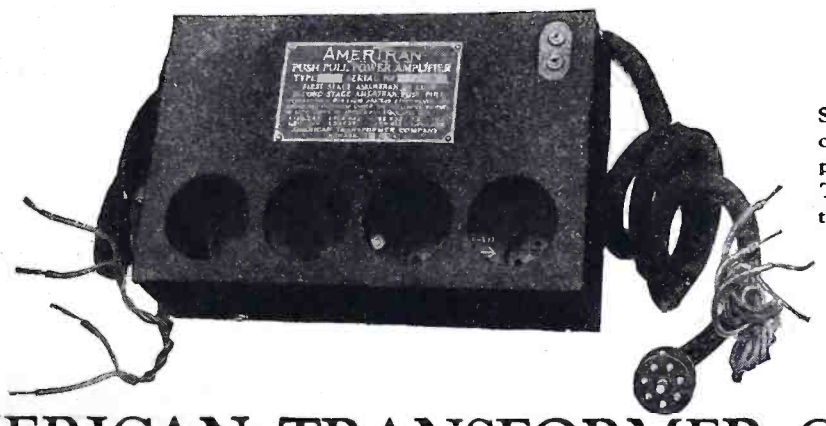
The Hi-Power Box may be placed in the base of a console or under a table away from the set. With its black finish, nickel trimming and hinged cover it will be suitable anywhere.

With either an AC power supply system or batteries, you'll find the fidelity of reproduction brought by the AmerTran Push-Pull Power Amplifier actually limited *only* by the perfection of the speaker. Operated from the AmerTran ABC Hi-Power Box, the input to the speaker is free from distortion and objectionable AC hum. The energy output is increased especially at the lower musical frequencies, bringing greater clarity at high or low volume. The amplifier connects to the detector of the receiver and may be entirely AC operated. It is furnished with cable and plug to connect directly with the Hi-Power Box. One of the important parts of this amplifier is the well-known AmerTran DeLuxe audio transformer.

These two companion units are designed to work together, and when used with a good tuner and speaker will reproduce without exaggeration a philharmonic orchestra or pipe organ as though actually present.

The AmerTran Push-Pull Power Amplifier. List price $60, east of the Rockies. Tubes extra.

A new standard of quality in Audio Amplification. The tone you have always wanted. Connects to the detector of any good receiver.



See these new AmerTran products on demonstration at any store displaying the sign "Authorized AmerTran Dealer" or, if you cannot obtain them, write direct to this Company.

Both wired units are licensed under patents owned or controlled by R C A and must be sold complete with tubes.

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Popular Radio

EDITED *by* RAYMOND FRANCIS YATES

FOUNDED 1911

VOLUME XIII | February, 1928 | NUMBER 2

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(Cover Design by A. G. Hagstrom)

DEPARTMENTS

VOLUME XIII | FEBRUARY, 1928 | NUMBER 2

Published monthly by Popular Radio, Inc., 119 West 57th St., New York, N. Y.; telephone number, Circle 8180; Douglas H. Cooke, President and Treasurer; Laurence M. Cockaday, Secretary; Emma A. Harm, Asst. Treasurer. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y., of March 3, 1879. Additional entry at Jamaica, L. I., N. Y. Copyright 1928, and title registered as a trade-mark by Popular Radio, in Great Britain by Popular Radio, Inc., 6 Henrietta St., Covent Garden, W. C., London, England. *For advertising rates, address* Popular Radio, Inc., 119 West 57th St., New York; or 225 North Michigan Ave., Chicago.

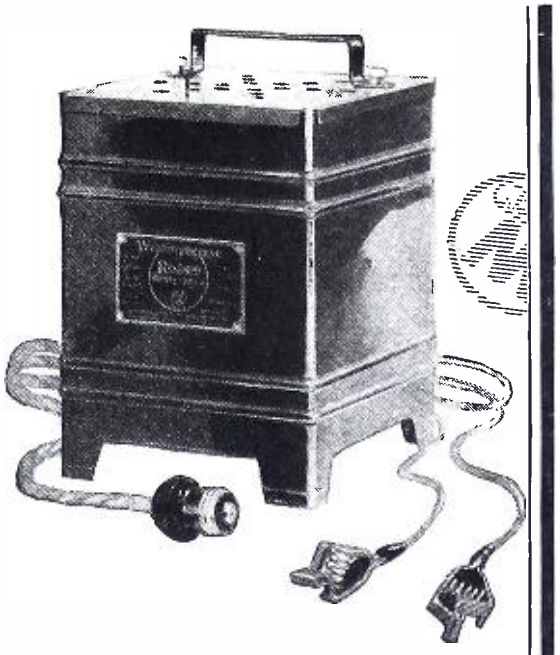
Printed in U. S. A.

COCKADAY, *Technical Editor*

CHARLES L. DAVIS, *Managing Editor*

Change one Rectigon lead–

for either trickle or high-rate charging



HERE'S a home charger that trickle charges, too! Rectigon has *two* charging rates. Under ordinary conditions, the low rate, "trickled in" during the hours that the radio is idle, will keep your "A" battery strong and efficient. Then, for occasions when prolonged use of the set drains more power than a trickle charger can replace, Rectigon's high rate charge will put your battery on its feet. Another change of terminals and you charge your wet "B". Also charges your automobile battery. *All with one charger*—Rectigon.

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~~$18.00~~
now
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5 Ampere Rectigon
~~$28.00~~
now
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Westinghouse Rectigon Battery Charger

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Offices in All Principal Cities ✦ *Representatives Everywhere*
Tune in with KDKA — KYW — WBZ—WBZA

Rectox—for trickle charging only. Connect it permanently to your wet "A" battery. Every time you turn off the set, let Rectox put in new power for the next program. Trouble free — uses no acids or chemicals, has no moving parts. Adjustable to ½ and ¾-ampere 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.

W
WESTINGHOUSE ELECTRIC

A Page With The Editor

Television is about to emerge from the laboratory. The recent demonstration by the General Electric Company at Schenectady (described on pages 122-124 of this issue) proved that beyond the flicker of doubt. Television is today in the "earphone" stage of development. What it needs more than anything is the attention of radio experimenters—the same experimenters whose contagious enthusiasm practically forced the growth and perfection of broadcasting.

* *

That television involves no great complication or expense may appear somewhat paradoxical to those who are unacquainted with the details. A washing machine motor, a neon lamp, a metal disc with spirally arranged holes, and the fervent zeal of the experimenter, are the essential requirements. The television images are in the air daily. Faces now mix with voices and music in the ether of space.

* *

Unless our judgment has gone completely to the bow-wows, radio fans will, before the close of the year, be head over heels in the construction of television receivers. This work affords still greater fascination and no greater expense than ordinary set building. Incidentally, a television receiver, to the chronic constructor of superheterodynes, would be a childishly simple task by comparison.

* *

The New York Central Railroad to Schenectady passes Sing Sing Prison. The party of which the writer was a member passed, en route to witness the television experiments, the prison where, the night previous, the gruesome and barbarous Snyder-Gray execution had taken place. It was difficult to reconcile the two events as belonging to the same era. In the one case electricity was used savagely to rend the bodily tissues of two unfortunate humans, while at precisely the same moment in history it blossomed forth in a startling new flower of intelligence, television. This *is* a queer world.

* *

Representative White, of Maine, author of a radio bill that was defeated in favor of the Dill Bill, believes that the Federal Radio Commission should be empowered with the authority to prevent monopolistic exploitation of the broadcast channels. From our own observation in the matter, it would seem that perhaps Representative White is a bit tardy with his suggestions. The monopoly of broadcasting may not as yet be perfected, but it appears to be well on its way, and the Federal Radio Commission does not seem to be unduly alarmed about the situation.

* *

The City Council of Fairfield, Iowa, has recently passed an ordinance that would seem to have some foundation in common sense. The council has made it unlawful to use, between the hours of noon and midnight, "any instrument, device or machine which shall cause electrical interference with radio reception." X-rays for legitimate medical purposes have been excluded.

* *

From a strictly legal standpoint, chronic radio interference, especially in cases of power electrical disturbances that devastate radio reception over a large area, becomes a public nuisance. The law can regulate such matters and it would seem that the Fairfield experiment might be the beginning of a movement that will sweep away much of our preventable "man-made static." In certain instances whole communities have become barren radio wastes simply because a shoe repair shop around the corner did not have five dollars' worth of fixed condensers shunted around the brushes of its power motors.

* *

The radio user who lives in a neighborhood supplied with direct current has not been in a position to take advantage of the advances made in power amplification without going to the expense of installing a 60-cycle AC generator. Naturally the cost of such a machine is prohibitive. The Technical Staff of Popular Radio has been alert to this problem for some time, and as a contribution toward its solution there will appear in the March issue of the magazine a power amplifier for 110-volt DC circuits, using four 171-a tubes in parallel. Naturally enough, the plates of these tubes must be operated at low voltage; yet amazing power in the output will be supplied. More power to the DC neighborhoods!

* *

There have been two important developments in radio valves during the year 1927—AC valves have been followed by screened-grid valves. Now it would seem logical to expect a combination of the two—a screened-grid valve of the AC type. Perhaps 1928 will bring forth this development.

* *

Those who wish to change their old receivers into instruments employing the new AC valves are going to have an easy time of it; for radio manufacturers are now busy producing all sorts of convenient attachments which will greatly facilitate the work. There are on the market at the present time several well-designed harnesses that make conversion simply a matter of slipping in and making a few connections.

* *

Raymond Heising's article on fading, on pages 111-113 of this issue, is particularly interesting. Heising has not only confirmed the work of other experimenters, but he has added greatly to the knowledge of the reflecting layer, and especially in regard to its behavior from the standpoint of motion. Popular Radio is indeed proud to chronicle the experiments of so able a research engineer as Mr. Heising.

* *

It is estimated that there are seven million phonographs of the old type in American homes. It would seem that some of our professional set-builders would do well to solicit the work of converting some of these old phonographs into modern electric reproducers. Two stages of low-frequency amplification, involving a 199 type valve and a 210 type, can be made to operate directly from the lighting circuit. This comparatively modest equipment, used with a good pick-up amplifier, will make of any old phonograph a musical instrument of marvelous potentialities. The editor knows of one professional set-builder who has kept himself busy during the past few months through work of this kind. These conversions can easily be made for less than one hundred dollars with a good profit margin.

* *

The lively interest displayed by commercial interests in receiving short-wave assignments from the Federal Radio Commission seems to indicate that the lower portion of the radio spectrum is a trifle more important than it was two years ago. So acute has the competition in these wavelengths become that amateurs of the country are beginning to worry about the security of their position. It would seem obvious that amateur work will be seriously jeopardized if they are pushed into the lower regions faster than they can develop reliable communication in the ultra-short wavelengths. It may be advisable to push the amateurs further back, but this should not be done until they have been given ample opportunity to develop their position.

Raymond F. Yates

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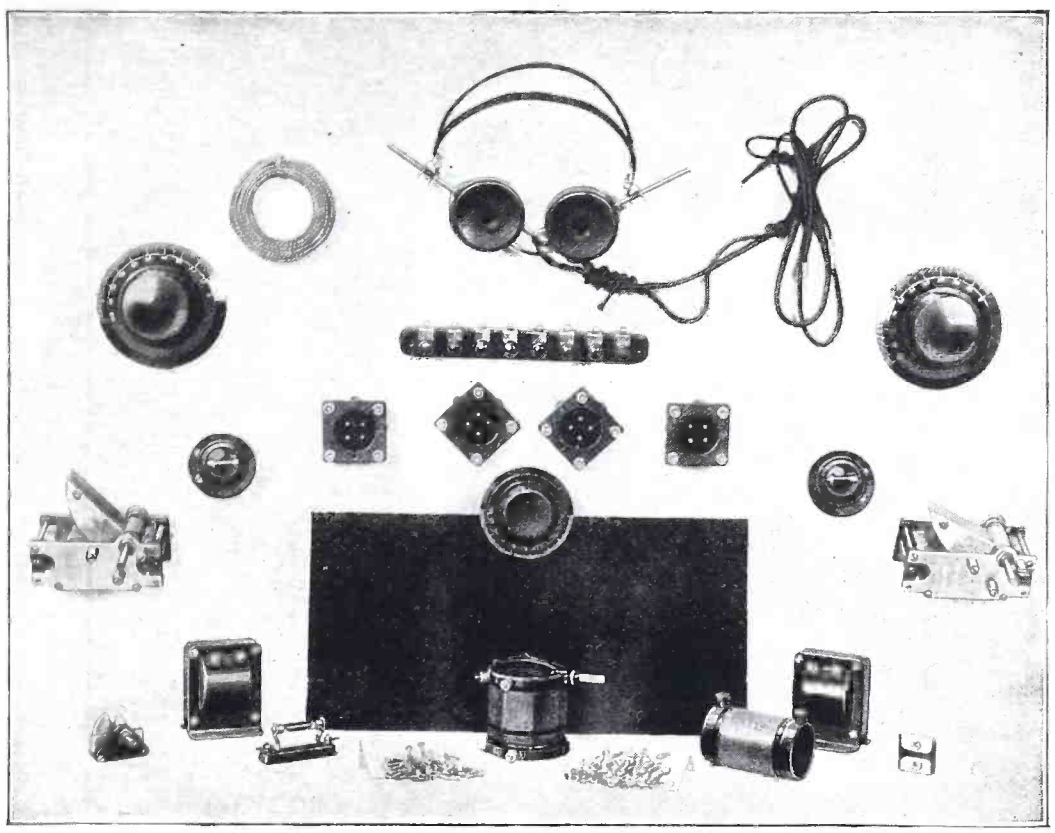
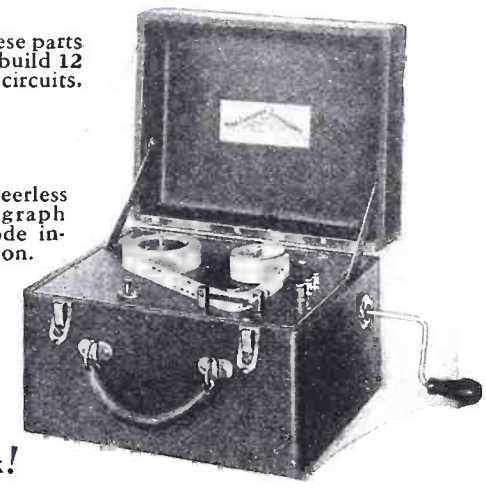
Rapid Advancement,
Glorious Adventure and
Phenomenal Success in
A Life Profession of
Fascinating Brain-work.



With these parts you can build 12 different circuits.



The Peerless Signagraph for code instruction.

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You can learn at home!

R. L. DUNCAN, Director, Radio Institute of America. Author of several volumes on radio

Here is your big opportunity! Radio pays hundreds of millions in salaries each year. In a few years the industry has progressed from almost nothing to one of the most important in the world. And the big demand for trained men continues in all the branches of radio. *Are you going to plod along at a thirty-five dollar a week job when REAL MONEY is waiting for you in radio?*

Our graduates are earning big money as radio designers, as executives with large radio organizations, in broadcasting work, as skilled mechanics, assemblers, service men and radio dealers. We have trained thousands of men to become successful radio operators on ships traveling to far corners of the globe where they meet excitement and adventure—to become radio operators in shore stations, sending and receiving radio traffic with countries across the two oceans. And now Opportunity is knocking at your door.

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After years of experience the Radio Institute of America has evolved a new radio course—the most up-to-date of any offered today. It starts with the fundamentals of radio and carries you through the most advanced knowledge available. The work has been prepared in simplified form by men who have written many volumes on radio.

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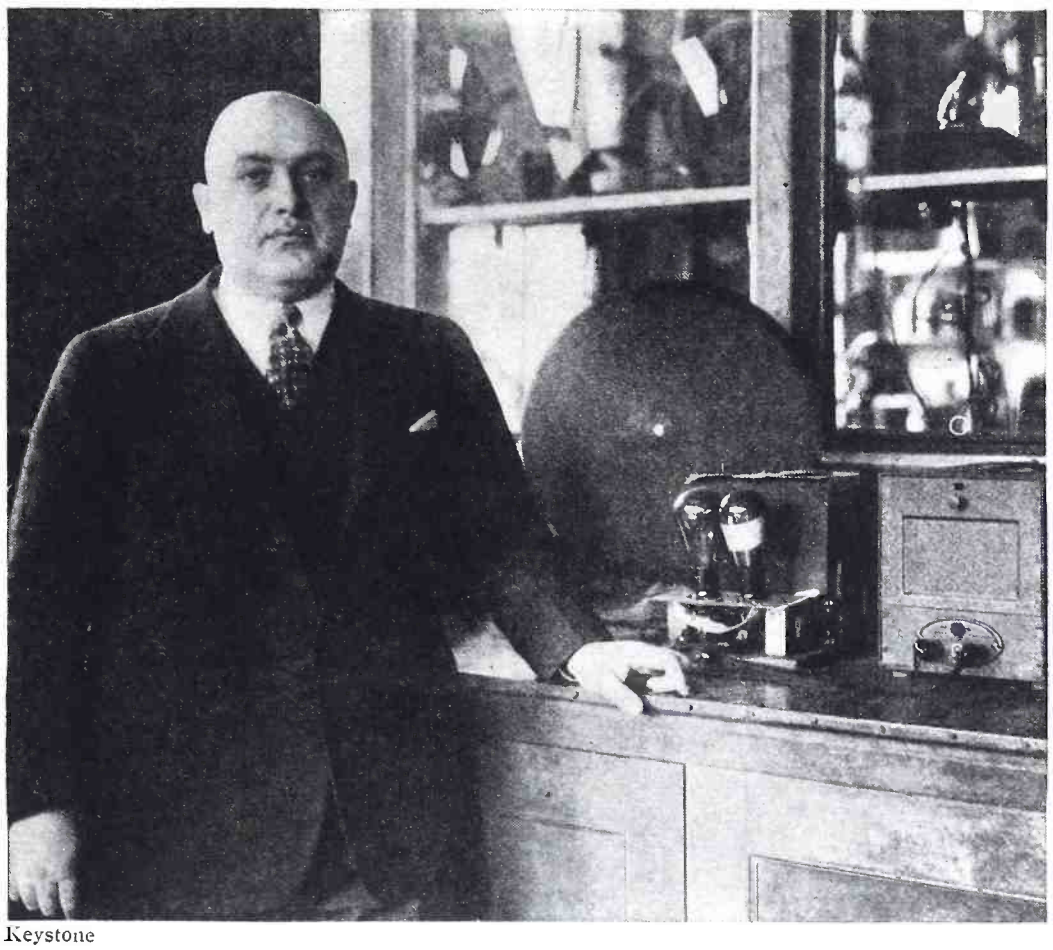
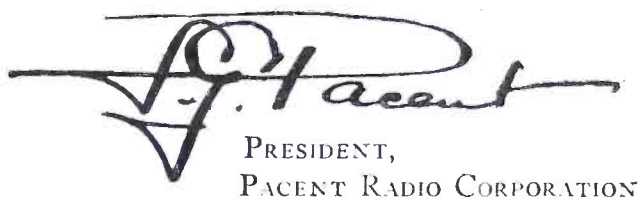


Keystone

"Deserving of Special Praise . . ."

"I think that POPULAR RADIO should be particularly commended for its pioneer efforts in developing and featuring all of the worthwhile things in radio.

"Its work in promoting interest in power amplification and power amplifier equipment to work with the new phonograph pick-ups is deserving of special praise and is an index to its vigilance and alertness. I am certain that many radio enthusiasts have POPULAR RADIO to thank for being the first to bring such equipment, in perfected form, to their notice."

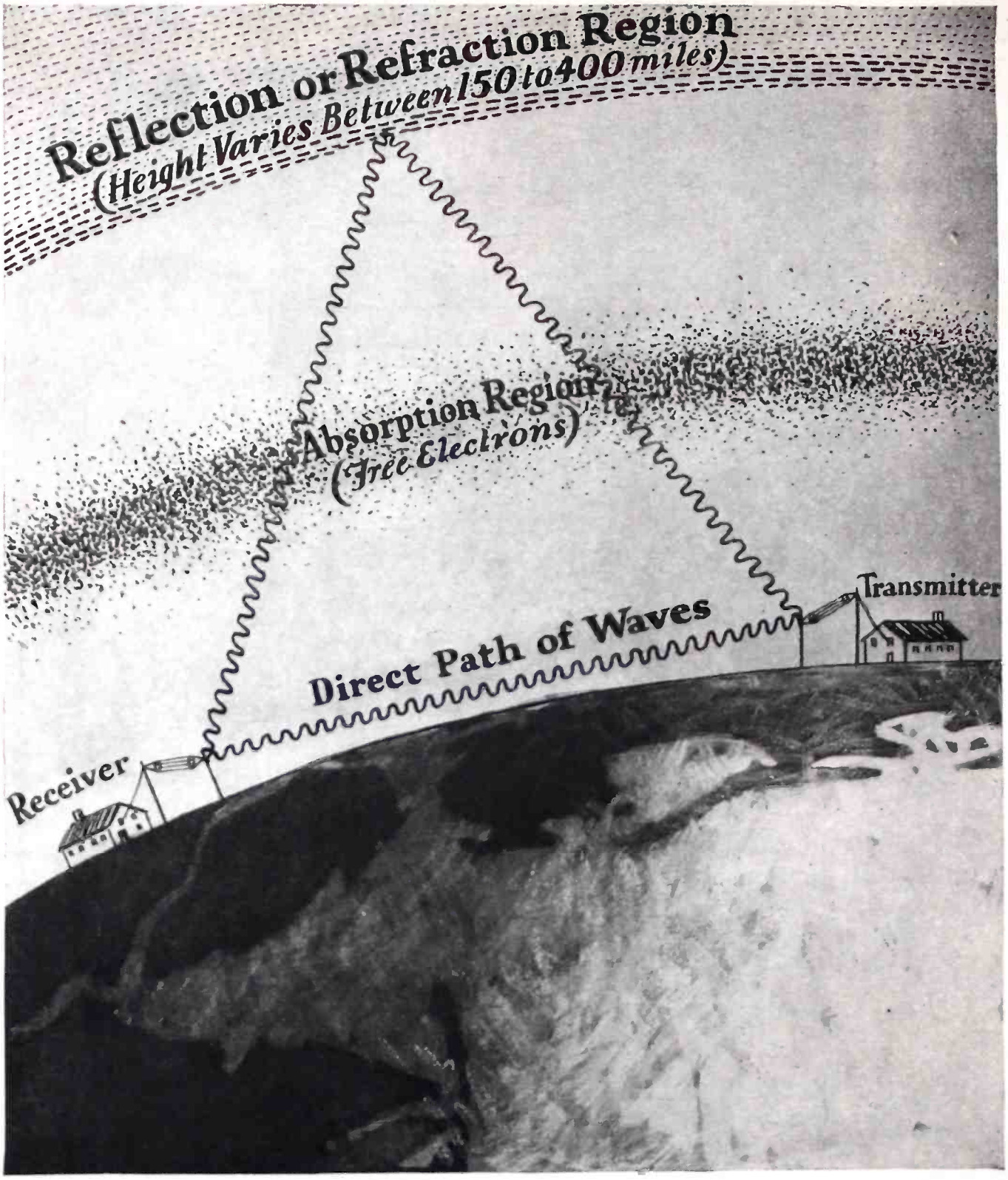


PRESIDENT,
PACENT RADIO CORPORATION

LOUIS G. PACENT

Among the true radio pioneers in this country should be counted Louis G. Pacent. Mr. Pacent's radio career began as an amateur in 1904. Since that time he has actively participated in every branch of radio development. He is a graduate Engineer, a Fellow of the Institute of Radio Engineers, a Fellow of the Radio Club of America, Member of the American Institute of Electrical Engineers, Chairman of the American Engineering Standards Committee on Parts and Wiring, and the author of several books and a number of radio papers.

As the inventor of several radio devices and a recognized authority on radio engineering, his predictions in radio may be taken by experimenters as endorsement from one well qualified to pass judgment in radio matters.



From a drawing made for POPULAR RADIO by **A. G. Hagstrom**

How Waves Are Reflected From the Radio Roof

A series of penetrating experiments proved in the past that radio waves, in passing from the transmitter to the receiver, travel over two such paths as are shown above. One is direct and the other is pyramidical, passing from the transmitter to a reflecting or refracting medium in the upper regions of the atmosphere, and thence to the receiver. Obviously these waves, having a longer distance to travel, will reach the receiver an infinitesimal fraction of a second later than those received along the direct path. By a careful calculation of the difference in time between incoming signals, science has found the approximate location of the region of reflection. Mr. Raymond A. Heising, whose article on the opposite page incorporates the latest discoveries about the nature of this region, deduces from his experiments that the reflecting layer rises and falls very rapidly at times, with the consequence that the amount of reflection, and hence the volume of received signals, varies. It is this action that we experience in the phenomenon of fading. Mr. Heising's experiments also lead to the belief that there is, between the earth and the reflecting region, another atmospheric layer where free electrons that are present from solar radiation absorb a considerable portion of radio energy, so that weaker high-frequency radiation will not survive the journey.

Popular Radio

VOLUME XIII February, 1928 NUMBER 2

IS FADING CAUSED BY THE MOTION OF

The Earth's "Radio Roof?"

It has been generally known for some years past that radio waves are practically earthbound. Their terrestial imprisonment is brought about by the existence in the upper and less ponderable regions of the earth's atmosphere of a stratum of gas molecules that acts as a reflector of radio waves. In this article Raymond A. Heising, who is one of America's greatest research engineers, describes a series of experiments that would seem to indicate that fading, the bugaboo of broadcast reception, is caused by the rising and falling of this layer.

RAYMOND A. HEISING

Research Department, Bell Telephone Laboratories, Inc.

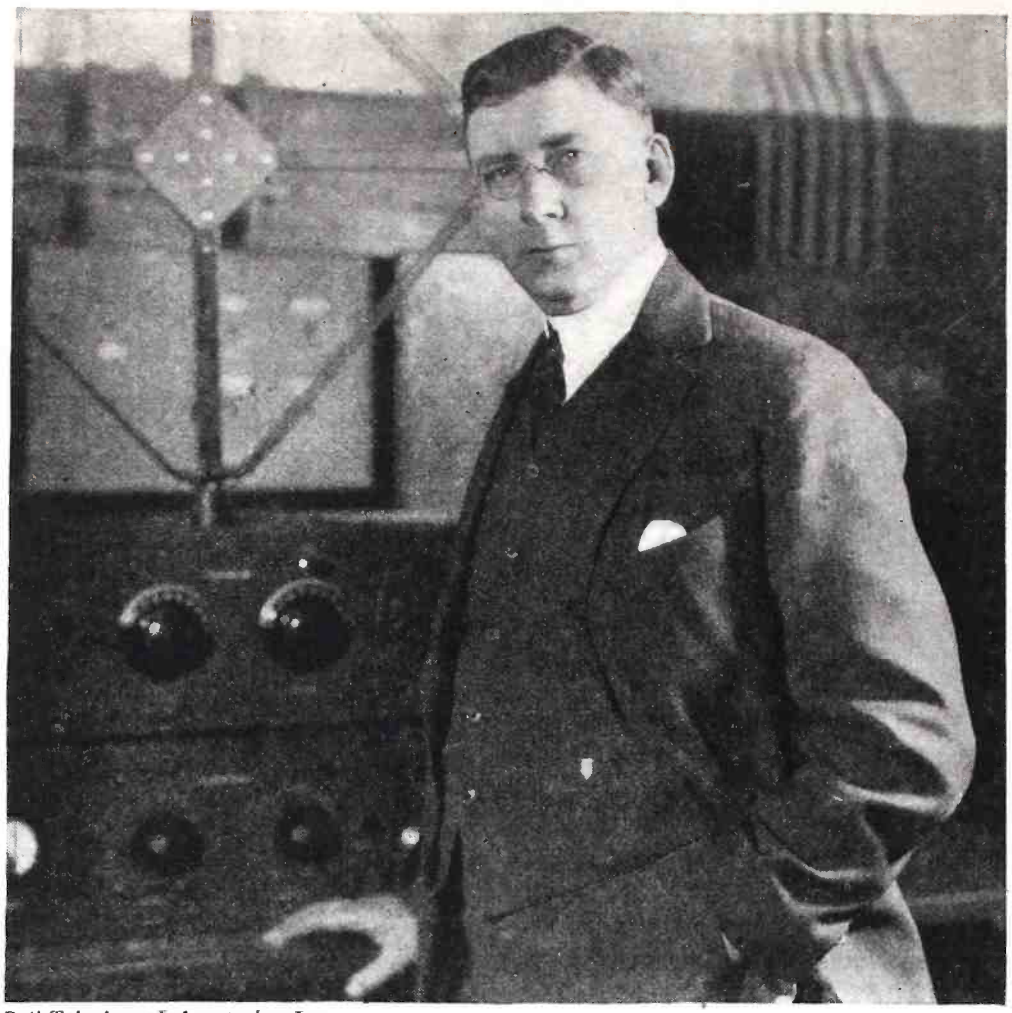
WITH the first transmission of radio signals across the Atlantic, a phenomenon was demonstrated which previously had been considered impossible. Electromagnetic waves of all kinds are believed to travel in straight lines unless deviated by some unusual condition, and so it had been considered impossible to transmit radio signals over long distances, because of the curvature of the earth. Success of the transatlantic transmission showed, however, that unless there were other elements entering into the transmission conditions than those previously considered, the theory of straight-line travel was wrong. Attempts were made to account for success of the transmission on the basis of atmospheric refraction, dispersion, and the effect of a conducting ground, but none of these explanations was entirely satisfactory. In the meantime it was suggested that the cause might be reflection from an ionized region in the earth's atmosphere.

When a wave enters a medium in which its velocity of propagation varies from point to point, its direction of advance becomes curved. If the change in velocity is rapid enough, the curvature is so abrupt that the effect is much the same as that of reflection from the surface of the medium. It is often convenient to speak of this phenomenon as reflection, although it is really one of refraction. How radio waves are supposed to be bent was shown graphically on pages 349-353 of the BELL RECORD for June, 1927.*

This suggestion was made over twenty years ago, but it is within the last few years that the ionized zone has been shown as the real cause of the transatlantic success.

To determine the existence of reflection from such an ionized medium, efforts were made to observe it by the most direct method possible. For such observations radio waves were transmitted from the Bell Telephone Laboratories' experimental station at Deal, New Jersey, to a receiving laboratory forty-seven miles away, near Mineola, Long Island. If there were a reflecting layer in the upper atmosphere, a second path for the waves would be available, much longer than the direct path along the ground, and signals traveling over the reflected path, symbolized in Figure 1, would take longer to arrive than those using the more direct course. Hence, reception of primary signals and then, a trifle later, of auxiliary signals would be evidence for the existence of such a reflecting layer;

* Further information on the Heaviside region of the atmosphere may be obtained from the following articles that have appeared in POPULAR RADIO: "A New Theory of Fading Signals," by Dr. E. E. Free, p. 409, October, 1924; "New Ideas of the Heaviside Layer," by Dr. E. E. Free, pp. 85-6, July, 1925; "The Up and Down Movement of the Heaviside Layer," by Dr. E. E. Free, pp. 61-3, January, 1926; "Why Signals Fade," by Charles C. Bidwell, pp. 531-8, October, 1926; "Three Blankets Around the Earth," by Dr. E. E. Free, pp. 327-30, April, 1927; "The 'Radio Ceiling,'" by Uthai Vincent Wilcox, pp. 552-3, June, 1927.

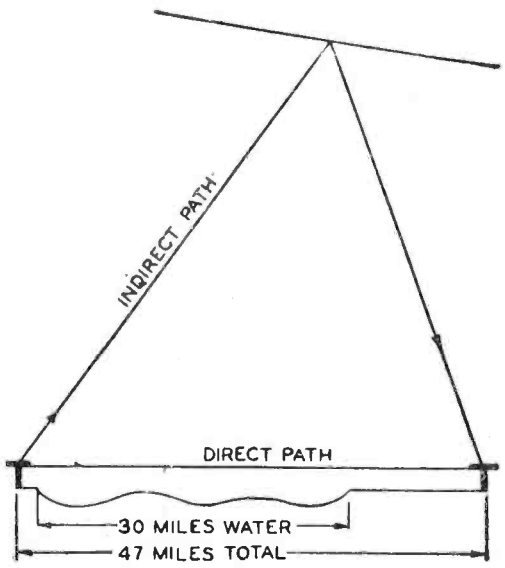


Bell Telephone Laboratories, Inc.

HE TRACES THE TRAILS OF RADIO WAVES

Raymond A. Heising, shown above, is known everywhere that broadcasting exists as the inventor of the Heising modulation system, used in all radiotelephone transmitters. He is an authority on all phases of radio transmission, and this article incorporates some of his most recent discoveries on the behavior of radio waves in the upper regions of the earth's atmosphere.

from the time interval between original and auxiliary signals the difference in length of the paths could be computed, the speed of radio waves being known.



THE TWO PATHS OF THE TEST BROADCAST WAVES

FIGURE 1: *This diagram shows the probable paths of the transmitted waves in the tests which were made between Deal, New Jersey, and Mineola, Long Island. The distance between the two stations was 47 miles, and the virtual height of the reflecting region was 150 to 400 miles.*

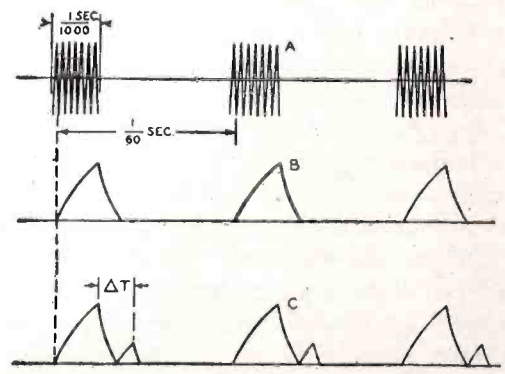
Signals of the type shown at A in Figure 2 were transmitted. High-frequency power was radiated for periods of approximately 0.001 second at intervals of about 1/60 of a second. Signals similar to those at B in Figure 2 were received with a sharply tuned set, and were recorded by an oscillograph. When there were two paths for transmission of the wave—a path with reflection from an overhead layer in addition to the direct path along the ground—two signals were received for each group of waves, transmitted as represented at C in Figure 2. This is strong evidence for the existence of the postulated zone of ionization. Drawings of the oscillograms of actual received signals are shown in the diagrams in Figures 3 and 4.

Even more than two paths were observed in many instances. Some of the paths would occur as represented in Figure 5, where paths B, C and D have one, two and three reflections respectively from the reflecting layer. The diagram at the right of the drawing shows the type of signal to be expected under such circumstances. As many as four signals may be received for each signal transmitted. Oscillograms in which signals arrived by several different paths are represented in Figures 3 and 4.

The theory of the reflecting layer thus postulated requires the presence of free electrons. When an electromagnetic wave traverses this reflecting region, the unattached electrons are moved by the influence of the wave and absorb energy from it. On account of their mass and charge and the presence of the earth's magnetic field, the electrons in their movements reradiate the absorbed energy slightly out of phase with the passing wave; in doing so they change the effective velocity within the refracting zone. This variation in effective velocity is, of course, the cause of refraction.

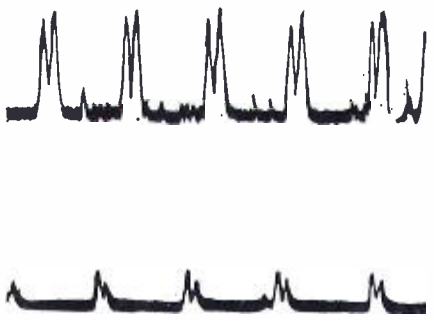
The electrons in this reflecting layer are supposed to come from two sources. There is good reason for believing that electrons are thrown out of sun spots and reach the earth. Other electrons are freed by the ultra-violet light which comes from the sun, and, reaching the atmosphere, knocks off electrons from molecules of its gases. It appears from experiments that the free electrons in the ionized regions of the atmosphere are produced by both of these causes; electrons from the sun spots are received both day and night, since their paths are bent by the earth's magnetic field, while ionization of the air molecules takes place on the sunlit side of the earth.

The free electrons do more, however, than refract or reflect the waves. When an electron absorbs energy from a passing wave and executes an oscillatory or circular motion in the atmosphere in its absorbing and radiating process, continuance is insured only as long as noth-



HOW VARIOUS TYPES OF SIGNALS RECORD

FIGURE 2: *The wave trains shown at A are those of steady high-frequency power radiated periodically. At B is the type of signal received on an oscillograph with a very selective set. This signal travels the direct path. At C is the type of signal received when two paths existed. From the measurement of the time difference, ΔT, the difference of length between the direct and indirect paths can be computed.*



WAVES THAT TOOK MORE THAN ONE PATH

FIGURE 3: *The upper graph is an oscillogram of a signal, received on a wavelength of 57 meters, in which the character of the curve indicates that both a direct and a reflected wave were received. A calculation of the time difference between the incoming signals indicated that the height of the reflecting layer was 221 miles. The lower graph also shows both direct and reflected waves, the latter being reflected from a height of 155 miles.*

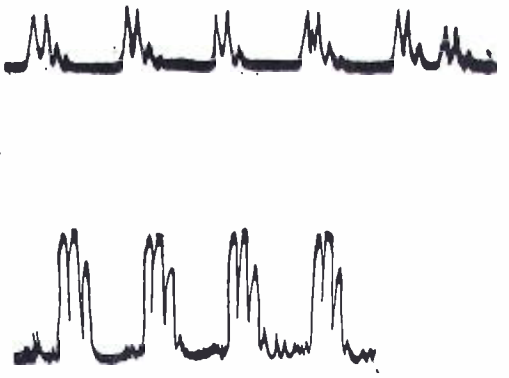
ing gets in the way. If there are many gas molecules around, the moving electron may strike one and lose a large part or all of its energy, or it may be deflected in such a way that the energy remaining is radiated at random, no longer contributing to the passing radio wave. In such a case the free electron must absorb more radiation before it can contribute further to the passing wave. The presence of gas molecules in the region where the free electrons occur thus causes absorption of energy from the wave. Under these circumstances the wave may be reduced in intensity, often to a very low value.

It has been shown in a paper by Nichols and Schelleng* that the frequency of collision with molecules is related to the magnitude of absorption. If the gas molecules are relatively close together—if the air is dense—a free electron can scarcely move under the influence of a passing wave, since the gas molecules block the way, and so neither absorption nor reflection occur. If the gas molecules become less numerous, the free electrons can move more readily. At a certain air density, therefore, maximum absorption occurs, because at that stage it is certain that practically all the electrons lose their energy by collision with gas molecules before they have had a chance to radiate again any appreciable part of it. As the density of the gas is still further reduced the molecules become so far apart that the electrons can execute a great number of oscillations before losing their energy by collisions. Density of the air thus determines locations of the zones at which waves are absorbed or reflected.

Atmospheric density is greatest at the earth's surface, and rapidly becomes less as the altitude increases. At a height of about fifty miles the density is reduced to the value causing the greatest absorption, and about twenty-five miles higher is so much less that the electrons can execute their oscillations with only rare loss of energy to the gas molecules in collisions; reflection, or more properly refraction, can therefore occur. That region where the air density is suitable for absorption is called the "absorbing region," while the zone higher up in which reflection or refraction may occur is called the "refracting region."

When an electromagnetic wave travels between two points separated by a considerable distance, on account of the earth's curvature, the wave received at a distance must travel up to the refracting region, and then turn downward to strike the earth at the receiving station. The wave must, therefore, pass through the absorbing region twice. On the way up, if many free electrons are present in the absorbing region, the energy of the wave may be so cut down that little is left to be reflected, and after reflection it will be cut down further on the return to earth. Long-distance radio communication can, therefore, be secured only by means of those waves which can make two or more passages through the absorbing zone without undue attenuation.

The experiments reported in the paper at the Radio Institute appear to support the hypothesis that free electrons are produced in the absorbing region of the atmosphere by ultra-violet light from the sun, making absorption thus a daylight phenomenon. It is not equivalent for all radio waves, but varies with the wavelength. At 15 to 20 meters it is very small, is fairly great for wavelengths around 100 meters, and is a maximum just over 214 meters; beyond this point it seems to become considerably less.



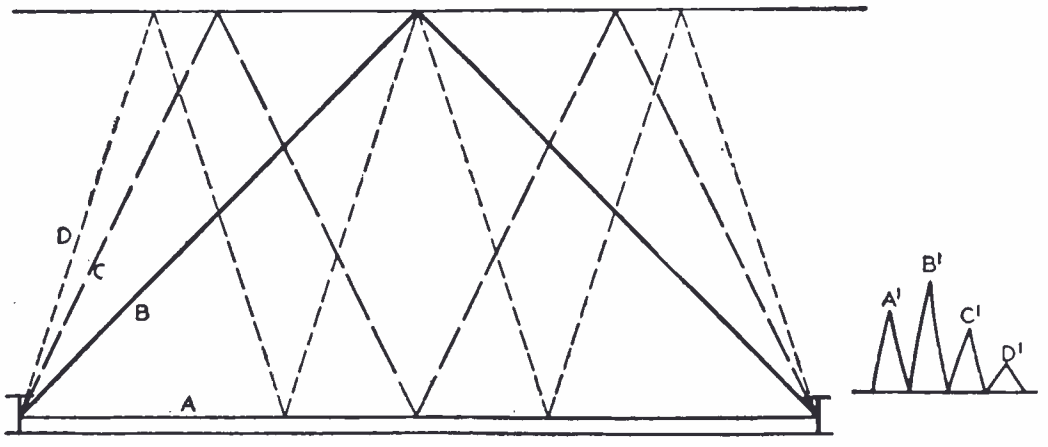
A GRAPHIC STORY OF REFLECTED WAVES

FIGURE 4: *Both of these graphs show signals that took more than one path between transmitter and receiver. In the upper graph the computed lengths of the four paths that the signals took were 47, 408, 809 and 1,240 miles. The wavelength was 57 meters. In the lower graph (another 57-meter signal) the three paths that the signal took were 47, 441 and 882 miles.*

The free electrons present in the refracting region at night appear to be those from the sun. There are also some "hold-over" electrons formed during the day and remaining uncombined with the positive gas ions. The electrons from the sun appear to be more numerous or more influential, for the data show that the refracting region moves up and down in a manner not compatible with other hypotheses. The apparent height of the refracting region at night is 150 to 400 miles. During the day, the larger part of the free electrons in the refracting region are caused by ultra-violet light from the sun. Since this light produces free electrons at altitudes as low as 16 miles, the apparent height of the refracting region is much lower during the day than at night.

From these observation we have concluded that the refracting region does not remain in any position, but moves up and down at a varying rate. A

(Continued on page 172)



HOW ONE SIGNAL CAN BE RECEIVED FOUR TIMES

FIGURE 5: *When the reflecting layer is parallel to the earth's surface, more than two paths can be taken by radio waves. In this diagram four paths are indicated, A, B, C and D, with progressively increasing distances that the signal has to travel to reach a given distance on the earth's surface. The small diagram to the right shows the type of signal received from waves taking each of these paths.*

* Bell System Technical Journal, April, 1925.

LOGGING STATIONS NEVER HEARD BEFORE

A turn of the dials of the Teletrol brings in station after station that the average broadcast listener has never heard of before—short-wave broadcasters from fabulous distances, amateur DX hounds, and the fascinating mystery of the short-wave code stations.

The Teletrol Wave Lifter

By CARL DORF

SHORT-WAVE broadcasting and reception have recently been attracting, more and more, the attention of radio fans and listeners. The tremendous distances that may be covered on short waves, and the freedom from fading with its accompanying distortion, have been demonstrated by the pioneering of short-wave stations, especially KDKA and WGY. The average reliable service range of 500-watt broadcasting stations on the usual broadcasting wavelengths is not more than 15 to 40 miles where really good reception is to be expected. On short waves—that is, wavelengths below 100 meters—broadcast signals are reliable for more than ten times that distance. To demonstrate, it is only rarely that listeners on the European side of the Atlantic pick up American broadcasting stations that operate on the regular broadcast band, but the short-wave station at Pittsburgh has, during the last two years, been consistently received as far away as Australia, which is half-way round the world. During the last winter the British Broadcasting Company has regularly broadcast to its British listeners complete programs from the American short-wave stations. Their plans for the coming winter include a regular service of this kind. This is an indication of the reliability of long-distance short-wave transmission and reception.

The Teletrol wave lifter is the key to a new and fascinating wonderland of radio. Short-wave reception is a luxury enjoyed by few radio fans, and yet this crop of wavelengths can be harvested nightly by the use of the simple device described here, that may be used with any broadcast receiver. In the region of the "little" waves there is no interference, and static is reduced to a minimum. The Teletrol catches these short waves and "boosts" them so that they become audible through your present receiver.

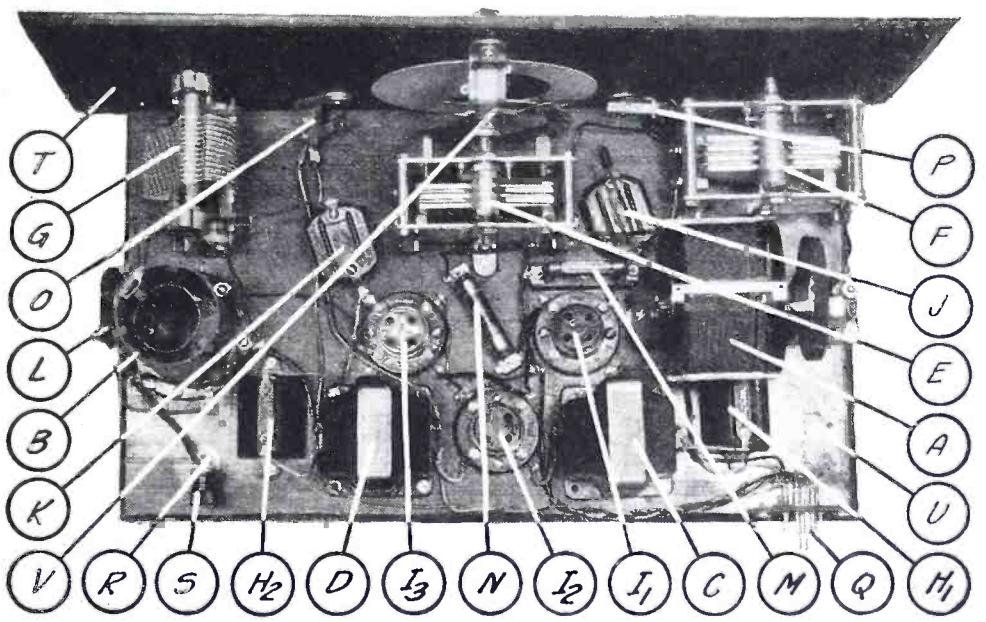
There are now at least 36 stations scattered throughout the country operating on short waves that can be picked up on a suitable short-wave receiver. Furthermore, stations in England, Germany, Holland and Japan are now operating regularly at these high frequencies with interesting programs that cannot possibly be received here in America through any other system. Amateurs are now receiving them even during the daytime on short-wave receivers. Up to the present time ordinary broadcast listeners have been as cut off from these excellent programs as if they never existed.

It is only recently that the difficult problem of efficient short-wave reception has been carefully and energetically studied and a reliable system of reception worked out. As a result, a unit has been evolved for attaching to any standard radio receiver for opening up the short-wave band to the regular broadcast listener.

The problem has resolved itself into the development of a unit which can be placed ahead of the regular broad-

POPULAR RADIO WORK SHEET

The Teletrol Wave Lifter



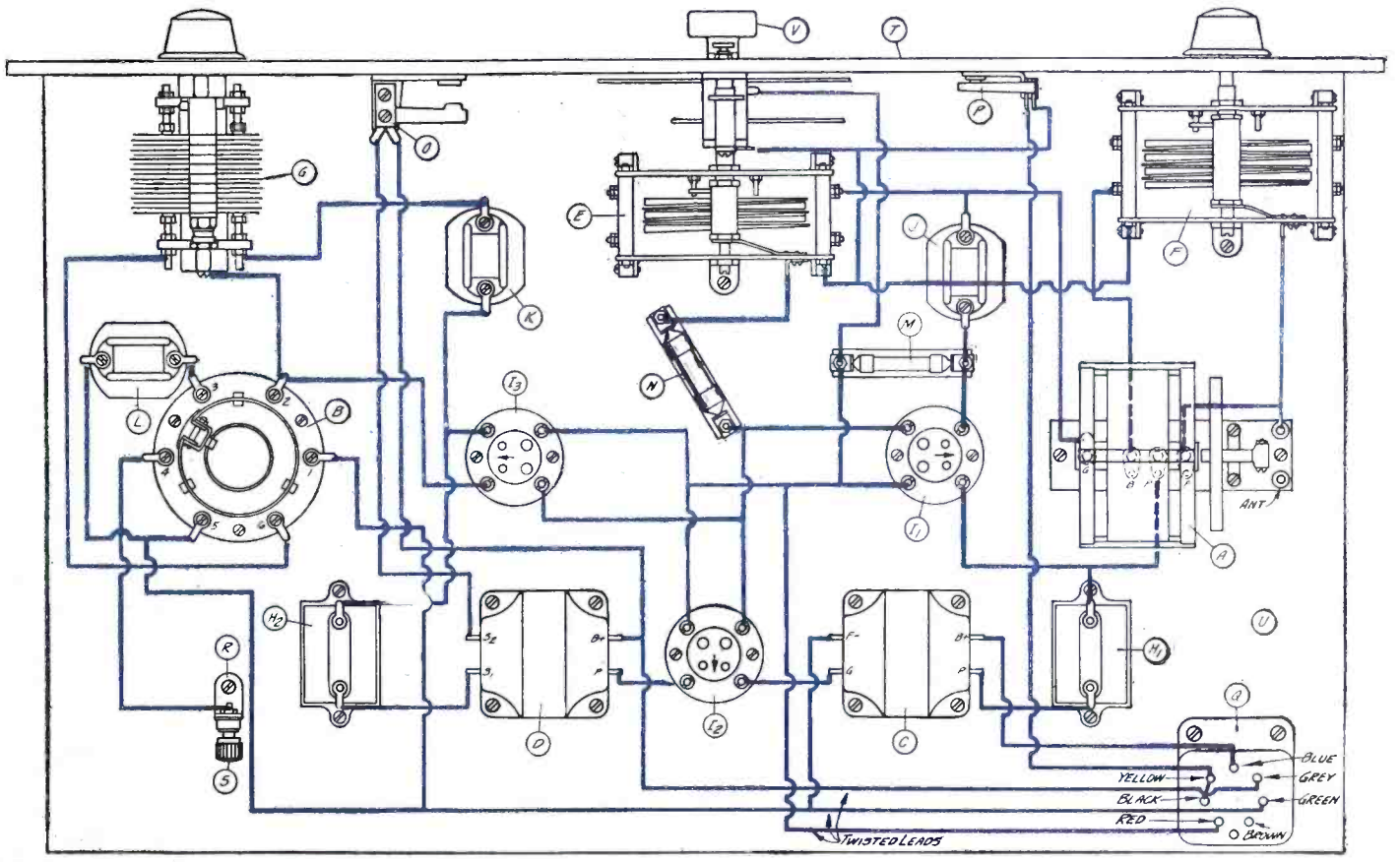
A TOP VIEW OF THE TELETROL

FIGURE 1: *The building of this unit requires no more skill than that necessary in constructing standard receivers, as this view shows.*

List of Parts Used in Building This Unit

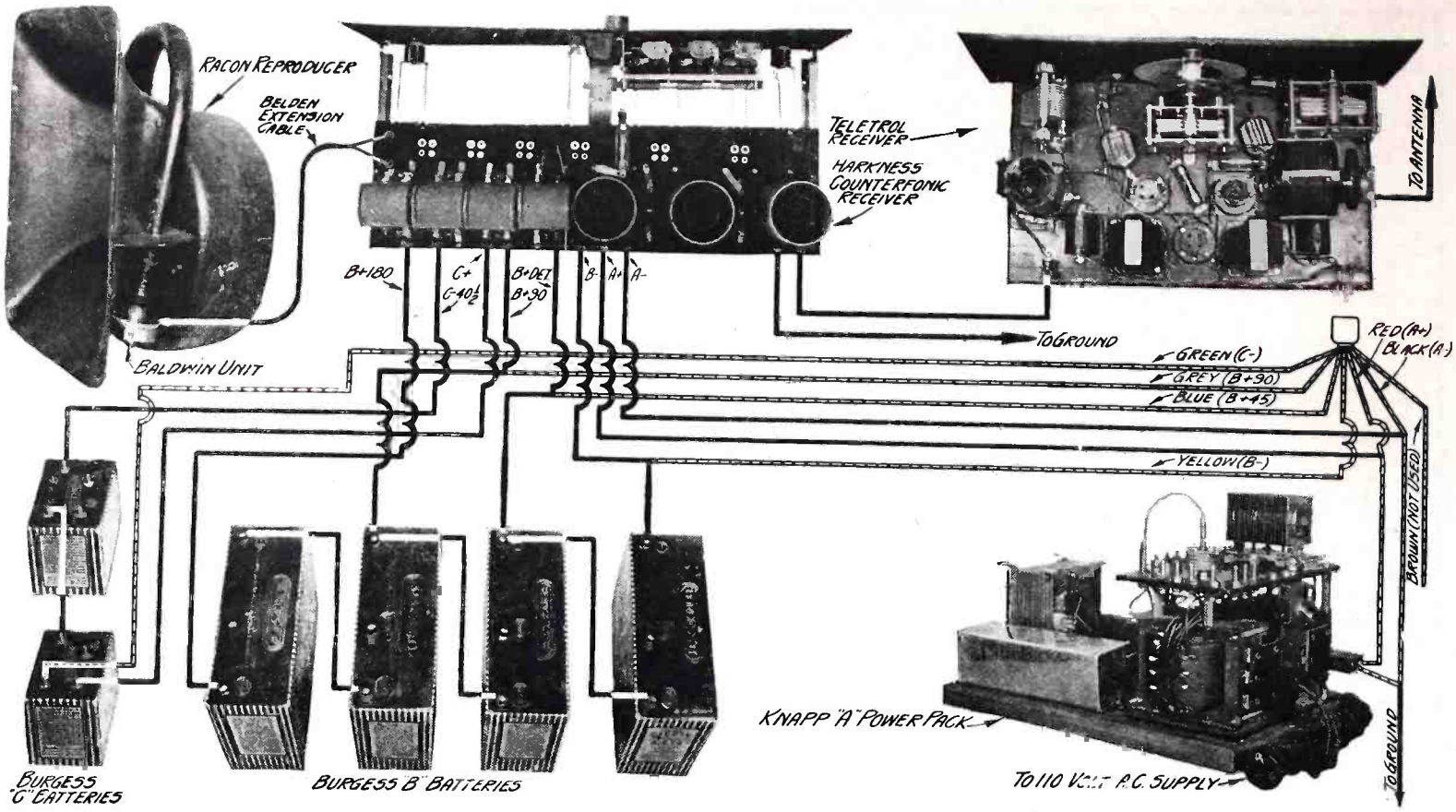
Cost of Parts—*Not over $65.00*

A—Aero coil set, type LT-125;
B—Aero coil, type 55;
C—Samson symphonic transformer;
D—Samson choke, type O;
E—Cardwell condenser, type 167-E;
F—Cardwell condenser, type 168-E;
G—National condenser, .0005 mfd.;
H1 and H2—Samson R. F. choke coils;
I1, I2 and I3—Na-ald sockets, type 481-XS;
J—Sangamo fixed condenser, .00025 mfd.;
K and L—Sangamo fixed condensers, .006 mfd.;
M—Durham grid-leak, 6 megohms, with mount;
N—Amperite, ¾ ampere;
O—Yaxley S. C. jack;
P—Yaxley filament switch;
Q—Yaxley cord and plug;
R—Brass angle, 1¼ by ½ inch;
S—Eby binding post;
T—Composition panel, 7 by 18 by 3/16 inch;
U—Wooden baseboard, 9 by 18 by ½ inch;
V—Marco illuminated dial;
15 feet of Corwico Braidite hook-up wire;
Mounting screws, solder, etc.



THE PICTURE WIRING DIAGRAM

FIGURE 2: *All the wiring is done above the baseboard, and is shown in this diagram in solid* BLUE *lines. The instruments are outlined in* BLACK.



HOW TO HOOK UP THE TELETROL TO YOUR BROADCAST RECEIVER

FIGURE 3: *The Harkness Counterfonic Six, whose construction was described in the January number of* POPULAR RADIO, *is shown as an example of standard receivers that may be used with the Teletrol. Note that only a simple change in the antenna and ground connections is necessary to plug in the Teletrol.*

cast receiver and which would tune to the incoming short-wave signals, on wavelengths from about 13 meters up to 100 meters, and so convert them that they will be accepted by the high-frequency amplifier in a standard radio receiver, operating from 200 to 550 meters.

The solution, when finally found, was so simple that it was almost unbelievable. It resolved itself into the design of a rather ordinary, but reliable, short-wave single-valve receiver with a stage of low-frequency amplification in combination with the already recognized Heising modulation system now used by all broadcasting stations, and a local oscillator that can be tuned to any particular wavelength in the broadcast band; altogether a three-valve circuit.

This is the system used in the "Teletrol" Wave Lifter, developed by two young engineers who have for years pioneered in short-wave reception. These two experimenters, Arthur L. Budlong and Bert E. Smith, well known among the members of the Amateur Radio Relay League, have combined the units spoken of above into a converter that performs admirably, and that may be connected to any radio receiving set now used for regular broadcast reception.

A study of the schematic wiring diagram of the new unit, shown in Figure 4, discloses the component functions of the regenerative detector and the Heising modulation scheme connected to a tunable oscillator, working as a unit, for "wave lifting." The unit employs three vacuum valves of special

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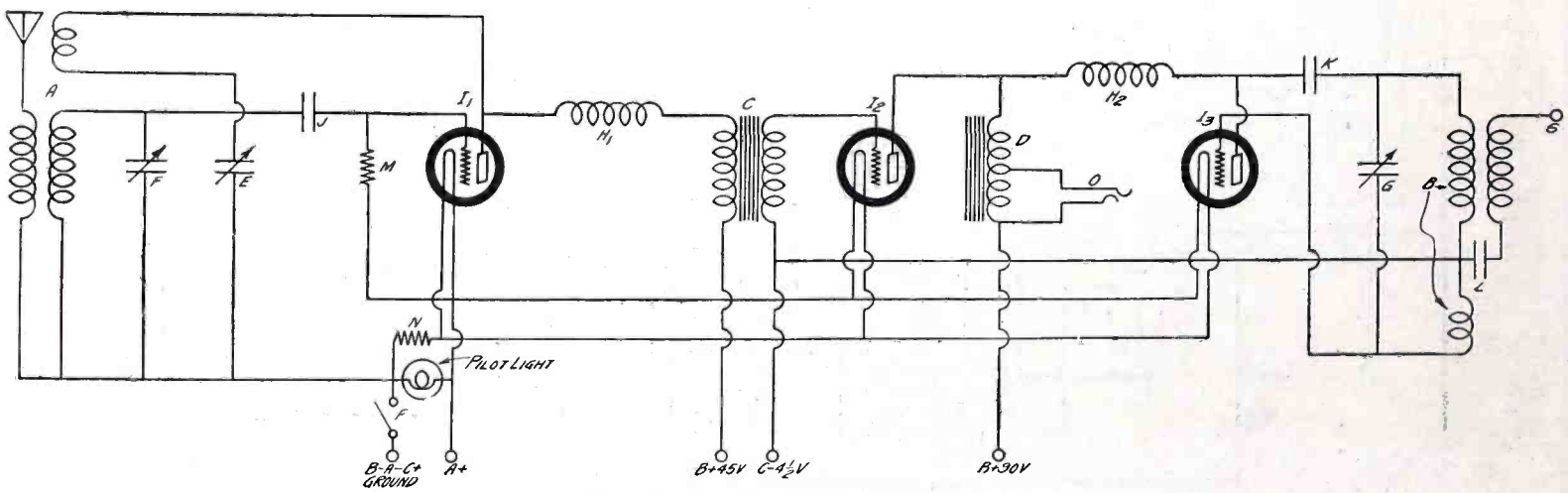


THE CIRCUIT OF THE TELETROL

FIGURE 4: *The Teletrol is not a complicated electrical device, as the above circuit diagram shows. It solves itself into a simple short-wave receiver circuit, shown at the left, supplemented by a stage of low-frequency amplification, shown in the center; its output modulates the oscillator circuit shown at the right, and thus lowered to a frequency that is acceptable to a standard broadcast receiver.*

What Radio Receivers Can Do With the New Magic of Shielded-Grid Valves

Just what are the possibilities of the new shielded-grid valves to the experimenter and the broadcast listener? How will they affect radio receiver design and operation? In the article below you will find an answer, drawn from actual tests on one of the first receivers designed to utilize these sensational products of radio ingenuity.

By LAURENCE M. COCKADAY

THE advent of the shielded-grid valve, especially as a high-frequency amplifying device, has made radio engineers revise many of their notions concerning this form of amplification. Whereas the amounts of amplification per stage were once of the order of *units,* now they are speaking of per-stage amplifications running anywhere from *25* to *50.*

Since the article on the shielded-grid valve in the November, 1927, issue of POPULAR RADIO, an American valve of this type has been placed on the market, and the interest in receiver designs incorporating the new type of valve, as a workable unit, has been growing rapidly.

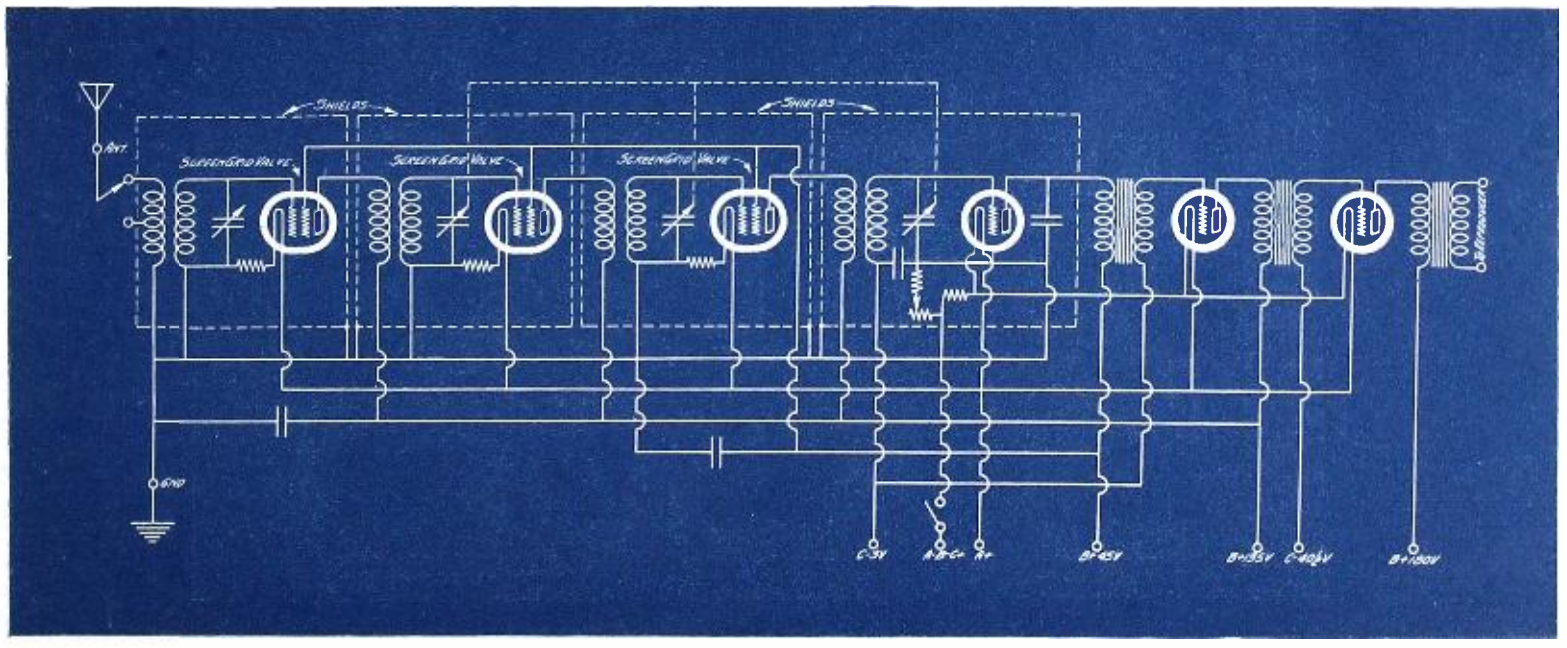
There is a common misconception on the part of the public that this new type of valve may be incorporated in almost any existing set without much change. This is not true. The new device is so extremely sensitive that it entails certain very definite precautions of design in the receiver with which it is to be employed, and usually it will be found that a general redesigning of the set is necessary. The shielded-grid valve must be used in a completely shielded high-frequency amplifier, in order to give stable operation at the enormous amplification that it is capable of producing.

One of the great difficulties encountered in the design of circuits and apparatus for use with this shielded-grid valve lies in the fact that although the effective input capacity of the new valve is extremely low, its capacity, looking out of the plate circuit, is of a very high order. This effect, when using conductively coupled tuning circuits, is naturally going to affect the complete amplification curve over the broadcast frequency range to a great extent, and if the design is not exceptionally carefully worked out the amplification curve will be far from being equal over the whole range, but will have a definite peak with a decided falling off at each end.

Another condition in the new valve is its high output impedance. This affects materially the design of shunt-plate-feed circuits and again calls for special consideration in the inductance and capacity tuning arrangement. It is imperative that the coils used in the circuit have an efficient form factor and that their impedance when tuned to resonance be of the highest possible value. The coupling condensers used should be of a relatively low impedance.

Other problems, such as shielding the control grid circuit from the plate circuit without increasing the effective capacity across the valve, and taking care of the mechanical design, must first be overcome before the high amplification that may be obtained theoretically is realized in practice.

One of the first receivers to be intro-



A RADIO CIRCUIT EMPLOYING THE NEW VALVES

FIGURE 1: *Above is the schematic wiring diagram of the Silver Shielded-Grid Six, employing a high-frequency amplifier of three shielded-grid-valve stages, shown at the left. The detector and low-frequency amplifier at the right are of standard design. The individual shielding of the high-frequency and detector stages is an essential feature of the design. Note also that the shielding grids are connected together to the "B" positive (+) 45-volt lead. The low-frequency amplifier is of standard design.*

duced to the public, with an arrangement of circuits specially designed to take care of the shielded-grid valve as an amplifier, is the Silver Shielded-Grid Six Receiver. This receiver uses three stages of shielded-grid-valve amplification followed by a standard vacuum valve detector and two stages of standard low-frequency amplification.

With this type of valve, it is of the utmost importance that the control grid and its associated circuit (the input tuning) be statically shielded from the plate or output circuit.

Referring to the schematic wiring diagram in Figure 1, it will be noted that the plate connection of each of the three shielded-grid valves is placed close to the side of the stage shield, so that it runs directly out of the can and into the input circuit of the following valve. It will also be noted that the shielding grids of all of the valves are connected together and a 45-volt positive potential is placed on them. From a high-frequency standpoint this shielded grid is placed at practically the same potential as the ground. This prevents feed-back that might otherwise cause what is ordinarily known as *regeneration*. This means that in a properly designed receiver the maximum amplification can be obtained without any accompanying unstability.

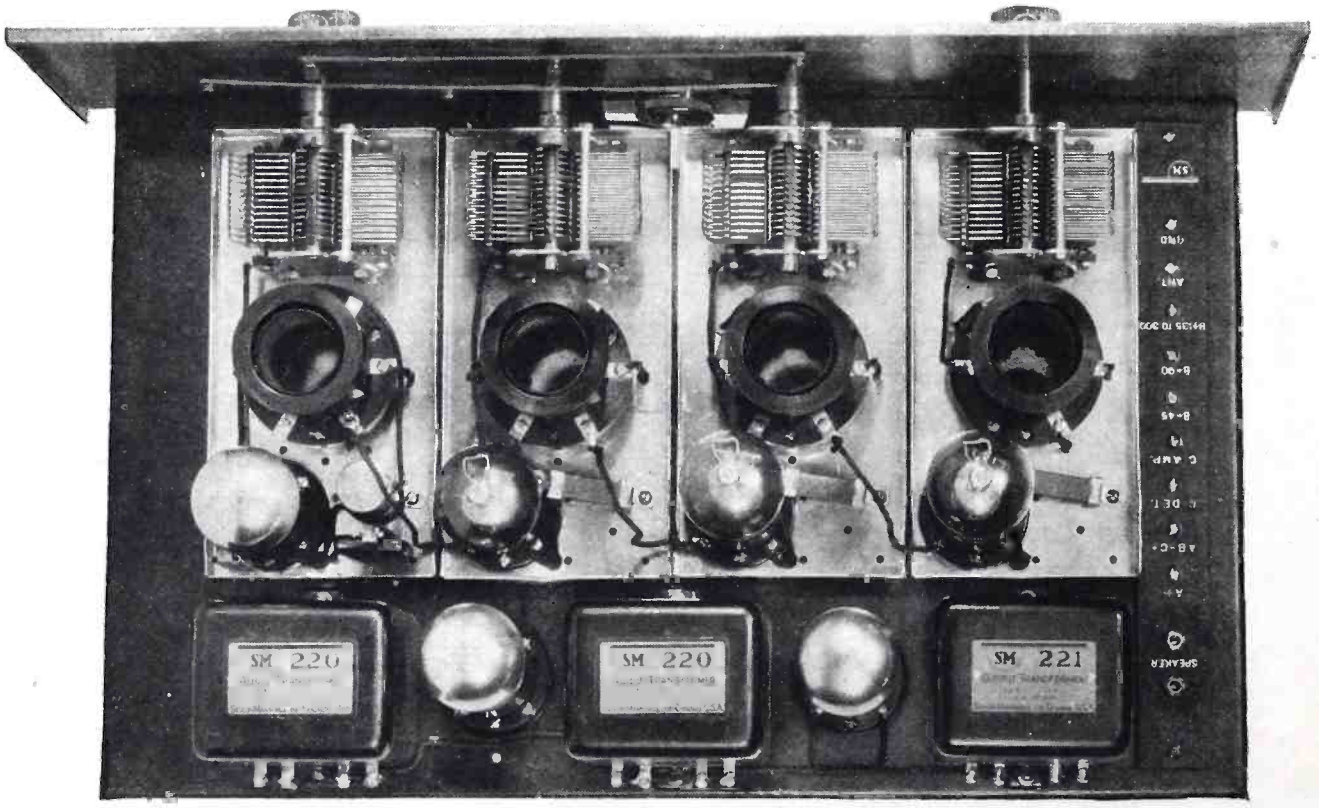
It must also be remembered that the new shielded-grid valve has a filament that is different from the standard valves, in that it consumes but a small amount of filament current, at about half the usual filament voltage. This variation from the standard characteristic is taken care of in the Silver Six by a series resistance and also by three fixed resistors, one in each stage. These last resistors also furnish the proper "C" bias, in the voltage drop across them, for the control grid circuit. These fixed resistors may be seen in Figure 2. The resistors are placed at the right of each shielded-grid valve. The terminal for the control grid is brought out at the top of each valve instead of in the base. This helps in spacing the terminals of the plate and the control grid.

Referring again to Figure 2, the first three stages on the right are the high-frequency amplifier stages, while the fourth stage at the left contains the input tuning to the detector, and the associated grid condenser and standard vacuum valve detector. In this case a 312 type valve is used for the detector and the first stage of low-frequency amplification, which is coupled with a low-frequency amplifying transformer. A second transformer couples this valve to a 371 type valve, which is used as a power amplifier, in conjunction with an output transformer. The general construction of the complete receiver follows, in layout, the standard Silver design, except as specialized in the high-frequency amplifying stages incorporating the shielded-grid amplifying valves.

The coils in this receiver are loosely or inductively coupled, but are of special ratio to take care of the large amplification that can be obtained with this new type of valve. Ordinary coupling inductances, such as used with the old-style amplifying valves, are practically useless so far as a consideration of maximum amplification is concerned. It is also a misconception that plate tuning must be used with the shielded-grid valves.

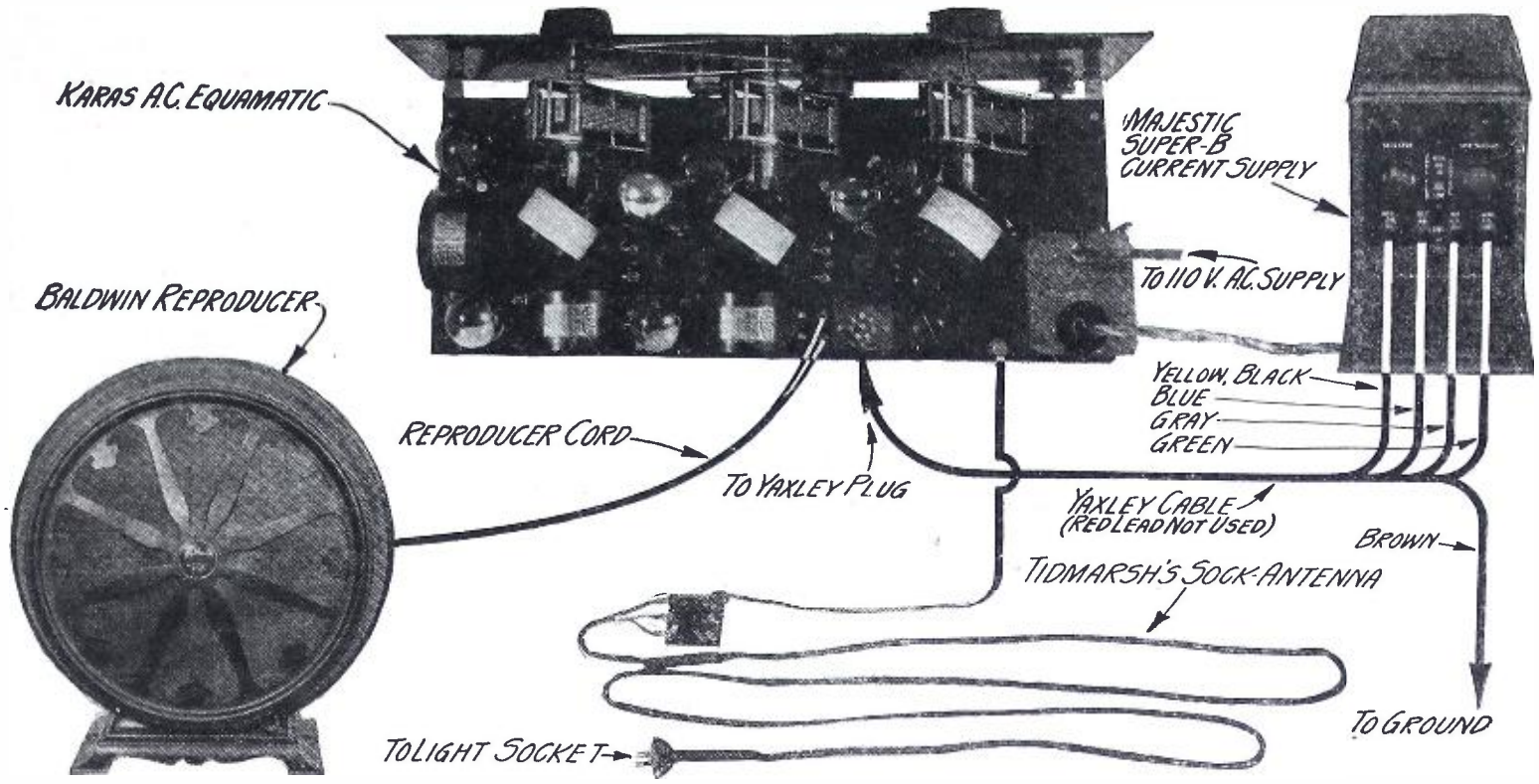
While experimenting with this new receiver in the POPULAR RADIO Laboratory, it was interesting to note that even a slight movement of the shields or a partial removing of one of the shields caused such a change in the amplifying conditions that reception varied immediately and became unstable. However, with the shields firmly in place, an enormous amplification was possible.

In tests on this receiver it was not difficult at all to bring in distant stations that have heretofore been considered on the very fringe of good reception, with a volume ordinarily associated with local reception. This may sound like an exaggeration, but when it is considered that the total amplification in a receiver of this type may go as high as 15,000 to 25,000, such great distance-getting ability does not seem to be at all impossible.



A VIEW OF THE SHIELDED-GRID SIX FROM ABOVE

FIGURE 2: *The three high-frequency stages and the detector stage are shown in their shield cans with the tops removed. The low-frequency amplifier is at the bottom. The clips at the tops of the valves are the control grid connections. The shielding grid leads come into the valves through their bases. Note that the plate leads from each valve to the transformer of the succeeding stage is made as short and direct as possible; this is highly important for the proper operation of the valves. The transformers themselves are of very different design from those used in ordinary high-frequency amplifiers.*



A PLUG-IN OPERATING COMBINATION FOR THE KARAS

FIGURE 1: *By using the "B" power-pack and the socket antenna shown in the above diagram, the AC Karas receiver may be made an entirely socket operating set, with no batteries to run down and no troublesome outdoor antenna to cause inconvenience or trouble to the set owner.*

13 Features in the AC EQUAMATIC

Light-socket operation takes a great step forward in efficiency and quality in the adaptation of AC valves to the well-known Equamatic circuit, as embodied in the new AC Karas Equamatic receiver described in this article. In addition to supplying all its own "A" current, the new 5-valve receiver features two-dial tuning and a variable coupling feature that gives equal amplification at all frequencies in the broadcast range.

By ALBERT G. CRAIG

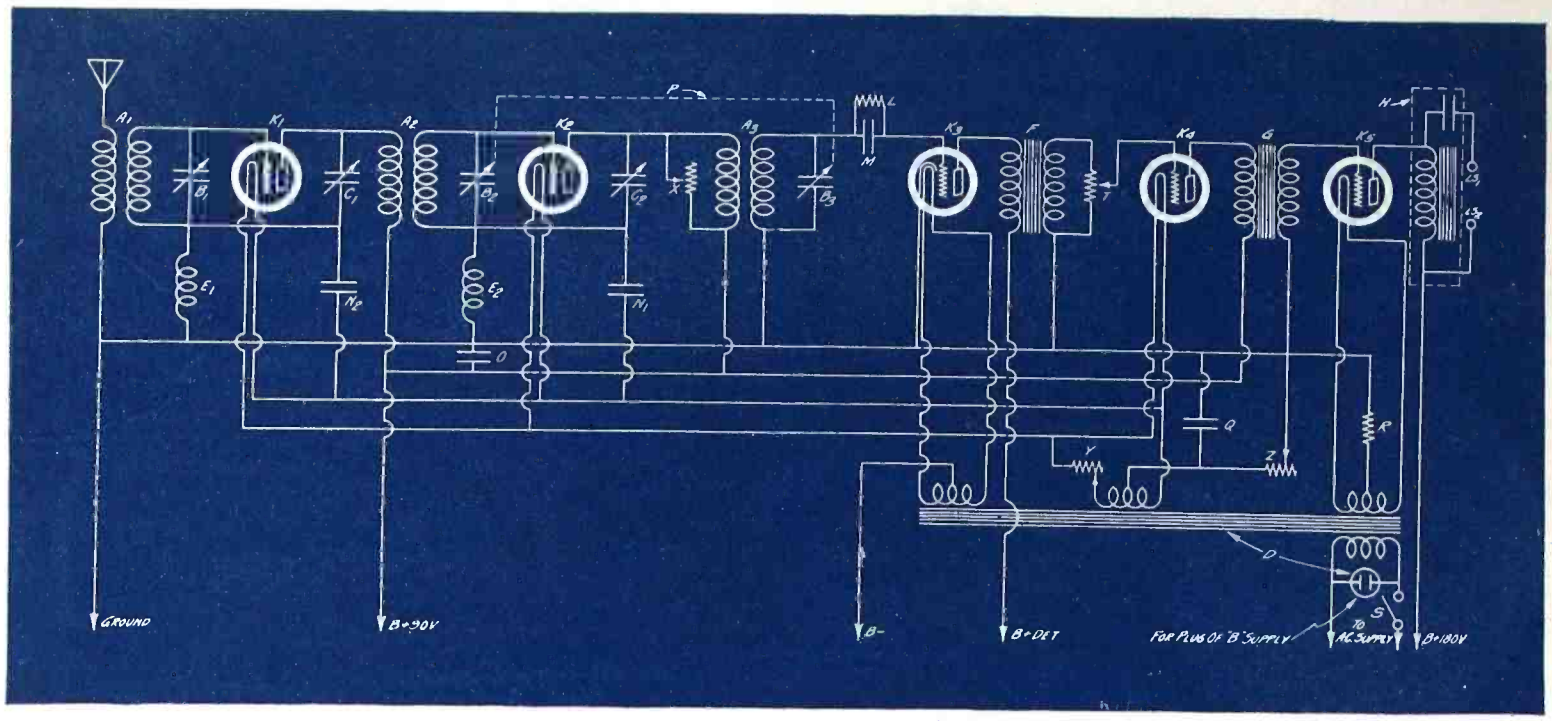
THIS new receiver is especially designed to use the new AC valves in the well-known Equamatic type of circuit, and operates entirely without batteries. It employs a variable coupling feature that allows practically equal amplification at all of the frequencies that lie within the broadcast range. Only two tuning controls are used on the main panel, one of them for tuning the antenna circuit and the second for tuning the second stage of high-frequency amplification and the detector circuit. These two latter circuits are controlled by two condensers that are harnessed together and operated by a single knob. All of these condensers are equipped with rotatable primary coils attached on the condenser shafts, so that the coils themselves revolve inside of their secondary coils when the condensers are rotated from the low wavelength range to the high wavelength range in the broadcast band.

The receiver incorporates two stages of transformer-coupled, low-frequency amplification with an efficient volume control. It employs an output filter, thus protecting the loudspeaker and reducing second harmonic distortion.

A study of the schematic circuit given in Figure 2 will bring to light some more interesting features of the receiver. It will be noticed that two high-frequency choke coils, E1 and E2, are connected in a combination arrangement with two small fixed condensers, N1 and N2, and two small balancing condensers, C1 and C2, to furnish the necessary stability for the two high-frequency amplifying circuits. The arrangement is in reality a balanced bridge that may be easily adjusted for controlling regeneration and eliminating oscillation at any particular frequency. In other words, condensers C1 and C2 may be adjusted so that at one particular wavelength the set may be stabilized so that it will not whistle or howl. This same balance, however, may be maintained throughout the whole field by the automatic control of the variable primary coupling coils already mentioned.

It will also be noticed that three of the new Televocal AC-226 type valves are used in the first, second and fourth sockets, while a Televocal AC-227 type valve is used in the third socket. A standard Televocal TC-171 power valve is used in the fifth or output socket.

As will be seen from Figures 3 and 4, the physical layout of the new receiver is neat and efficient, which makes for easy construction. The tuning unit of the receiver occupies the center portion of the sub-panel and the amplifying and power apparatus are placed along the back edge. The sub-panel it-



THE SCHEMATIC CIRCUIT OF THE KARAS RECEIVER

FIGURE 2: *The standard Equamatic circuit for the high-frequency amplifier is shown above adapted for use with valves whose filament current is drawn from the Karas AC-Former, D. The low-frequency amplifier at the right is of the standard two-stage transformer-coupled type with an output filter, H.*

self is mounted on three straight brackets that support the whole assembly and furnish a means for binding together into a compact unit the front panel and the set proper.

The receiver when installed in a standard cabinet presents a very pleasing appearance and will give much improved results over the older and more familiar DC model formerly known as the Two-dial Equamatic.

How to Construct the Receiver

The first job to be done in building this receiver is to mount all of the parts on the top of the sub-panel, W, which may be procured already cut and drilled.

The parts should be mounted as shown in Figure 4 and turned in the relative positions shown in the diagram in Figure 5. These two illustrations indicate the details of the mounting work so clearly that no additional information will be necessary here.

The parts to be mounted underneath the sub-panel, W, should be attached, as shown in Figure 3, and the three brackets, BR1, BR2 and BR3, should be fastened by means of two screws to each bracket.

Now the two condensers, B2 and B3, should have attached to their shafts the coupling gear that allows them to be tuned as one single unit. Of course, the shaft of condenser B2 must be shortened so that it will not protrude through the front panel. The two control units, T and X, should be attached to the front panel, as well as the switch, S. in the positions indicated. Then the front panel, V, should be screwed tightly to the three brackets, BR1, BR2 and BR3. The two vernier dials, U1 and U2, should then be attached and adjusted so that they will read "100" when the condenser plates are set "all in."

This completes the construction work and the wiring may be started.

How to Wire the Receiver

The receiver itself should be wired up exactly as shown in the picture wiring diagram in Figure 5.

In this drawing all of the wiring is shown in heavy red lines. The solid red lines indicate that portion of the wiring which is to be done above the sub-panel, W, and the dotted red lines show the wiring that is run down underneath the sub-panel. All of the instruments themselves are outlined in black.

In wiring up the receiver, it is recommended that an insulated flexible wire be used, such as Celatsite. It will be noticed that the wiring diagram in Figure 5 specifically indicates the portions of the wiring that must be twisted together. This is done to prevent inductive effects from the alternating-current filament circuits that might produce undesirable hums.

After the wiring has been completed, it should be checked over carefully with the picture wiring diagram that carries out the form of circuit shown in the schematic wiring diagram in Figure 2. The leads from the power transformer, D, to the switch, S, should be made from the small loop of wire that is located in the opening of transformer, D. This loop of wire should be cut and pulled out to the correct length to reach to the switch, S, and each half of the wire joined to one terminal of the

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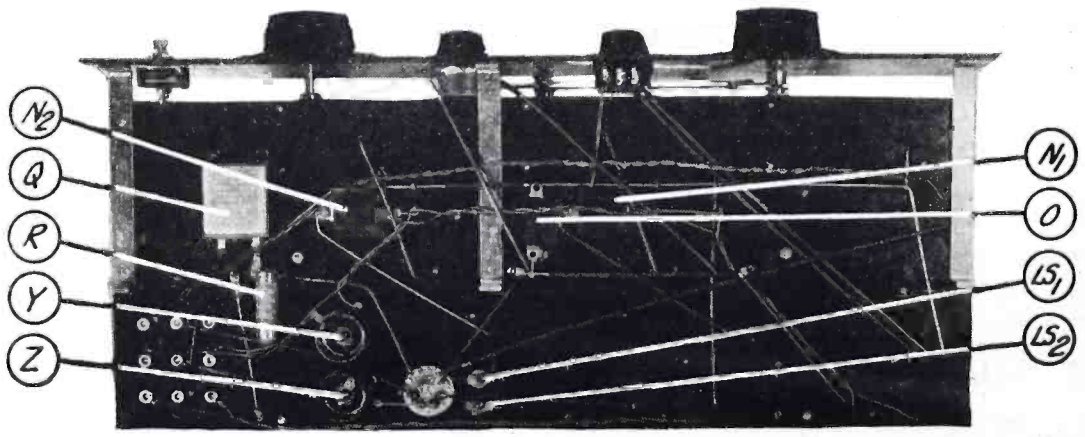


THE UNDER SIDE OF THE SUB-PANEL

FIGURE 3: *Most of the wiring is done under the sub-panel with Celatsite wire. Note, however, the twisted cables of the AC leads. The sub-panel may be obtained ready drilled, thus simplifying the job of mounting the instruments.*

POPULAR RADIO WORK SHEET

The AC Karas Equamatic Receiver

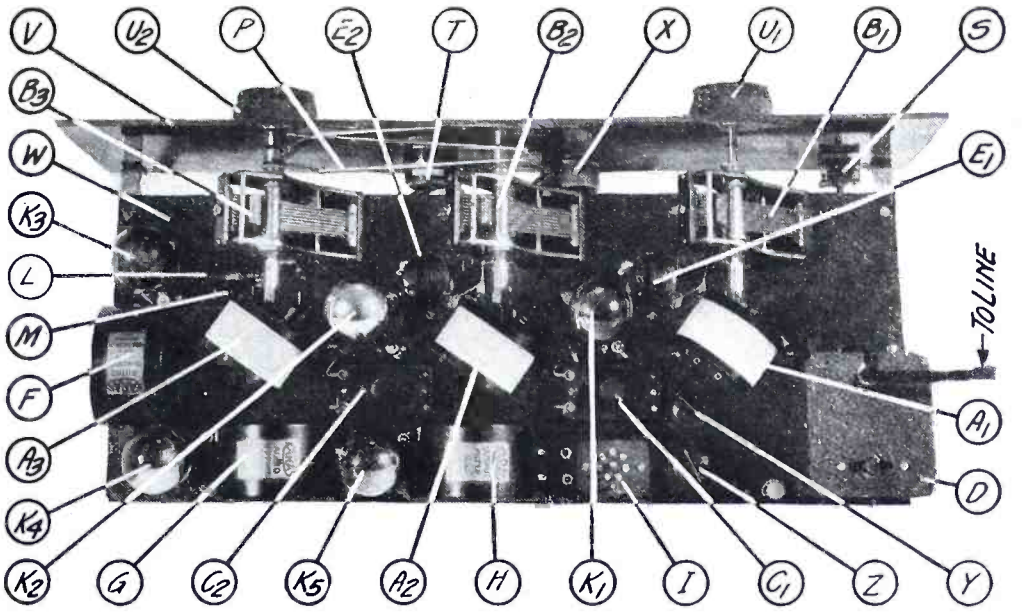


FIGURE 4: THE PANEL LAYOUT OF THE RECEIVER.

List of Parts for Building This Receiver

Cost of Parts—*Not over $115.00*

A1, A2 and A3—Karas equamatic coils;
B1, B2 and B3—Karas variable condensers, .00037 mfd.;
C1 and C2—Samson balancing condensers;
D—Karas AC-Former;
E1 and E2—Hammarlund high-frequency choke coils, 85 millihenries;
F and G—Karas low-frequency transformers, type 28;
H—Karas output filter;
I—Yaxley connector plug;
J—XL binding post;
K1, K2, K4 and K5—Benjamin Clera-tone vibrationless sockets (4-prong);
K3—Benjamin 5-prong socket;
L—Durham metallized grid-leak, 2 megohms;
M—Carter mica fixed condenser, .00025 mfd., with grid-leak clips;
N1 and N2—Carter mica fixed condensers, .00015 mfd.;
O—Carter mica fixed condenser, .006 mfd.;
P—Karas coupling gear for condensers B2 and B3;
Q—Carter by-pass condenser, No. 210, 1 mfd.;
R—Electrad truvolt fixed resistor, type B-20, 2,000 ohms;
S—Carter power switch, type No. 110;
T—Electrad potentiometer, type E, 500,000 ohms;
U1 and U2—Karas Micrometric tuning dials;
V—Drilled and engraved panel, 7 by 24 by 3/16 inch;
W—Drilled sub-panel, 9 by 23 by 3/16 inch;
X—Carter rheostat, No. M-75, 75 ohms;
Y—Carter rheostat, No. MW-1/5, .2 ohm;
Z—Carter potentiometer, No. MW-2,000, 2,000 ohms;
LS1 and LS2—Carter tip jacks, No. 10;
BR1, BR2 and BR3—Karas sub-panel brackets;
10 lengths of Celatsite insulated bus bar.

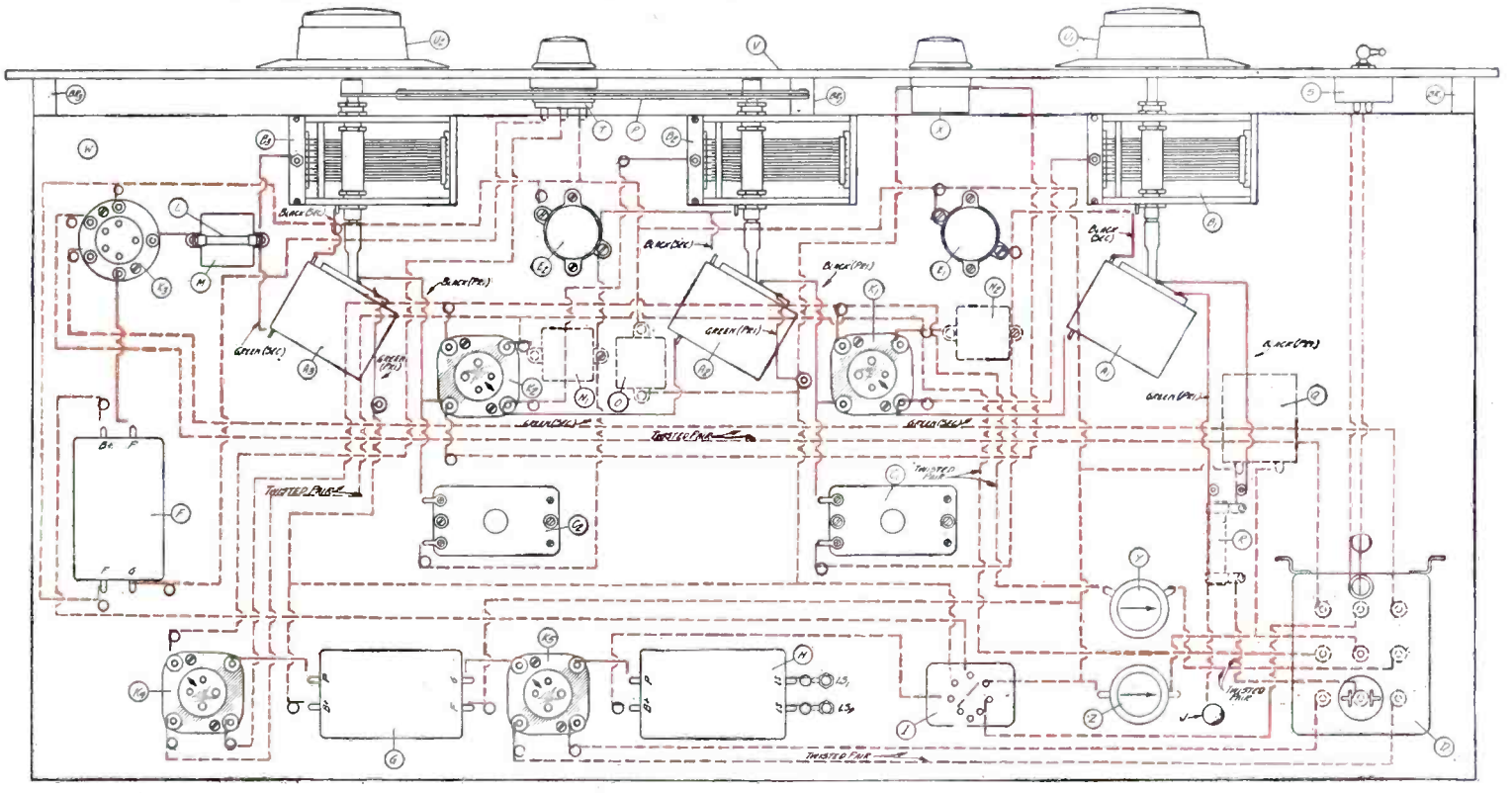
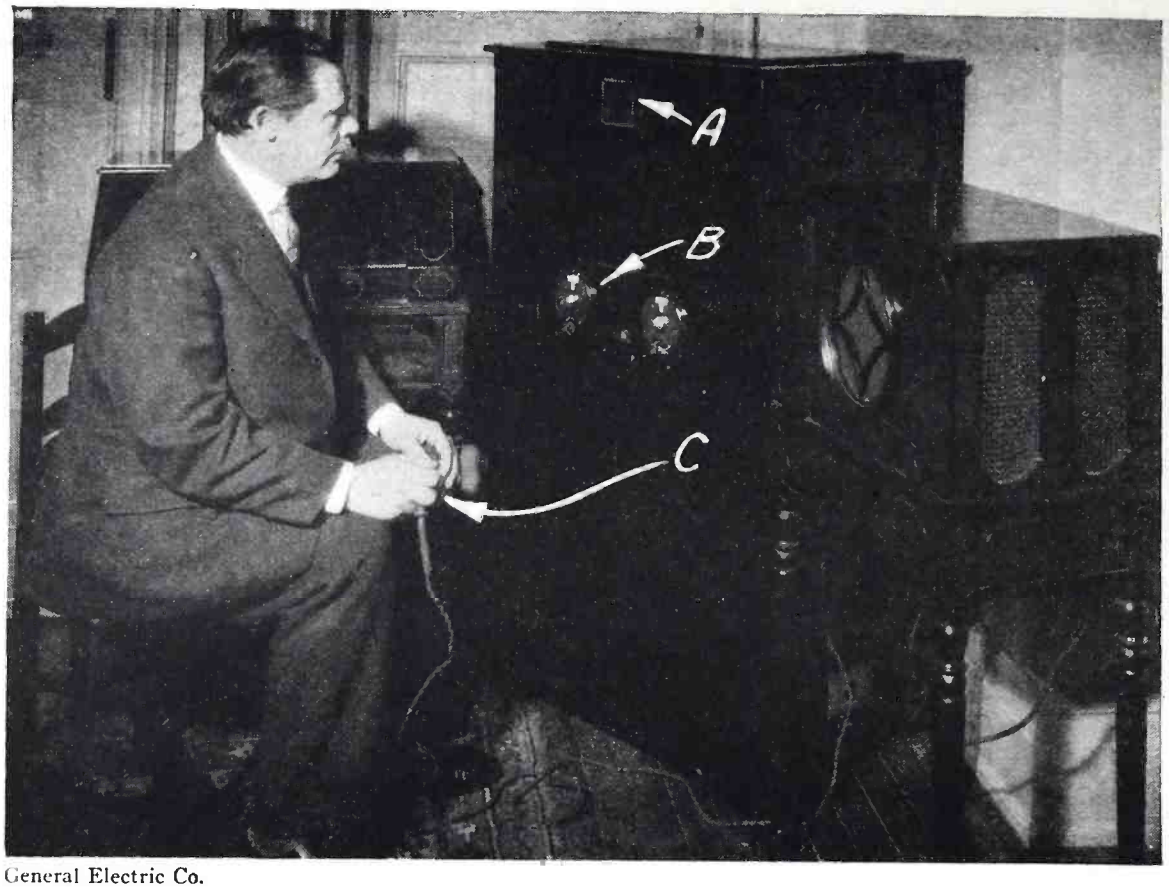


FIGURE 5: THE PICTURE WIRING DIAGRAM OF THE EQUAMATIC.



A BROADCAST LOOKER

At the right is E. F. W. Alexanderson, of the General Electric Company, with one of the television receivers. At A is the chamber where the image appears; B is the short-wave tuning panel, and C is the resistance that regulates the speed of the motor.

General Electric Co.

Now You Can Be a "Looker-In"!

Fans Everywhere Are Getting Ready to Tune to Pictures

By BENNETT DE LACY

Television has come out of the laboratories at last! It is preparing now to enter into our homes and take its place in our families just as its older sister, broadcast listening, did six years ago. The television apparatus described in this article is built of such parts as radio fans can buy easily, and its construction and operation are such as any person familiar with radio receivers can master. And its results are on the same plane as those of the receivers that caught the ether waves of our pioneer broadcasting stations.

TODAY we are listeners-in. Tomorrow we shall be listeners-in and lookers-in, for radio television is no longer the dream of engineers. Almost overnight it has become a reality. The vast research that has been conducted during the past five years has finally been co-ordinated and we have today a practical realization of the efforts of yesterday's pioneers.* In Schenectady at the present time there are a number of radio television receivers that daily pick up picture programs over a special 37.8-meter short-wave broadcaster operated by the General Electric Company. The voice is simultaneously broadcast on a wavelength of 379.5 meters from station WGY.

After a careful examination of the television broadcast system by the writer, during a demonstration sponsored by the Radio Corporation of America in collaboration with the General Electric Company, it became apparent that wide-awake radio fans should now begin to prepare themselves for the reception of picture programs. Not only are these programs being broadcast daily by the General Electric Company's special transmitter at Schenectady, but arrangements are also being made to broadcast similar programs every day from a large Western station.

The apparatus employed in the receiver is amazingly simple, and its construction comes easily within the abilities of the average radio fan. The cost, contrary to what might be expected, is small, for the major portion of the equipment is simply a broadcast receiver for short waves; the additional equipment is in the form of a fractional horsepower motor that can be controlled to run synchronously with the transmitter, an aluminum disc, and a small neon lamp.

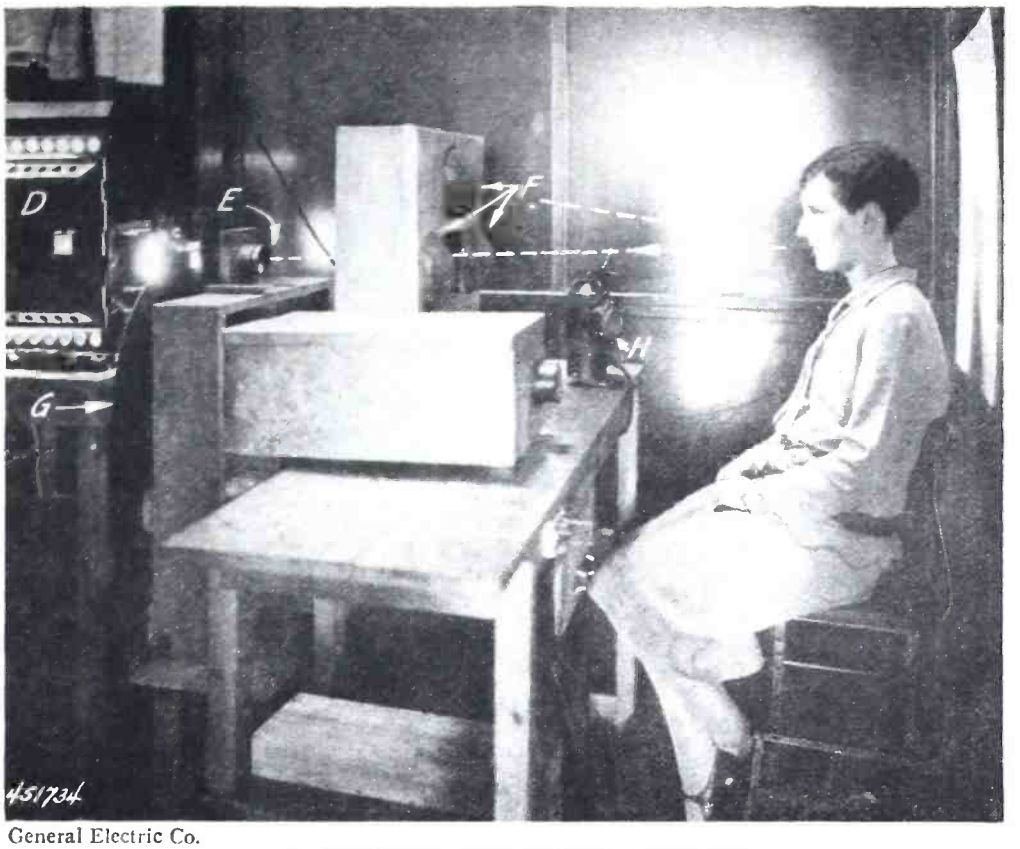
The operation of both the transmitter and the receiver can easily be understood by reference to the diagrams in Figure 1. The transmitter proper is a standard type of circuit connected to a special antenna. Its carrier wave, however, instead of being modulated with sound, is modulated with light.

* Those seeking information on the subject of early experiments in television may find it in the following articles that have appeared in past issues of POPULAR RADIO:

"Motion Pictures by Ether Waves" (a description of the Jenkins television apparatus), by Charles Allen Herndon, August, 1925; "The Televisor" (a description of the Baird television apparatus), by Orrin E. Dunlap, Jr., November, 1926; "Radio in 1950," by Dr. Lee De Forest, March, 1927; "Television and Black Light" (a further description of the Baird apparatus), by A. Dinsdale, May, 1927; "What Shall We Do With Television," by Thomas Elway, June, 1927.

For the ordinary microphone of the broadcasting studio there is substituted what might be called a "light microphone," which takes the form of a series of photo-electric cells that receive the light impulses which are reflected from the object to be broadcast. The light source is an electric arc lamp, and the beam from this lamp falls upon a rapidly revolving aluminum disc in which small holes are drilled in the form of a spiral. As the light from the light source passes through the spirally arranged holes of the disc, a beam of light is caused to scan the face of the object whose image is to be broadcast. The scanning or exploration process is carried on very rapidly, so that the complete surface of the object being broadcast is covered about once every .18 of a second. It will be seen, therefore, that only one beam is operating at one time, and that during the course of one revolution of the disc this beam is swung across every bit of the surface of the object being broadcast.

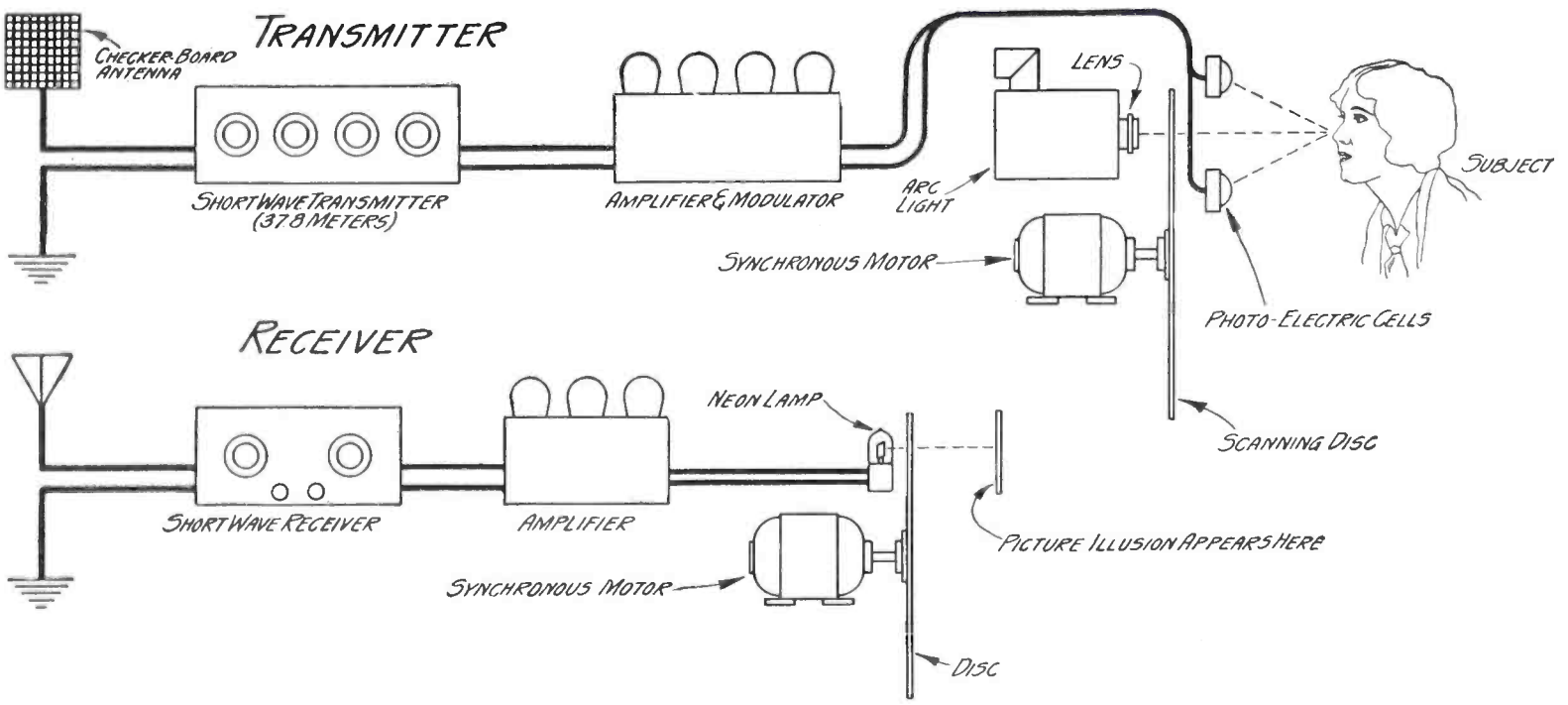
From the object to be broadcast the beam is reflected back to three sensitive photo-electric cells. These cells make up the light microphone, for they permit a varying degree of current to flow through them, depending entirely upon the intensity of the light striking them. For instance, if this beam strikes the hair of a brunette, very little light will be reflected and very little current will flow through the photo-electric cells. Consequently, the wave of the short-



General Electric Co.

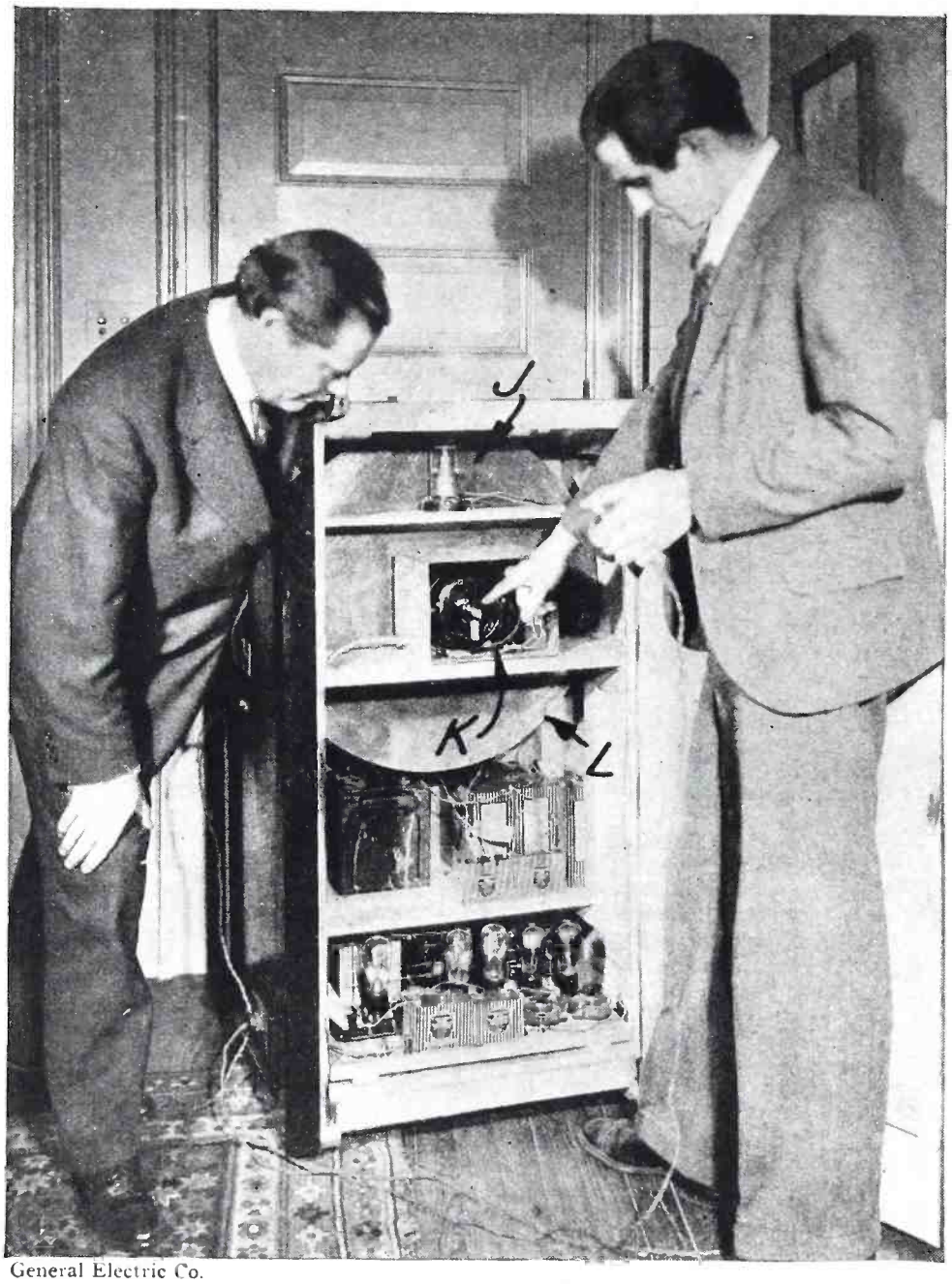
A PIONEER TELEVISION STUDIO

Above is the transmitting apparatus that successfully broadcast moving images to television receivers around Schenectady, N. Y. A beam of light from the arc light, D, passes through the focusing lens, E, and, by means of a rapidly revolving slotted disc in the box behind the photo-electric cells, F, is made to fall successively on every part of the face of the young lady seated before it. The light falling on her face is reflected back into the photo-electric cells at F, where it is converted into electrical impulses whose strength varies with the amount of light reflected. The rest of the transmitting process is simply a matter of using this fluctuating current to modulate the carrier wave of a short-wave transmitter



THE TWO ENDS OF THE TELEVISION BROADCASTING PROCESS

FIGURE 1: *These two diagrams show graphically arrangement of apparatus in broadcasting moving images. At the transmitting end, an amplifier, modulator and transmitter of the type familiar in short-wave telephony is connected to the "light microphone" assembly at the upper right. This assembly consists essentially of a light source, a scanning disc and motor, and a photo-electric cell. At the receiving end, the output of a standard short-wave receiver is delivered to the "light loudspeaker," at the lower right, consisting of a neon lamp and another motor and disc similar to that used in transmitter.*



General Electric Co.

THE WORKINGS OF THE TELEVISION RECEIVER

Most of the apparatus in this receiver is familiar to the average radio fan. At the bottom of the cabinet is the short-wave receiver and amplifier. Above it may be seen the operating batteries. At the top of the cabinet is the apparatus that converts the output of the receiver amplifier into light images. At J is the neon lamp; its varying light output is reassembled by the revolving disc, L, into the same light pattern that was impressed on the photo-electric cells at the transmitter. The motor that drives the disc is seen at K.

wave transmitter will be practically unmodulated, and darkness will appear at the receiver. On the other hand, if the beam strikes, for instance, a diamond tie pin, a great deal of light will be reflected and a brilliant flash will appear at the receiver.

Thus minute current changes take place in the photo-electric cells which are the result of varying changes in light intensity. The conventional low-frequency amplifier carries these to the transmitter, where they modulate the carrier wave of the transmitter.

The receiver used for television reception is very similar to the type employed by amateur operators throughout the country. It is simply a short-wave set of conventional design provided with a low-frequency amplifier, constructed of standard parts. In place of the conventional loudspeaker, however, a special neon bulb is used. This neon lamp is sensitive to current changes, but instead of recording these current changes audibly, the amount of light it gives varies. If, at the transmitting end, a great deal of light is being reflected from the broadcast object, more current will flow through the photo-electric cells of the transmitter, and consequently more current will flow from the output of the low-frequency amplifier of the short-wave receiver. This causes the Moore lamp to glow more brightly for an instant, and since there is practically no inertia to these changes the Moore lamp can easily keep pace with the rapid fluctuations of the scanning device at the transmitter. Interposed between the face of the broadcast observer and the Moore lamp there is an aluminum disc with holes spirally arranged to correspond to those in the transmitter. Both of these discs—the one in the receiver and the one in the transmitter—are driven synchronously by motors similar to the type used in washing machines. It is the duty of the disc at the receiver to rearrange the light impulses from the neon lamp into a pattern similar to that of the object at the broadcasting station. This is accomplished by making the disc revolve in exact synchronism with the scanning disc at the transmitter; thus, at each instant of the television operation, the beam of light that falls on the broadcast object at the transmitting end is being duplicated at the receiving end with a beam of light of exactly the same intensity, *and directed at a corresponding point in space.*

The result is that an exact image of the object broadcast is produced in the air in front of the disc. This image, which is in tones of red, due to the light given out by the neon lamp, appears at the approximate location shown in Figure 1. The picture appears in the form of a soft-focused photograph, and every movement by the person whose face is being broadcast is reproduced at the receiver. So sensitive are the photo-electric cells at the transmitter that even so intangible a thing as cigarette smoke reflects enough light to cause an exact reproduction to be seen at the receiver.

"Tuning" the picture in is especially interesting. First, the broadcast receiver is tuned to the wavelength of the transmitter, and then the operator, by means of a manually operated synchronizing resistance, changes the speed of his motor to the point where dim likenesses begin to appear in the frame of the receiver. There is a critical point of this adjustment at which the picture suddenly appears. Another few seconds are required for the operator to bring the picture perfectly into the frame, which is also a matter of synchronization. Once in the frame, the picture is maintained in position by manipulation of the resistance.

The present success of television has been due primarily to the invention of a single man, D. McFarlan Moore. It was back in 1906 that Mr. Moore first developed his neon lamp. At that time Mr. Moore made the then somewhat visionary prediction that this type of lamp would some day be used for television purposes. It was not until 1913 that he obtained enough of the rare

(*Continued on page 168*)

NEW "IMPEDANCE BALANCER" GIVES

More Pep for Phonograph Pick-ups

By ROBERT W. TAIT

THE popularity of the electrical pick-up unit and a low-frequency radio amplifier in connection with the rejuvenation of the old-style phonograph is growing by leaps and bounds. When the owners of these old phonographs find that they can get music comparable with the best that can be obtained from a high-priced radio receiver out of the new phonograph records by the simple addition of an amplifier and a radio reproducer, they are interested immediately. The next step is to choose the combination of apparatus that will be best suited to their particular needs.

In the six preceding issues of this magazine a number of methods for accomplishing these results have been described. This article describes a completely socket-power operated amplifier employing AC valves and push-pull amplification which, when hooked up to the lighting lines and the other apparatus shown in the combination diagram in Figure 1, gives a reproduction from the phonograph that is comparable to the original musical production in all its intricate tone quality. Furthermore, the volume obtainable is enough for any use up to that necessary for filling a large hall. Absolutely no batteries are required.

The amplifier is the AmerTran push-pull power-pack amplifier, the construction of which was fully described in detail in the January, 1927, issue of POPULAR RADIO.

In the diagram in Figure 1, at the left is shown the phonograph turn-table,

A new feature of extreme interest to those interested in the use of radio amplification apparatus in connection with phonograph pick-ups is the impedance balancer used in phonograph combination described in this article. This unit matches up the output impedance of the pick-up and the input impedance of the amplifier for the greatest transfer of energy at all musical frequencies. Its use with the power-operated AmerTran amplifier makes this combination unsurpassed as a quality musical reproducer.

which may be any old-style phonograph with a turn-table that revolves easily. On the arm of this phonograph is attached a Pacent electrical pick-up, which is connected by two wires to the volume control and in turn to the impedance equalizer which matches up the input impedance of the amplifier and the output impedance of the pick-up unit for the greatest transfer of energy at all musical frequencies. In the center is shown the push-pull amplifier with a balanced-tension loudspeaker at the right. A back view is shown of this instrument. The connections between the instruments are shown in heavy black lines. If a console type of phonograph cabinet is used, all of the apparatus except the loudspeaker may be installed in the part of the phonograph compartment not being used for records. Another alternative is to install the amplifier in the portion of the phonograph cabinet previously occupied by the phonograph horn, which may be taken out, as it will not be used.

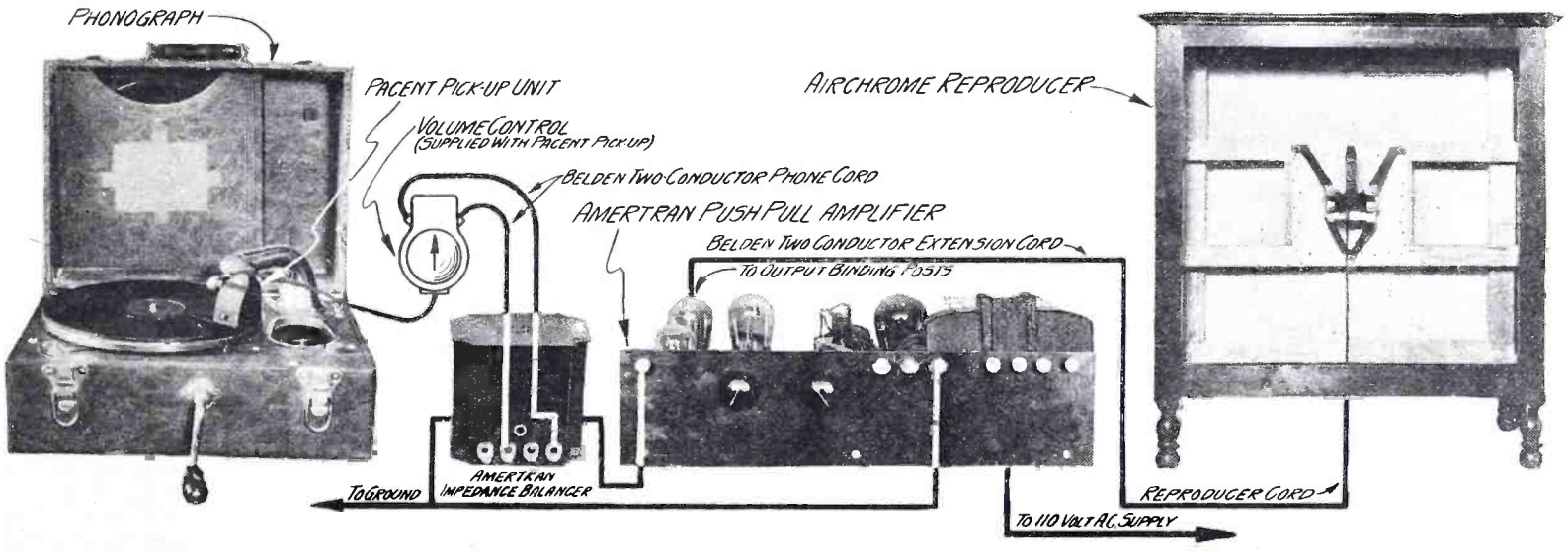
All that is necessary to place this combination of apparatus in operation is to insert the lamp cord on the AmerTran unit and plug into the 110-volt, 60-cycle AC socket and turn "on" the switch.

The amplifier uses one CY-227 type valves, two CX-310 type valves, and one CX-381 type rectifier valve.

The volume of the complete unit may be controlled from a whisper to a volume that is astonishing in its quality and power.

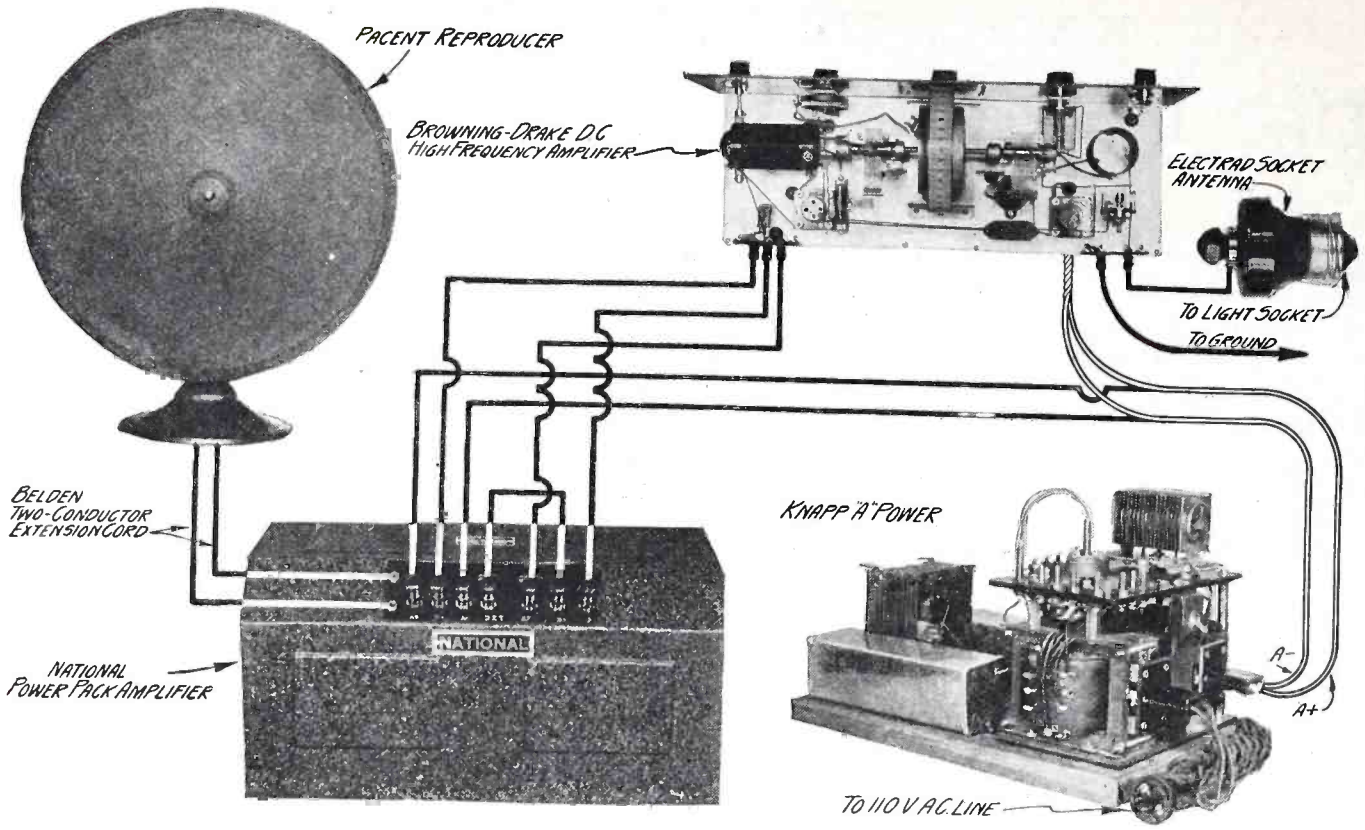
The unit may be used in the home for entertainment in place of an orchestra, or for dancing. It is also of sufficient power to be used in restaurants and other public places.

It is the highest type of combination of apparatus that it is possible to obtain for this purpose. A similar installation was made by the author in a well-known country club for furnishing music in the ballroom and it excited a great amount of interest and ability for itself, and since the day it was installed it has been used for entertainment almost continuously.



A POWER COMBINATION WITH A TREMENDOUS VOLUME

FIGURE 1: *With the units shown above hooked up as indicated by the heavy black lines, phonograph music may be reproduced with a volume equal to that of an orchestra, and with a clarity and resonance that leaves nothing to be desired.*



FOR GOOD RESULTS WITH THE DC BROWNING-DRAKE

FIGURE 1: *The hook-up combination shown above has been found very satisfactory in tests made in the* POPULAR RADIO *Laboratory, and is recommended to fans who want to get the best results out of the Browning-Drake tuner. Of course, radio users who live in localities where AC current is not available can substitute batteries for the Knapp "A" power unit, and use a good low-frequency amplifier with batteries instead of the National power-pack and amplifier shown above.*

A Battery-Operated Browning-Drake

DC operation still has its ardent supporters, and the Browning-Drake tuner described in this article has been designed to make available to them the many excellent features of the 1928 Browning-Drake high-frequency pack. The foundation unit and most of the parts used in the AC model of the tuner are employed in the DC set, and the construction differs only slightly.

By GLENN BROWNING

THE 1928 Browning-Drake two-valve tuner was designed so as to be readily adaptable to either AC or DC operation, so that fans and set builders could easily install it with the type of wiring that was more convenient or desirable.

In the January, 1928, issue of POPULAR RADIO the tuner was described as used with AC valves. This article describes the construction of the set as used with DC valves.

It will be noted in the accompanying diagrams and illustrations that standard four-prong sockets are used in place of the five-prong sockets in the AC model. A rheostat has also been added in place of the original volume control. This rheostat should have a resistance of 30 ohms. Another addition is the fixed filament control for the two valves used as the high-frequency amplifier and the detector, respectively.

In constructing the DC two-valve tuner the general precautions already noted in the article on the AC tuner may be observed, with special reference to the changes shown in the top view of the set in Figure 2 and the picture wiring diagram in Figure 3, The set itself should be wired completely with a solid insulated bus bar, such as Celatsite, for connections running above the metal panel, and with rubber-covered Corwico hook-up wire for the connections below the metal panel. The two filament leads are to be brought out with two twisted, rubber-covered wires.

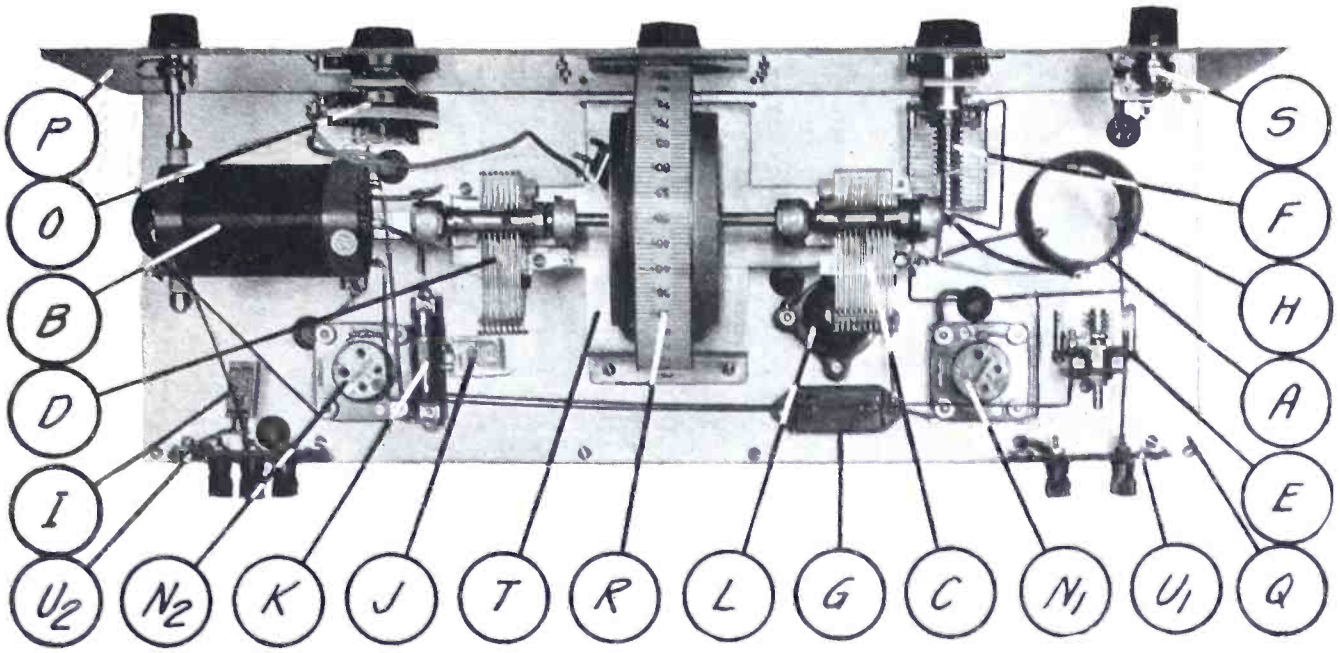
When the set has been finally wired up, according to the information given in Figure 3, it should be carefully checked over for possible error or for any omissions of wiring. After everything has been ascertained as correct, the set may be installed with any complete low-frequency amplifier that the builder desires to use with it.

The combination diagram in Figure 1 shows the set working with the National resistance-coupled power amplifier, which has been found to give exceptionally fine results when used with the DC tuner. In this combination all of the connections between the receiver and the amplifier are shown clearly, utilizing a Corwico battery cable for this

(*Continued on page 149*)

POPULAR RADIO WORK SHEET

The DC-Operated Browning-Drake Receiver



THE RECEIVER FROM ABOVE

FIGURE 2: *Most of the parts used in this assembly are identical with those used in the AC model of the tuner, described in the January number of* POPULAR RADIO.

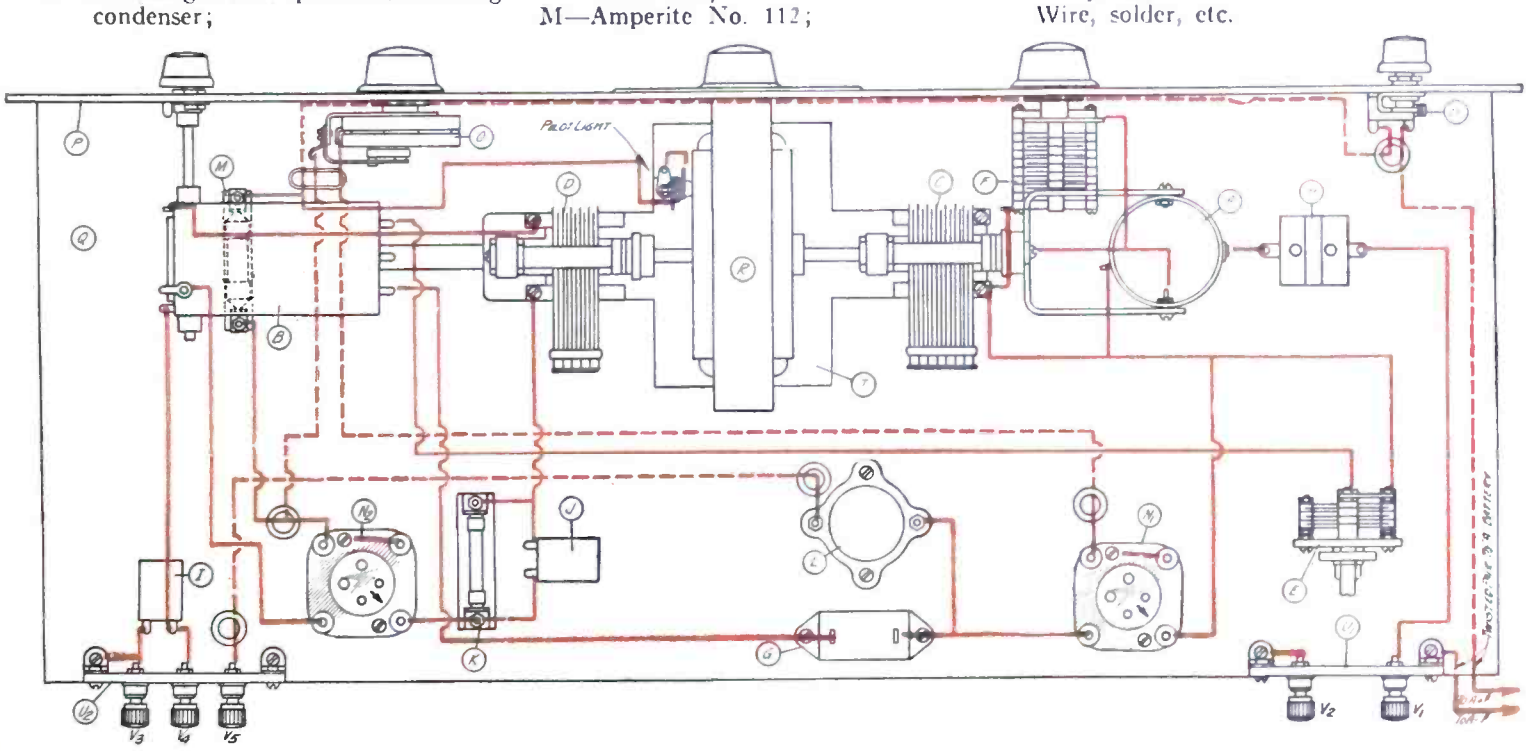
List of Parts Used in Building This Receiver

Cost of Parts—*Not over $55.00*

Browning-Drake single-mount kit, containing:
- A—Browning-Drake antenna coil;
- B—Browning-Drake high-frequency transformer;
- C—Hammarlund midline variable condenser, .00045 mfd.;
- D—Hammarlund midline variable condenser, .0003 mfd.;
- R—Browning-Drake illuminated drum dial;
- T—Aluminum brackets, mounting brackets and hardware;

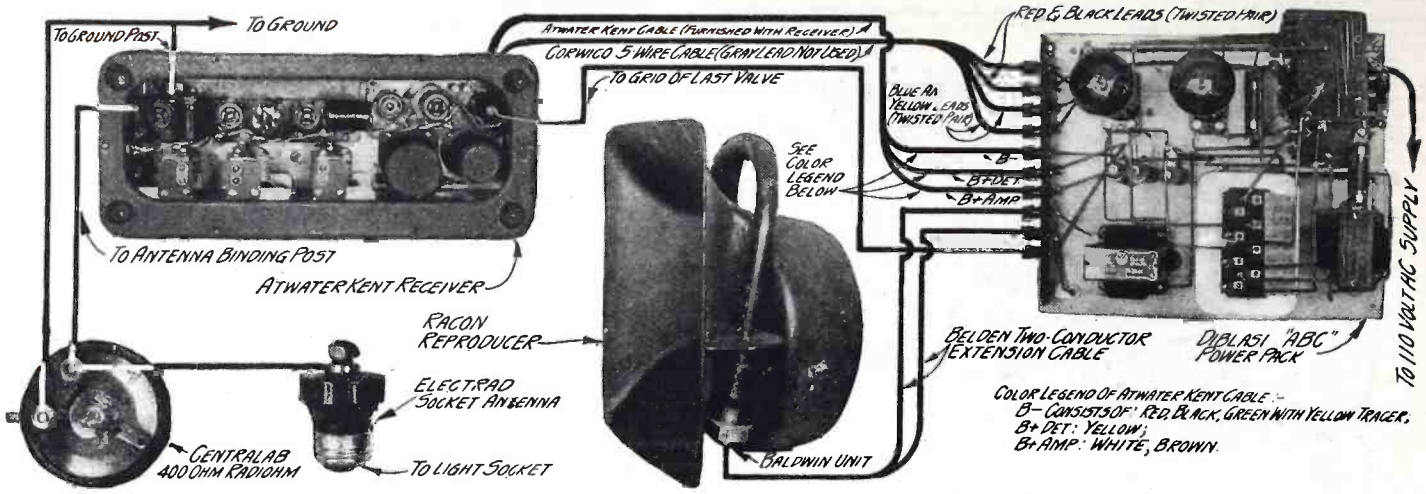
E—Browning-Drake special neutralizing condenser;
F—Browning-Drake variable midget condenser, .000135 mfd.;
G—Aerovox or Tobe special blocking condenser, .5 mfd.;
H—Aerovox fixed condenser, .0001 mfd.;
I—Tinytobe fixed condenser, .001 mfd.;
J—Tinytobe fixed condenser, .00007 mfd.;
K—Tobe Veritas grid-leak, 6 megohms, equipped with standard Lynch mounting;
L—Browning-Drake high-frequency choke coil;
M—Amperite No. 112;
N1 and N2—Benjamin Cle-ra-tone 4-prong sockets;
O—Yaxley 30-ohm rheostat;
Browning-Drake foundation unit, consisting of:
- P—Drilled and engraved front panel;
- Q—Drilled aluminum sub-panel complete with hardware;

S—Yaxley offset filament switch;
U1 and U2—Micarta binding-post strips;
V1, V2, V3, V4 and V5—Eby binding posts;
Wire, solder, etc.



HOW THE SET IS WIRED

FIGURE 3: *The wiring that is done above the sub-panel is shown in solid* RED *lines and that under the sub-panel in dotted* RED *lines.*



HOW TO HOOK UP THE HOME-MADE POWERIZER

FIGURE 1: *The heavy black lines show all the connections necessary for hooking up the home-made Powerizer to the Atwater Kent model 35 receiver. The operation of the receiver is exactly the same as before, except that the volume is controlled by the Centralab resistor at the lower left.*

Build a Powerizer in 2 Hours

Any receiver of standard voltage and current requirements, whether it is a manufactured set or a home-built job, may be operated entirely from the light socket with the easily built powerizing unit that is described in this article. And along with ease in construction and efficiency in operation, the new unit has the further advantage of being one of the least expensive "ABC" power units ever designed.

By JOHN DI BLASI AND W. F. SCANLAN

WITH the advent of the new AC valves a great field of opportunity has been opened to owners of standard radio receiving sets. These receivers are easily adapted to complete AC operation by the use of the proper power units, supplemented by the new valve-socket adapters.

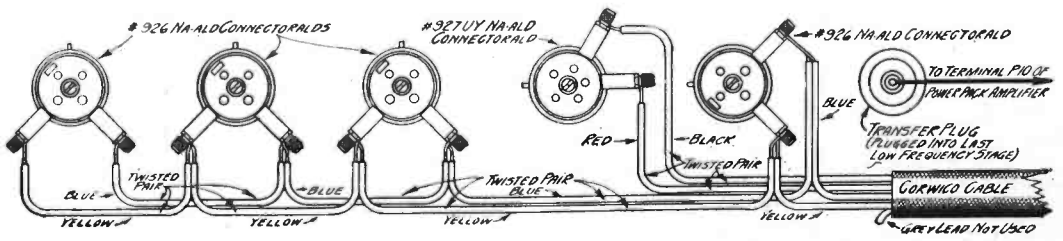
The powerizing unit whose construction is described in this article may be adapted with very little trouble for use with any of the standard manufactured receivers, or it may be used with home-made or custom-built sets, or with the kit sets that have been described in this magazine, to allow operation without the use of any batteries at all.

This article, in addition to giving the full constructional details for the powerizing unit, gives also specific directions for installing the unit with the Atwater Kent model 35 receiver. The conversion may be made so that CX-326 and CX-327 valves may be used in the receiver without changing any of its original wiring. This will eliminate all batteries and the receiver will, from then on, function directly from the 110-volt, 60-cycle lighting lines.

How to Construct the Powerizer

This new device may be easily put together and mounted by the amateur set constructor or the professional set builder in a short time.

The various parts should be set in place as shown in Figures 3 and 4. The arrangement of these parts is so simple that no detailed information is necessary; the diagrams and illustrations show the exact locations very clearly.



HOW TO CONNECT THE CABLE LEADS

FIGURE 2: *The Connectoralds are shown in the relative positions that they would occupy in the valve sockets of the Atwater Kent model 35 receiver; the transfer plug of the powerizer is in the last valve socket. Care should be taken to twist the leads of the Corwico cable as indicated and to connect them to the proper filament lugs. The gray lead is not used in this hook-up.*

Be sure that the sockets, E and F, are turned in the correct positions, as shown in Figure 4.

The binding-post strip, O, should be cut and assembled with the binding posts, P1 to P10, attached, and with the two small brass brackets for fastening it down to the baseboard, N.

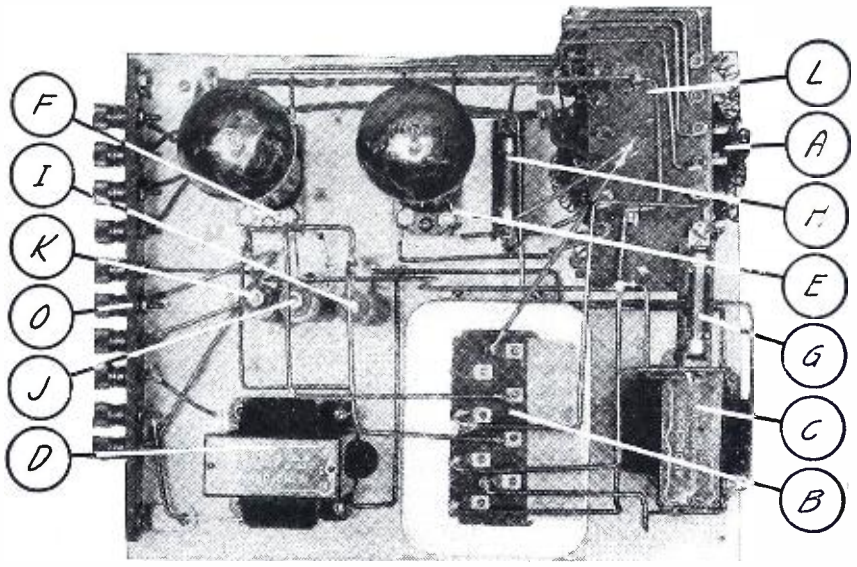
The picture wiring diagram in Figure 4 shows the wiring that runs between the various instruments and parts in heavy red lines. The parts themselves are outlined in black.

Wire up the unit with either rubber-insulated wire or a braided insulation, such as Corwico Braidite. The wires indicated in the diagram as "Twisted Pair" should be twisted for their entire length, when running between the binding posts and the terminals of the connection block, L, of the transformer, A. It will be noted that an extra 1 mfd. condenser unit is incorporated in the condenser block, B, for the purpose of having an emergency "spare" condenser. This extra terminal is not wired, except in case of a breakdown of one of the other condenser units.

(*Continued on page 170*)

POPULAR RADIO WORK SHEET

The Di Blasi Powerizer



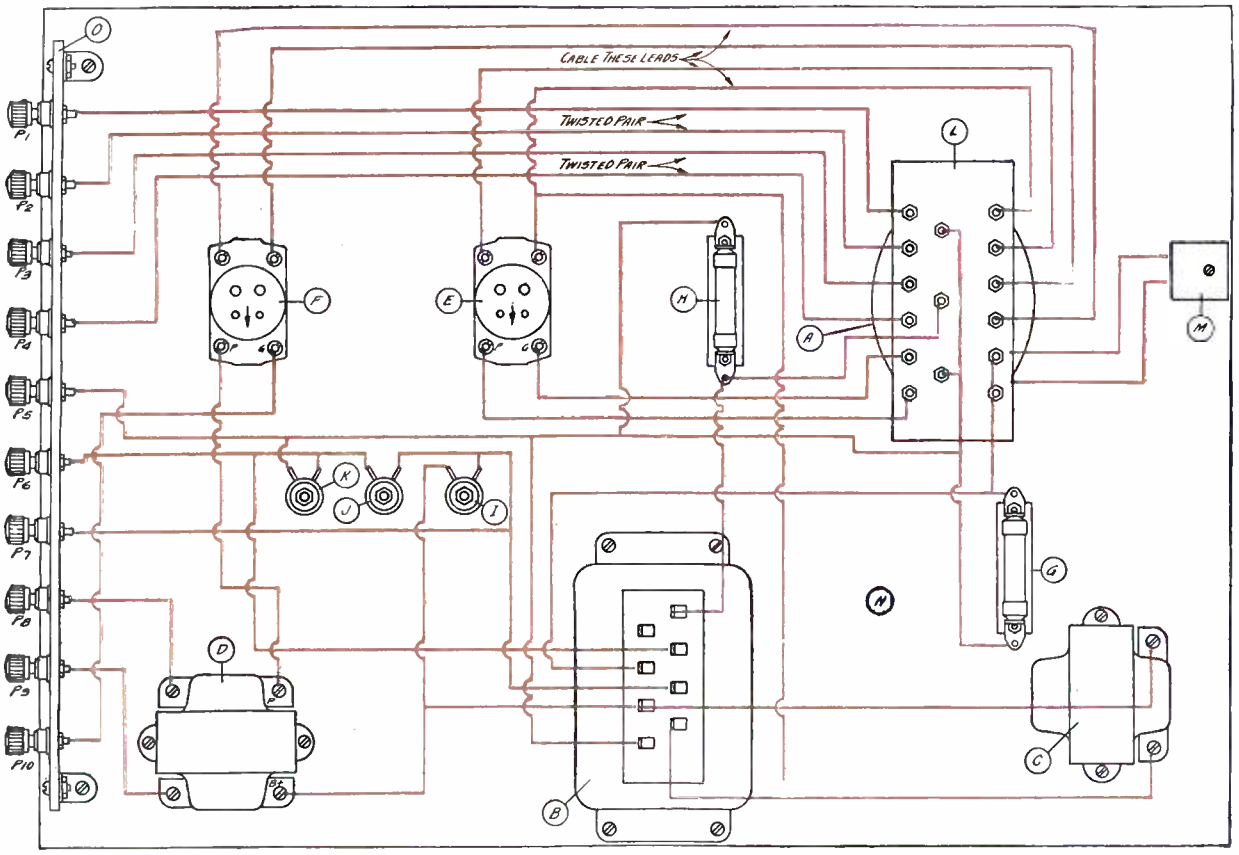
THE MOUNTING OF THE PARTS

FIGURE 3: *All of the instruments and parts are mounted above the baseboard in the positions shown above. Note how few instruments are required, and how simple their arrangement is on the baseboard.*

List of Parts Used in Building This Unit

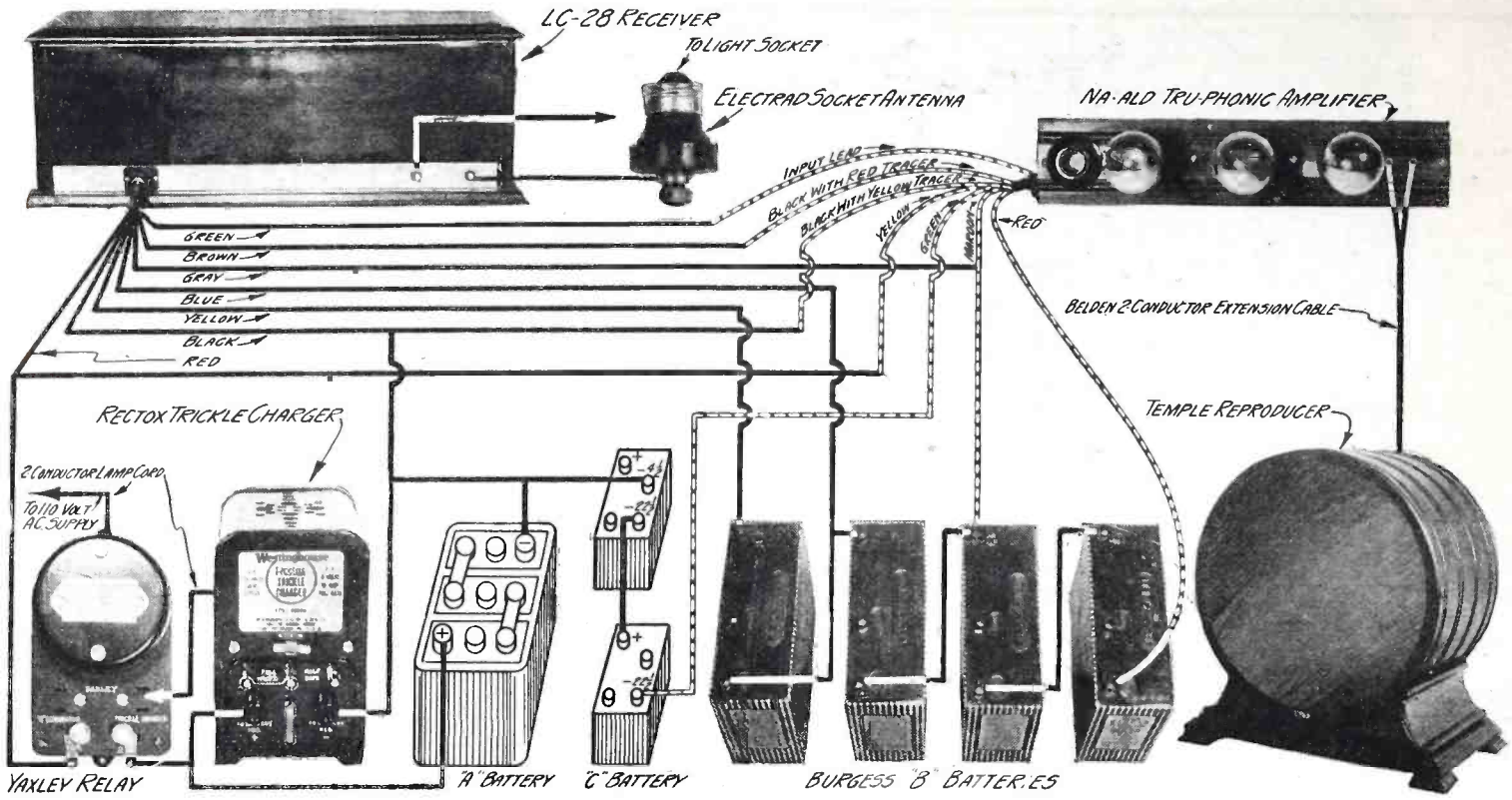
Cost of Parts—*Not over $63.00*

A—Radio Receptor power transformer, type No. KXY-210, equipped with terminal board, L;
B—Dubilier condenser bank, type PL-730, total of 10 mfds.;
C—Pacent audiochoke, No. 29;
D—Pacent output transformer, No. 27-B, 1 to 1 ratio;
E and F—Pacent UX sockets, No. 83;
G—Lynch suppressor and mounting, 1,600 ohms;
H—Lynch suppressor and mounting, 700 ohms;
I and K—Lynch power resistors, 8,000 ohms;
J—Lynch power resistor, 10,000 ohms;
M—Separable attachment plug;
N—Wooden baseboard, 10 by 12 by ½ inch;
O—Formica binding-post strip, 9 by 1 by ¼ inch;
P1, P2, P3, P4, P5, P6, P7, P8, P9 and P10—Eby binding posts;
20 feet of Corwico Braidite.



THE WIRING OF THE POWERIZER

FIGURE 4: *All the wiring is done above the baseboard, and is shown here in heavy* RED *lines. The wiring is greatly simplified by the fact that the transformer, A, comes with all its leads brought out neatly to a terminal board, L.*



A COMPACT HOOK-UP THAT GIVES EXCELLENT RESULTS

FIGURE 1: *In the hook-up shown above, which has been tested in* POPULAR RADIO *Laboratory and found to give very fine results, all the operating voltages are drawn from batteries. The small size of the Na-ald Truphonic amplifier makes this hook-up a very practical one where a limited cabinet space is available.*

Flawless Amplification for the LC-28

Absolutely humless reproduction, easy control of voltages, low initial cost—these are a few of the many advantages of battery operation of receivers. And the two amplifier hook-ups for the LC-28 described in this article have all these virtues that come from battery operation, and in addition both combinations are extremely compact, efficient and easy to install and operate.

By LAURENCE M. COCKADAY

EVEN in these days of extraordinary enthusiasm for complete AC operation of radio receivers there are still a goodly number of conservative fans who believe that battery operation still affords the most satisfactory solution of their radio power problems.

Some of the theoretical reasons for this preference of radio fans are the following:

(1) Batteries can produce no hums or extraneous noises.

(2) A battery installation can be made entirely separate from the alternating current line and the probable chance of inductive hums in nearby circuits is greatly reduced.

(3) Batteries give constant and uninterrupted source of voltage during their useful life.

(4) Battery voltages are not subject to interruption of service due to electric or wind storms or other outside causes that are beyond man's control.

(5) Batteries may be tapped to obtain the exact voltages necessary for any particular work.

(6) Batteries of varying ratings may be used to furnish power economically for circuits of varying power conditions.

These points of consideration are frequently little understood by radio users. It is a fact, however, that quality radio reception can be obtained with the least expense of engineering skill, with the least expense of money and with the use of much less complicated circuits, when batteries are employed as a power supply.

Of course, AC-operated apparatus has its definite advantages, although it entails much greater intricacies of circuit design and, in most cases, a higher initial cost for the apparatus.

As stated before, there is a definite field and use for both storage batteries and dry cell batteries in radio that will always exist and that can be filled by no other devices or combinations of apparatus.

There are also those who live in outlying districts where the necessary alternating current is not available, who must rely on batteries for their set operation. There are, therefore, many thousands of radio set owners in these categories who will be interested in the two new DC-operated amplifier units described in this article. These are the fourth and fifth amplifiers to be described as suited for operation with the LC-28 high-frequency pack. Those who have built the LC-28 receiver and must rely on DC operation will find in either one of these power amplifiers an economical and wholly satisfactory unit for quality reproduction at adequate volume for all home needs.

The first of the two units to be described is the new Truphonic power amplifier. This unit consists of three stages of the now famous Na-ald Truphonic amplification incorporated in a small, neat metal container, equipped with a filament control and an extension cable for all connections.

The complete hook-up for the Truphonic amplifier, with all of the recommended accessory apparatus and the LC-28 high-frequency pack, is shown pictorially in the combination diagram in Figure 1. In this diagram the Truphonic amplifier is shown in the upper right-hand corner, with the Temple exponential horn reproducer connected to the two output binding posts. It is advisable, in an installation of this kind, to use an extension cord for the reproducer and place it on the opposite side of the room from the set.

In the lower portion of this same diagram are shown the necessary batteries required, with a Yaxley relay and a Rectox trickle charger for keeping the "A" battery fully charged at all times. The relay and the trickle charger, of course, are used only where a 110-volt AC supply is available. In the upper left-hand corner is a rear view of the Corbett cabinet, with the Yaxley cable connected in place and the antenna and ground connections made to the two small tip jacks.

An Electrad socket antenna is recommended, although a regular outdoor antenna may be used, if so desired. All of the connections between the units are clearly indicated. The dotted lines show the connections to the cable of the Truphonic amplifier. All of the equipment, except the set and the socket antenna, may be installed in a radio table compartment, with the set arranged on top of the table; or, if preferred, a regular Corbett console may be used. These two types of cabinets are made expressly for the LC-28 receivers.

When all of the apparatus has been installed, insert two Televocal TC-201-a type valves in the first two sockets, at the left in Figure 1. Insert a TC-171-a type valve in the right-hand socket.

The tuning of the set will be exactly as explained in the article in the October, 1927, issue, and the set will turn "on" and "off" with the switch-rheostat on the face of the panel.

The set will give all of the volume that is necessary for home reproduction and the quality will be exquisite on both high and low tones, as the combination of the Temple reproducer and the Truphonic amplifier produces an extremely even tone range.

The Second Combination

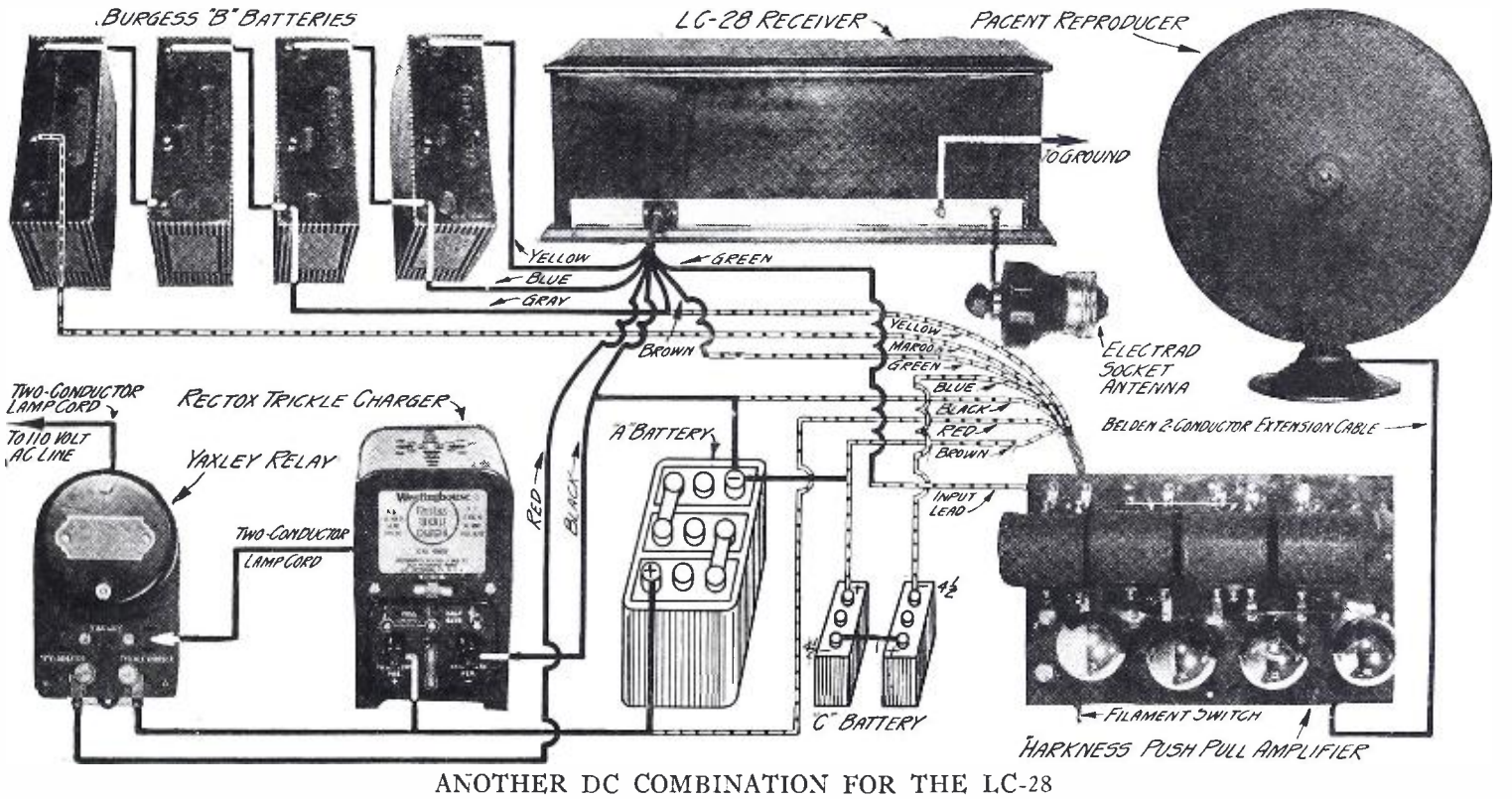
The second unit that will be described is intended for the special benefit of radio fans who are interested in double-impedance amplification. This unit is the Harkness amplifier, incorporating two stages of double-impedance amplification followed by one stage of double-impedance, push-pull amplification; this last is a recent development. This unit may be obtained complete, as shown in the lower right-hand corner of the combination diagram in Figure 2. The diagram gives the proper connections for the LC-28 high-frequency pack and the new push-pull amplifier. It also shows the connections for the "A," "B" and "C" batteries and for a Yaxley relay and trickle charger for automatic charging of the "A" battery.

For the best results the new Pacent cone reproducer is recommended for this amplifier and its proper connection is indicated. The dotted lines in the wiring indicate the wires of the cable with which the push-pull amplifier is equipped, while the black lines indicate the connections of the Yaxley cable, which is part of the equipment of the LC-28 receiver.

As in the previous case, an Electrad socket antenna is recommended and should give excellent results without bothering about an outdoor antenna. A standard outdoor antenna may be used, however, if so desired.

The vacuum valves for this receiver are two Televocal TC-201-a type valves placed in the two sockets on the left, as shown in Figure 2, and two TC-112 type valves in other sockets.

This amplifier and reproducer, in combination, produce excellent tone quality and volume, particularly on the low notes, as the new Harkness tuned units are incorporated in the amplifier. The two 112-type valves are used in "push-pull" arrangement and thus produce the necessary volume without overloading, with the utmost conservation of the life of the "B" batteries.



ANOTHER DC COMBINATION FOR THE LC-28

FIGURE 2: *The Harkness amplifier, shown at the lower right, has been found to handle the detector output of the LC-28 with exceptional power and fidelity. It employs double-impedance and push-pull (last stage) coupling. The operating voltages may be taken from batteries, thus insuring absolutely humless reproduction.*

POPULAR RADIO WORK SHEET

The General Radio Push-Pull Amplifier and Power-Pack

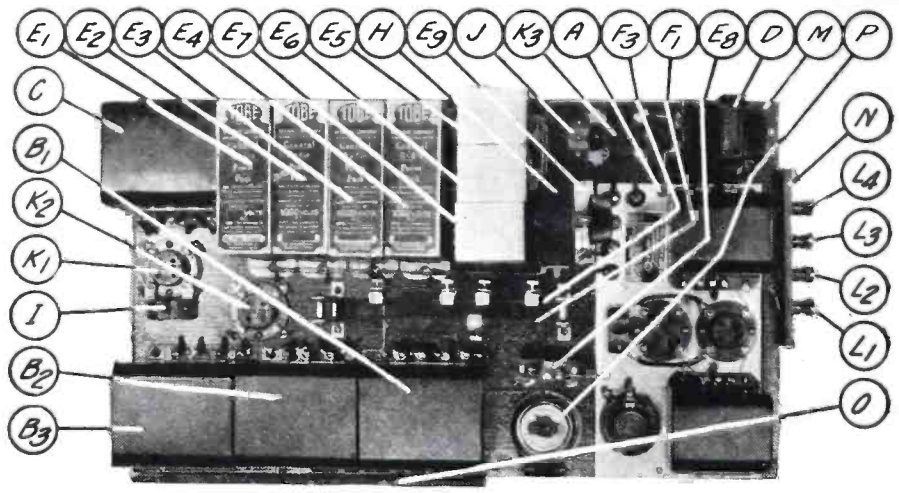


FIGURE 1: THE PANEL LAYOUT OF THE UNIT.

List of Parts for Building This Unit

Cost of Parts—*Not over $113.00*

A—General Radio push-pull amplifier, type 441, completely wired and mounted on metal chassis;
B1, B2 and B3—General Radio power transformers, type No. 365;
C—General Radio filter choke, type No. 366;
D—General Radio low-frequency transformer, type No. 285-D;
E1—Tobe special high-voltage condenser for G. R. power-pack, No. 1102, 2 mfd.;
E2, E3 and E4—Tobe special high-voltage condenser, No. 604, 4 mfd.;
E5, E6 and E7—Tobe special high-voltage condensers, No. 601, 1 mfd.;
E8 and E9—Tobe by-pass condensers, 1 mfd.;
F1 and F2—General Radio, type 446, resistance units mounted together;
G—General Radio resistance strip, 6 ohms, for 1 ampere;
H—General Radio variable resistor, 2,000 ohms, with bracket;
I and J—General Radio center-tapped resistors, type 439;
K1, K2 and K3—General Radio 4-prong sockets, type 349;
L1, L2, L3 and L4—Eby binding posts;
M—Wooden baseboard, 12 by 20 by ¾ inch;
N—Formica binding-post strip, 2 by 5 by 3/16 inch;
O—Formica protection panel, 2½ by 10¾ by 3/16 inch;
P—G. E. snap switch.

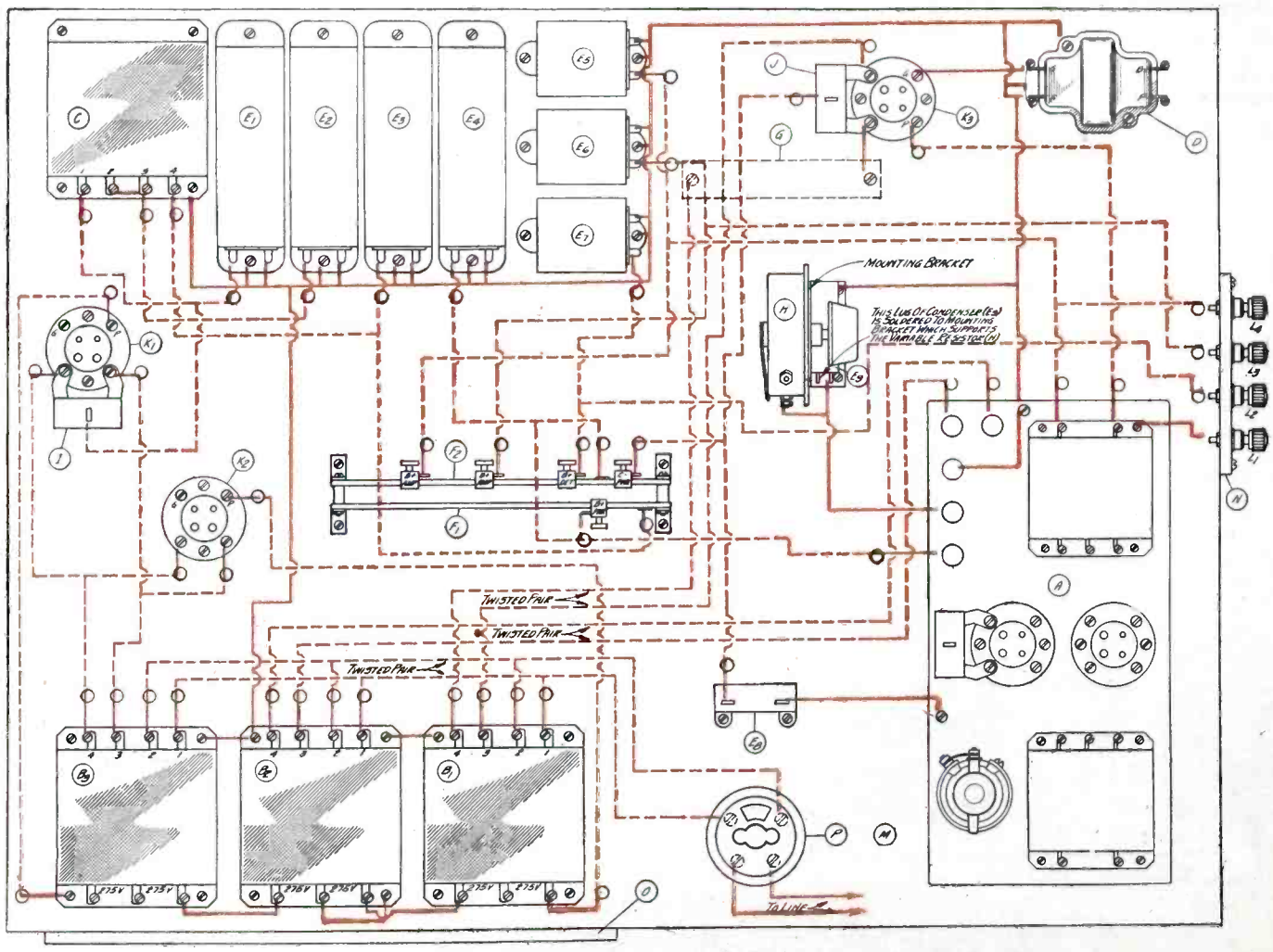
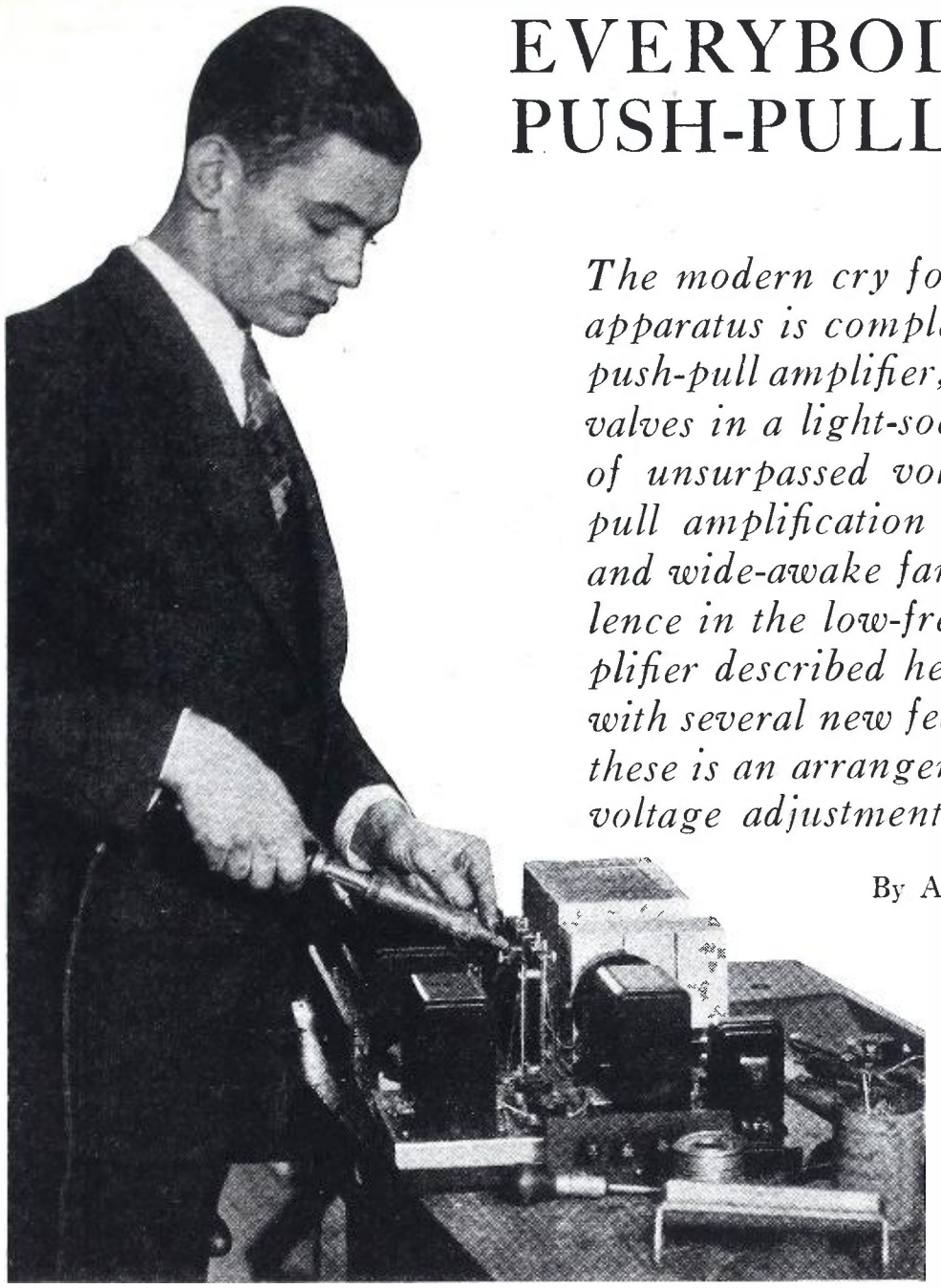


FIGURE 2: THE PICTURE WIRING DIAGRAM OF THE UNIT.

EVERYBODY WANTS A PUSH-PULL AMPLIFIER!

The modern cry for power in low-frequency apparatus is completely satisfied in this latest push-pull amplifier, employing 310 type power valves in a light-socket-operated combination of unsurpassed volume and quality. Push-pull amplification is admitted by engineers and wide-awake fans to be the acme of excellence in the low-frequency field, and the amplifier described here combines all its virtues with several new features of its own. Among these is an arrangement for providing a plate voltage adjustment over a very wide range.

By A. R. WILSON



FOR those people who demand the most perfect radio reproduction, a power amplifier is a necessity. A power amplifier is not intended primarily to increase the volume of a set, but rather to make use of amplifying valves capable of many hundred times the power delivery of the ordinary standard type. When a large amount of energy is delivered to the reproducer, low notes and overtones, which heretofore have been either inaudible or distorted, are heard with remarkable fidelity.

Prior to the input of the last amplifying valve, we are concerned in securing a voltage amplification gain, but at the end of the amplifier we have a device, our reproducer, which requires real physical energy to operate it satisfactorily. Hence the use of power valves is necessary for the most successful operation of a reproducer.

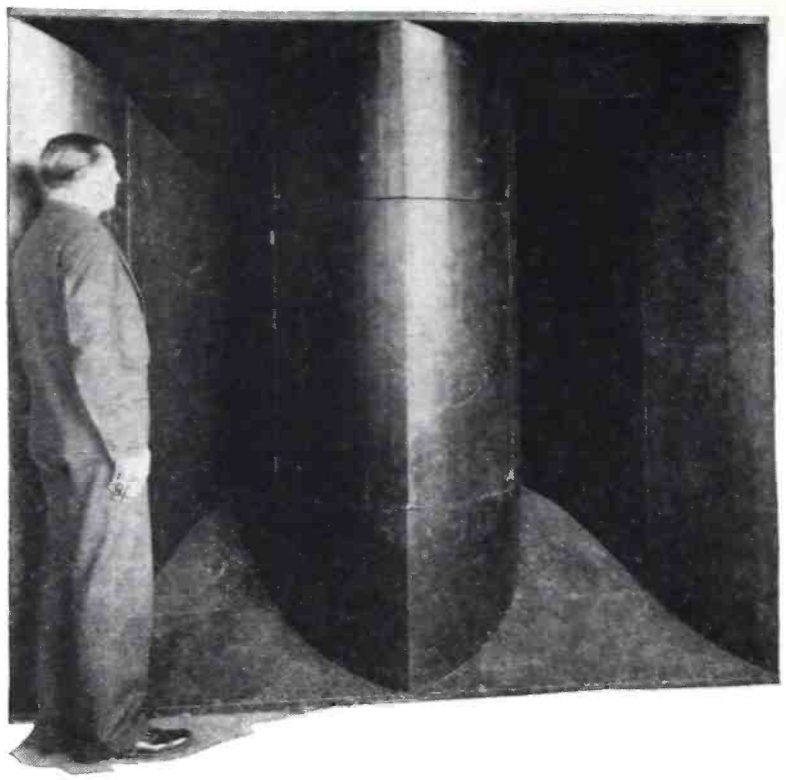
The introduction of the CX-310 type power valve has meant much in the advancement of quality reproduction. When this type of valve is used in a push-pull system, which has the advantage of minimizing or eliminating most of the harmonic distortion caused by the valves themselves, the reproduction becomes almost perfect. The push-pull system also has the advantage of increasing the power output four or five times. To a certain extent, the greater the power output the better the quality. With proper power, an unusual *fortissimo* passage in reproduction finds the vacuum valves handling it with ease, just as a good high-powered automobile takes a hill without diminution of speed. There is enough energy to give the bass notes the proper color and intensity with a factor of safety to spare.

Why all this power? Let us draw an analogy. Today there is less and less opportunity for fast driving on the public highways—yet greater power is a feature of all new motor cars. It is much more comfortable to drive a seventy-mile-an-hour car at thirty-five miles an hour than to drive a fifty-mile-an-hour car at the same speed. It is the flexibility and reserve which makes the more powerful car desirable. This idea applies also to radio reproduction. With the 310 type of valve the receiver is literally loafing along, even when great volume is being used.

The General Radio power-pack amplifier described here is a complete two-stage, AC-operated amplifier, adaptable for use following the output of a radio detector circuit or with a phonograph magnetic pick-up. In addition it will supply all the "B" voltages necessary for the set with which it is to be used. It uses transformer-coupling with a CX-326 type valve in the first stage and two 310 type valves in the last stage connected in push-pull arrangement. The rectifier system has been designed to furnish approximately 750 volts when two CX-381 rectifying valves are employed.

The voltages placed on the plates of the two 310 type valves have been made adjustable over a wide range, as it is felt that the common practice of connecting the plate of the last stage power valve directly to the high-voltage side of the rectifying system is not in keeping with the maximum efficiency. In similar devices the grid voltage for the last valve is usually obtained by the voltage drop through a resistance placed in the grid return. This resistance is usually variable and any adjust-

(*Continued on page 148*)



THE MOUTH THAT MADE THE "ECHO" AUDIBLE

At the right is the huge 8-foot orthophonic horn by means of which the radio "echo" of Lindbergh's voice was made clear and distinct to the 5,000 people who had gathered to hear him speak.

A Radio "Echo" That 5,000 Heard

By J. R. JACKSON

NEARLY every radio fan has at some time heard Colonel Charles A. Lindbergh broadcast, or has heard his phonograph records, which were recorded from a radio broadcast. But seldom, if ever, has Colonel Lindbergh himself been afforded so unique an opportunity to hear his own voice on the radio, as he was during his reception last fall in Atlantic City.

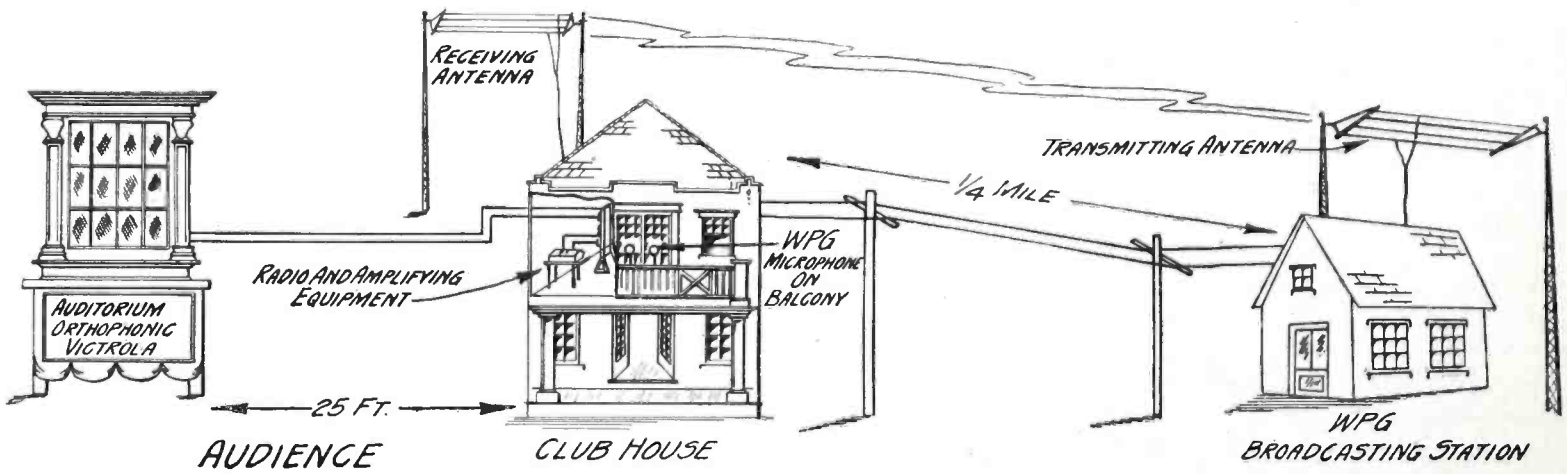
Colonel Lindbergh flew to the Atlantic City Municipal Airport from Baltimore, Md., in his famous ship, the *Spirit of St. Louis*. He circled over the field several times, and then made a perfect landing several hundred feet from the speakers' stand. He was taken to the airport club house, where the speakers' stand was arranged on the balcony.

Station WPG broadcast the Lindbergh reception to thousands of listeners within receiving range of this station. Colonel Lindbergh himself and the great throng of people whom he was addressing were a part of this radio audience. A radio receiving set operating in conjunction with the amplifying and reproducing equipment of a giant Auditorium Orthophonic Victrola was located but a few feet from the speakers' stand. The radio broadcast was received, amplified and reproduced in this super-loudspeaker with such great volume and clarity that it could be heard by all of the audience of 5,000 people.

Such a demonstration as this has proved another of the great possibilities in radio broadcasting. The engineers of the Victor Talking Machine Company, working with station WPG, have accomplished something which would have seemed quite impossible a few years ago—the production of tremendous radio loudspeaker volume without any trace of distortion, overloading or interference.

The microphones of station WPG were located on the speakers' stand im-

(*Continued on page 171*)



HOW THE "ECHO" WAS PRODUCED

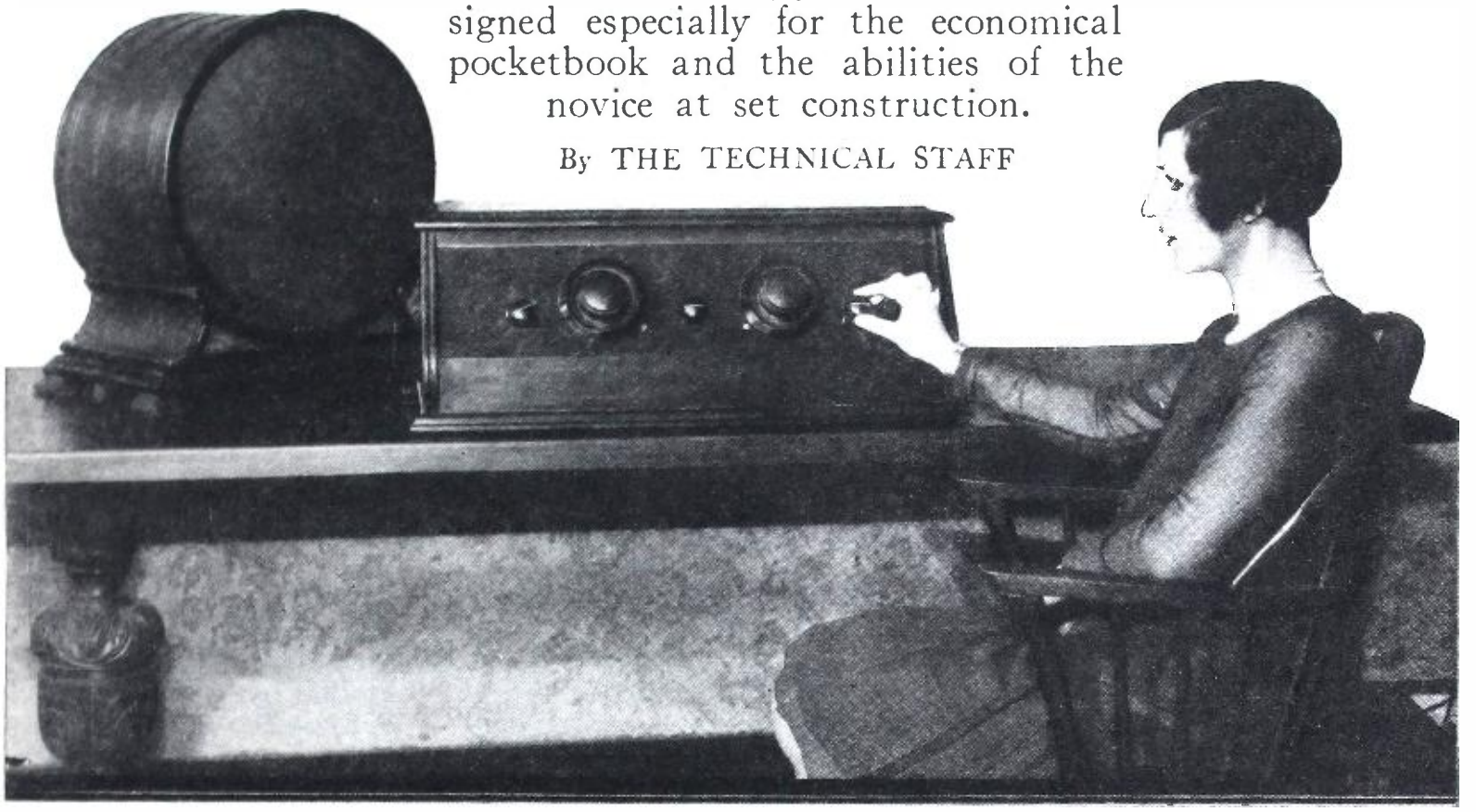
Colonel Lindbergh stood on the balcony of the club house in the center and spoke into the microphone before him. His voice was carried by wire to station WPG and broadcast. It was picked up by a receiving set in the club house, amplified and reproduced with the aid of the giant orthophonic horn at the left, so that the 5,000 people gathered in front of the club house could hear distinctly every word that Lindbergh uttered.

IF YOU ARE LOOKING FOR QUALITY *AND* ECONOMY

Build the Hammarlund-Lynch "5"

Here is a receiver whose appearance and operation place it among the best that can be built, yet it has been designed especially for the economical pocketbook and the abilities of the novice at set construction.

By THE TECHNICAL STAFF



THERE are many people who would like to build radio sets, but who, as beginners, feel a bit timid in attempting to assemble one of the more complicated receivers involving expensive parts. A fear of costly failure deters them. For this particular reason POPULAR RADIO has brought out a receiver that might well act as a confidence-builder. Those beginners who decide to construct it can do so with the feeling that success will be assured, and that there is actually little prospect of failure. The parts needed are of good quality, though inexpensive, and the number of connections to be made have been reduced to an absolute minimum.

Though the receiver described here is primarily a "novice job," from the point of view of easy constructibility and operation, it is nevertheless a very efficient set, with excellent tone quality and sufficient sensitivity and selectivity to provide reception without interference from a large number of stations. It consists, essentially, of a "deck" or sub-panel upon which are mounted three stages of efficient resistance-coupled amplification. This deck may be obtained completely assembled, with the various resistors, sockets, capacities and a large part of the wiring already completed. The cost of this unit is low, although nothing has been spared in making it an efficient amplifier. Also, the front panel, upon which are to be mounted two variable condensers, a coil and two rheostats, may be obtained already drilled and engraved.

The entire assembly can be done with a screw driver. As to wiring up, the job is extremely simple. A glance at the picture wiring diagram in Figure 3 will bear out the statement.

A completed receiver, installed in the slanting-panel cabinet of the LC-28 type, gives a finished appearance that cannot be outdone by many receivers costing four to five times the amount that is necessary to build the Hammarlund-Lynch "Five."

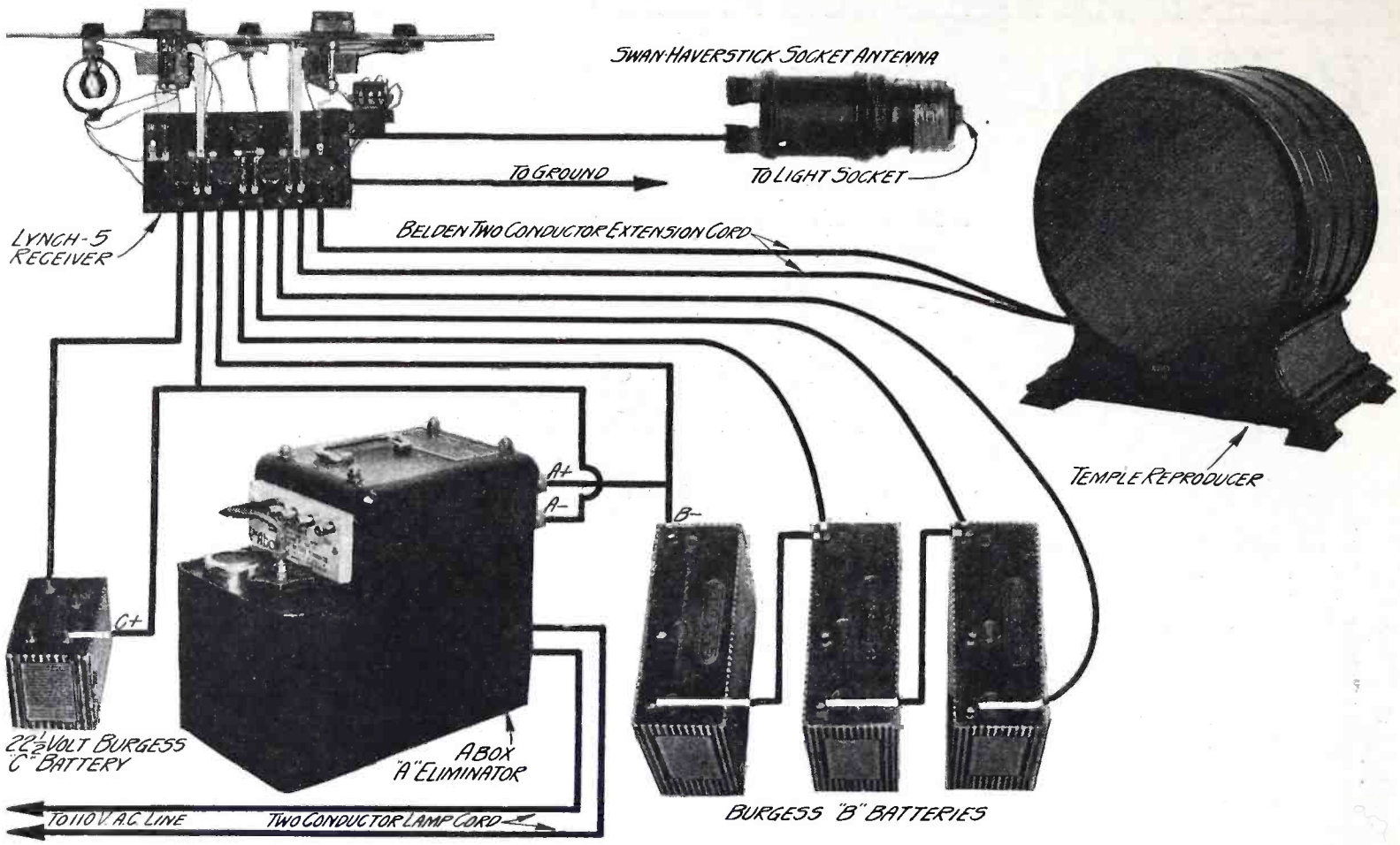
How to Assemble the Set

The first job to be undertaken in putting this efficient receiver together is to mount the 12 binding posts, K1 to K12, along two sides of the deck, E, in the holes already drilled for them. Then the Lynch suppressor and mounting, H, is screwed down to the panel of the deck. These two locations are shown clearly in the diagram in Figure 2.

Next fasten down the two small semi-circular fixtures of the brackets, M1 and M2, as shown in the same illustration. Then fasten the antenna coupler, A, to the left-hand edge of the deck, in the corner hole. These positions are also indicated in Figure 2.

Now begin with the mounting work on the panel by mounting the two variable condensers, C and D, and the coupler-coil, B. The two rheostats, F and G, should then be mounted on the front panel. The large sections of the brackets, M1 and M2, should then be screwed to the panel by two screws to each bracket and fastened by two more nuts and bolts to the semi-circular portions mounted on the deck, E. These should be tightened only partially and the set should be inserted in the Corbett LC-28 cabinet for the correct positions before the brackets are fastened tightly. When the panel is in place, the deck should lie flush along the floor of the cabinet. The four nuts and bolts may then be tightened up on the brackets so that this position will be maintained.

This completes the assembly of the receiver, and wiring may be started.



FOR EFFICIENT OPERATION OF THE HAMMARLUND-LYNCH "5"

FIGURE 1: *The accessories shown above form an inexpensive and easily assembled operating hook-up for the receiver. The use of a socket antenna eliminates the bother of erecting an outdoor antenna system; however, an outdoor antenna will give very satisfactory results with the hook-up shown here.*

How to Wire the Receiver

The wiring of this simple set, which employs one stage of high-frequency amplification and an efficient regenerative detector, followed by three stages of resistance-coupled amplification, is shown in exact layout in the picture wiring diagram in Figure 3.

It is recommended that Corwico Braidite hook-up wire be used in doing the wiring. With this wire, connections are extremely easy, as the proper lengths may be cut and the insulation merely pushed back for making a soldered joint.

Follow out carefully each connection shown in the picture wiring diagram and there will be no possibility of mistake.

After the wiring has been completed, check it over to be sure that everything is correctly done. Then the set may be placed in its Corbett LC-28 cabinet and it is ready for operation.

How to Operate the Receiver

The set in its cabinet may be placed on a table and the batteries arranged beneath and hooked up in the manner shown in the combination diagram in Figure 1. This diagram shows the various apparatus that is recommended for use with the Hammarlund-Lynch "5," and it also indicates exactly how the necessary hook-up wires are to be connected.

The set may be used with a light socket antenna, if so desired, but a regular outdoor antenna may, of course, be connected, for greater volume and distance. The Temple reproducer should be installed on the opposite side of the room, and for this purpose it would be advisable to use a Belden extension reproducer cord.

The vacuum valves recommended for this receiver are a Ceco type K high-frequency amplifier valve that is to be inserted in the high-frequency socket. This is the socket that is nearest the panel when the reader is looking at the set from the front. A Ceco type H special detector valve should be inserted in the first socket at the right. Two Ceco Hi-Mu valves should be placed in the two middle sockets in the row, and a Ceco type F power valve should be inserted in the socket on the left.

When all of the connections have been made to the batteries, the exponential horn reproducer and the antenna and ground, the set is ready for use.

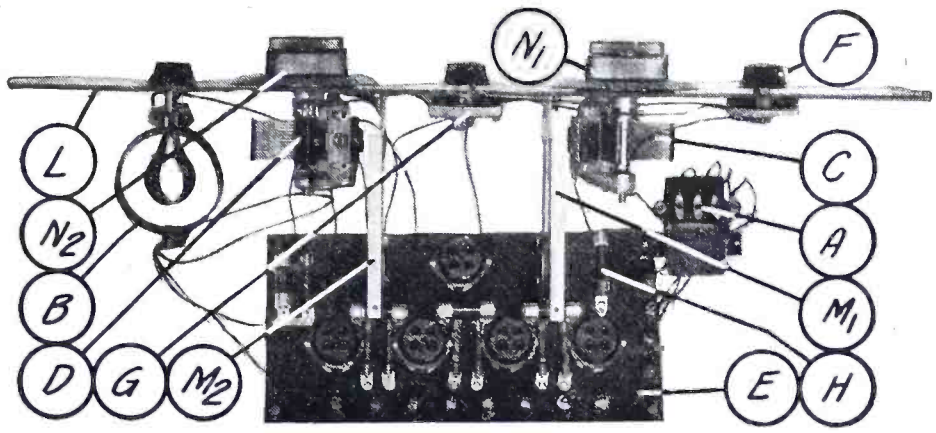
To turn "on" the receiver, the middle switch on the rheostat, G, should be rotated in a clockwise direction for about three-quarters of the way. The same should be done with the rheostat, F. All of the vacuum valves should then light up and the two dials on the condensers, C and D, may then be rotated until a station is tuned in. If the set whistles, the rheostat, F, control knob should be turned in an anti-clockwise direction and the knob of the coil, B, controlling amplification in the detector circuit, should also be revolved slowly in an anti-clockwise direction until just the right setting is obtained, where the amplification is maximum without oscillation.

In using the receiver for the first time, it is advisable to make a tuning chart, setting down the call letters of each station and the dial settings for the two main dials and for the two outside small controls. The small middle control on the panel may be left set where the tone quality is found to be best.

In tests on this inexpensive receiver in New York City it was found that it operated with satisfactory selectivity for tuning in without interference and with a tone quality that was really pleasing to listen to. Both in appearance and in consideration of the results obtained, the new receiver is exceptional for the amount of money it costs.

POPULAR RADIO WORK SHEET

The Hammarlund-Lynch "5" Receiver



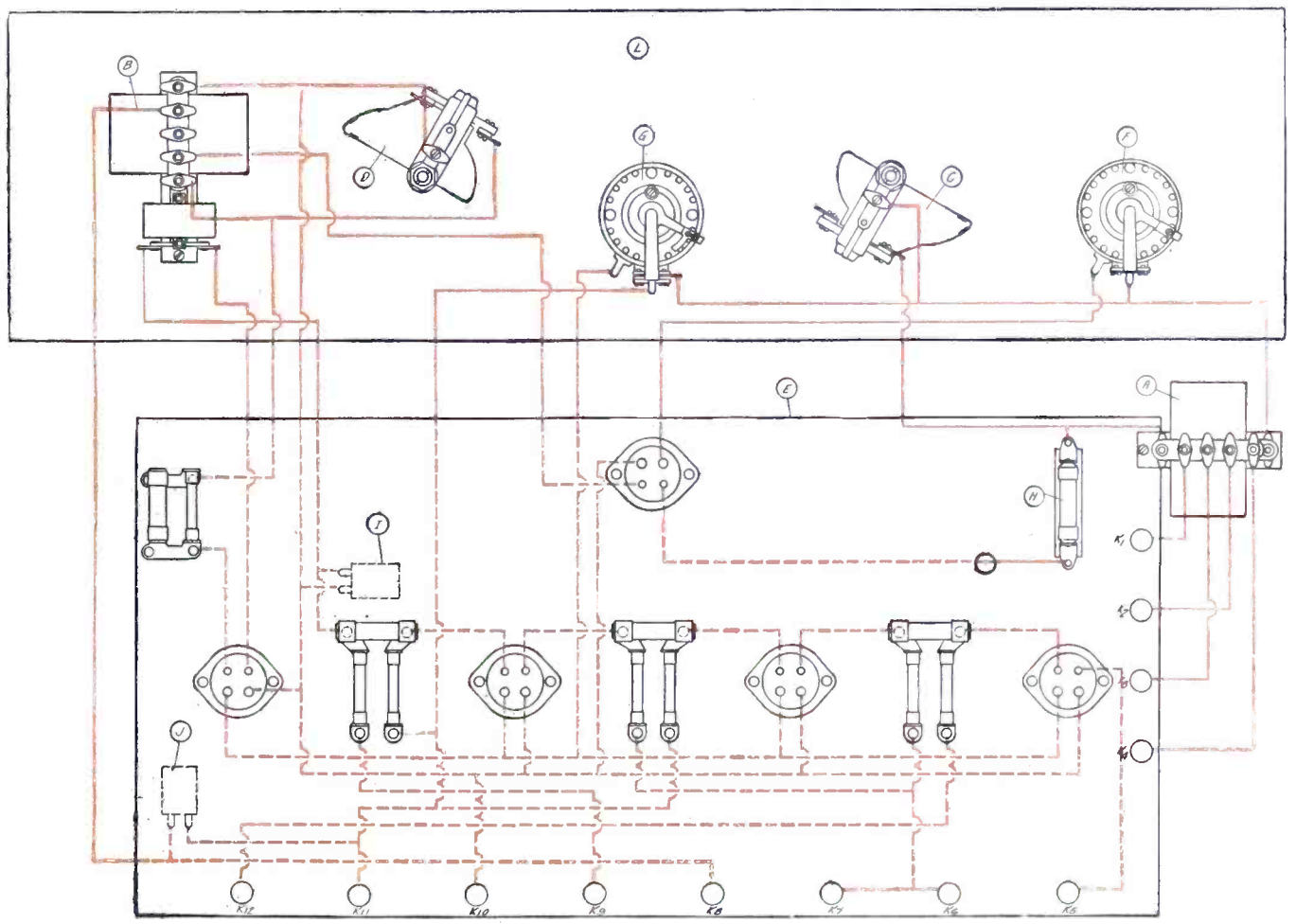
A MOUNTING JOB FOR THE NOVICE

FIGURE 2: *The Lynch deck, E, may be obtained with the complete low-frequency amplifier ready mounted. The remainder of the instruments may be assembled and mounted by the most inexperienced fan in a very short time.*

List of Parts for Building This Receiver

Cost of Parts—*Not over $49.00*

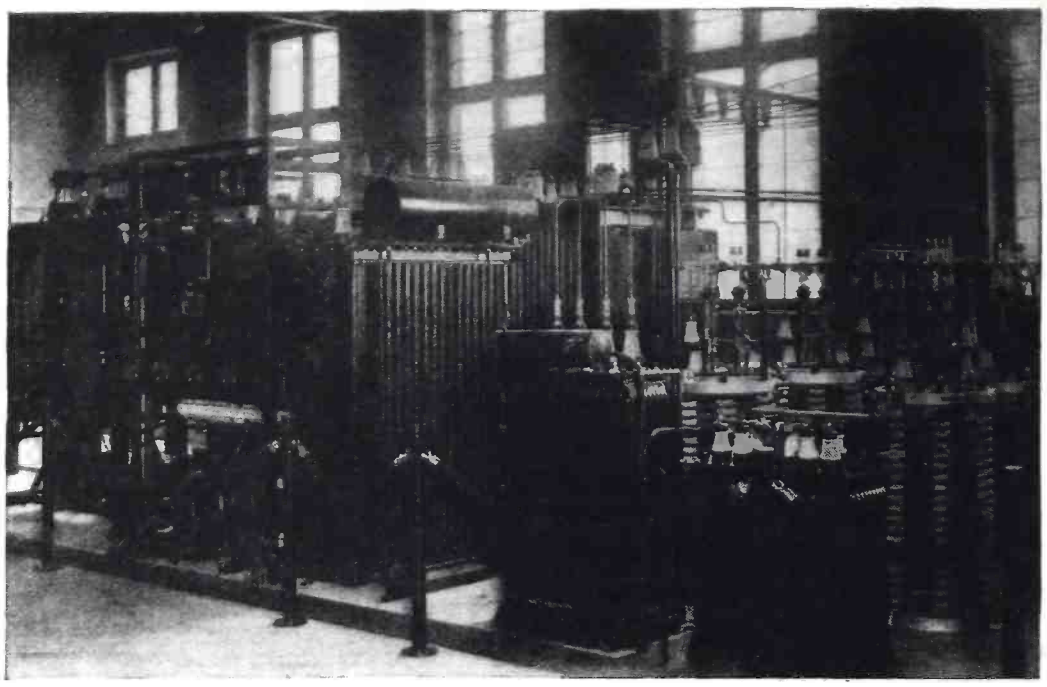
A—Hammarlund antenna coupler, type HR-23;
B—Hammarlund coupler coil, type TCT-23;
C and D—Hammarlund midline variable condensers, .0005 mfd;
E—Lynch 5-valve deck, comprising 3 stages of resistance-coupled amplification;
F—Yaxley rheostat, 20 ohms;
G—Yaxley switch rheostat, 6 ohms;
H—Lynch suppressor and mounting, 700 ohms;
I—Tinytobe condenser, .0005 mfd.;
J—Tinytobe condenser, .006 mfd.;
K1 to K12—Eby binding posts;
L—Micarta panel, 6 by 26 by 1/8 inch;
M1 and M2—Benjamin shelf-supporting brackets, No. 8620;
N1 and N2—Karas micrometric dials;
Wires, screws, solder, etc.



A WIRING JOB THAT WILL GIVE NO TROUBLE

FIGURE 3: *The solid* RED *lines indicate wires that are run above the Lynch deck, and the dotted* RED *lines wires that run beneath. The job of wiring up the receiver should give as little trouble as that of mounting the instruments.*

Germany Enters the Race for Super-Power



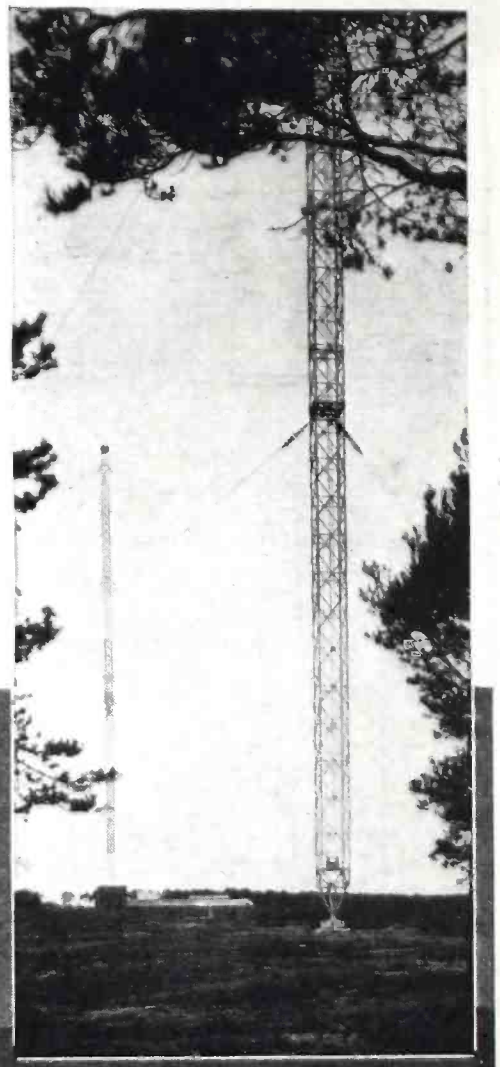
Underwood & Underwood

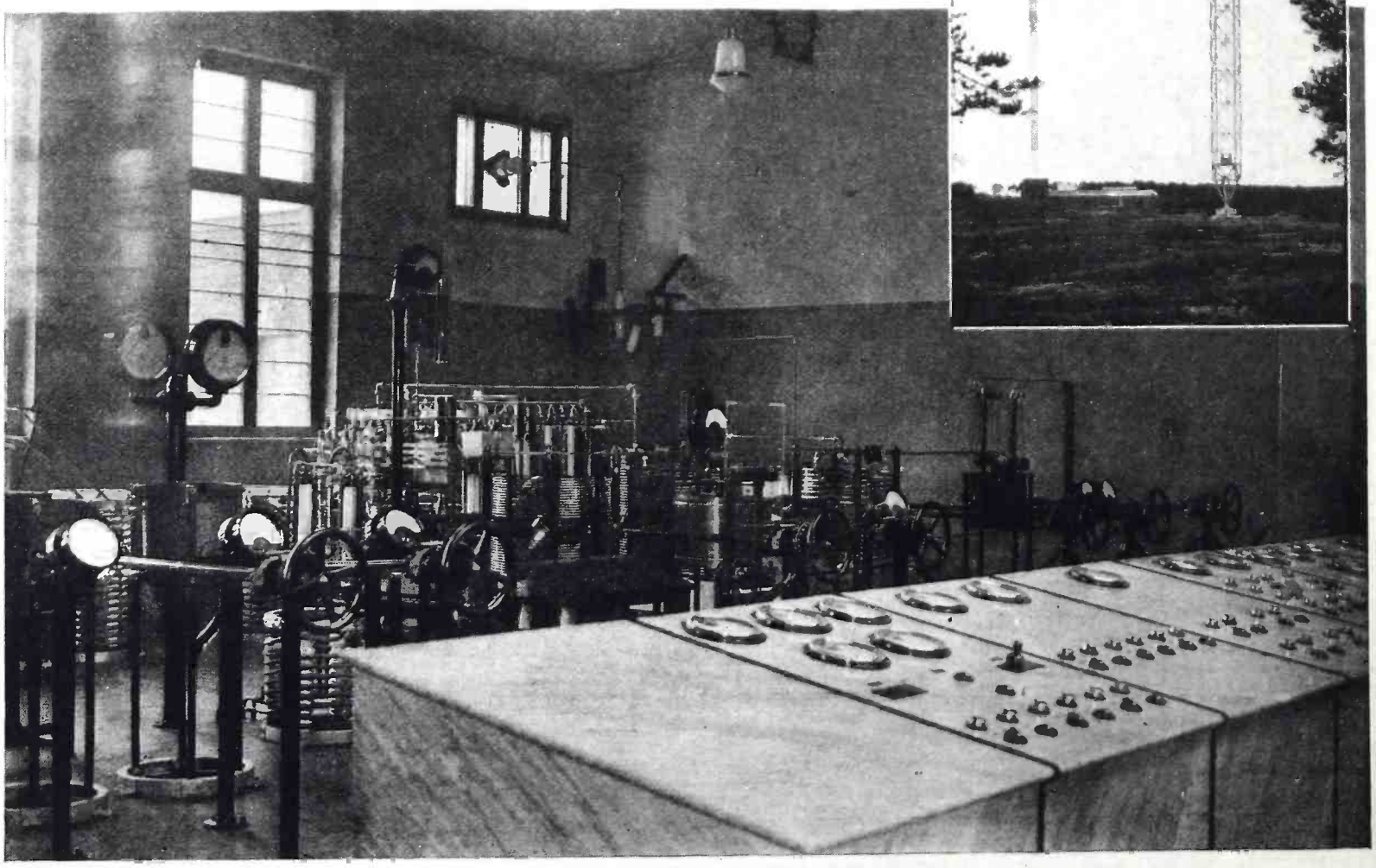
THE POWER SOURCE FOR 120,000 WATTS

In the basement of the new station at Zeesen are the transformers that supply the 120,000 watts of broadcasting energy. This power rating puts the new German station at the head of the broadcasting stations of the world, surpassing both the English station at Daventry and the American station, WEAF, at Bellmore, L. I. Note at the right the elaborate chokes in the power supply apparatus.

THE LARGEST BROADCASTING ANTENNA IN THE WORLD

At Zeesen, southwest of Berlin, rise the 700-foot basket antenna masts shown in the picture below, forming the radiating system for the most powerful broadcasting station in the world. With the erection of this station, Germany steps to the front in the race for broadcasting power.

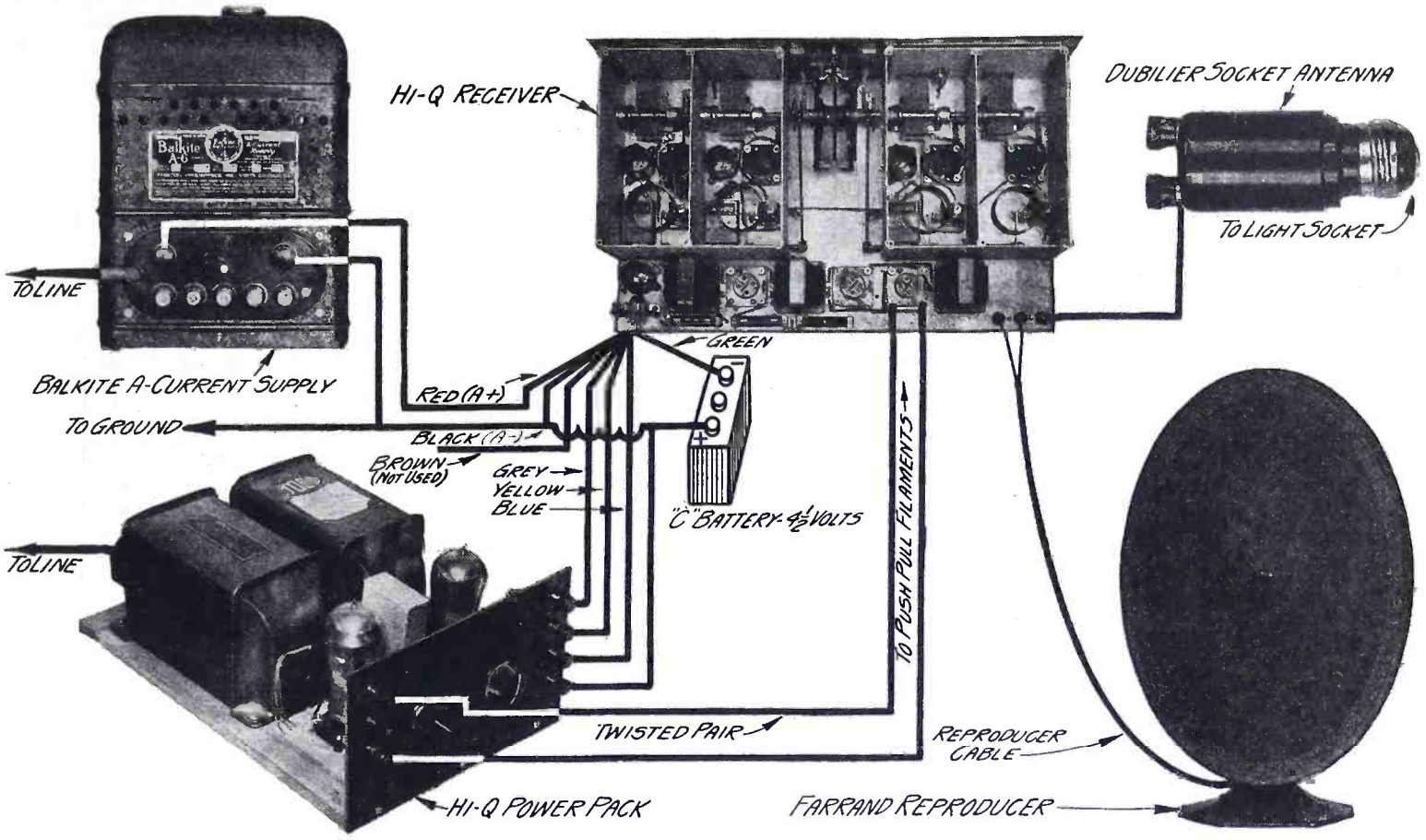




Underwood & Underwood

THE NERVE CENTER OF THE NEW SUPER STATION

This view shows the elaborate control apparatus on the ground floor of the new station. In the foreground are the marble-covered meter panels, where the operating voltages of the transmitter may be read. In the background is the high-frequency oscillator, with its helices, vacuum valves and high-frequency regulating controls. At the back of the room is the lead to the antenna.



A POWER HOOK-UP FOR THE IMPROVED HI-Q

FIGURE 1: *With the addition of a final stage of push-pull amplification in the Hi-Q "Six," the receiver makes greater demands on the power supplying apparatus than the older model; and the operating combination shown above is planned to take care of this need. The No. 713 power block of the Hi-Q "B" power-pack, whose construction was described in the January number of* POPULAR RADIO, *must be replaced with a No. 718 power block, in order to supply the proper voltages for the push-pull stage.*

PUT MORE SNAP IN YOUR RECEPTION BY INSTALLING

PUSH-PULL for the HI-Q

With push-pull amplification coming into favor more and more each month, fans who own the new Hi-Q's will want to add this feature to their receivers. The necessary changes may be made in a very short time, and the addition of the powerful push-pull stage will make the Hi-Q a receiver of unsurpassed quality.

By LESLIE BILES

SINCE January, 1924, when the principles of push-pull amplification were first made available to the radio public, receiver design has improved to an almost unbelievable extent. However, the design of push-pull has kept abreast of general radio progress, and today it is judged by increasingly larger numbers of experts and fans as the premier method for the last stage of low-frequency amplification.

In a splendidly designed receiver such as the Hi-Q, the use of modern push-pull amplification may be expected to give an added power and truthfulness of reproduction that is well worth trying.

This article shows exactly how to incorporate push-pull in the Hi-Q "Six," and to operate it with the official Hi-Q power-pack. A change is necessary in the Hi-Q power-pack, in that the Samson power block No. 718 is to be substituted in place of the regular block type No. 713. All the other parts and the wiring remain the same, however. The Hi-Q "Six" receiver construction was given completely in the November, 1927, issue of POPULAR RADIO, and the construction of the Hi-Q "Six" power-pack was given in January, 1928.

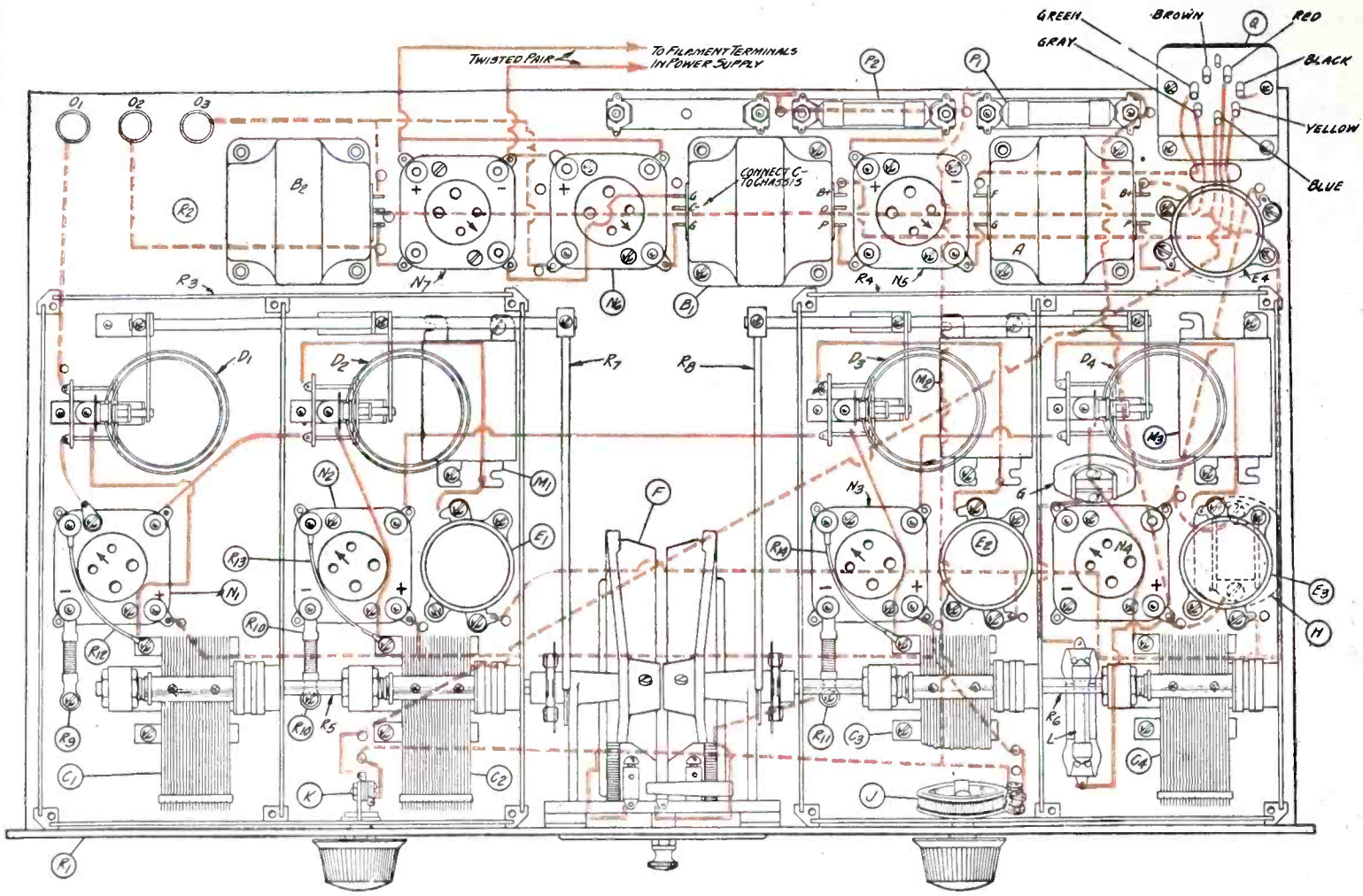
The Changes Necessary to Be Made in the Hi-Q "Six"

The picture wiring diagram in Figure 2 and the illustration in Figure 3 show the addition of an extra socket, N7, and the substitution of a Samson input push-pull transformer, B1, for the original transformer, B. These illustrations also show the addition of an output push-pull impedance, B2. The amperite, B3, is not used.

This, of course, will necessitate changes in the wiring. The completely wired instrument, with the changes, should conform to the picture wiring

POPULAR RADIO WORK SHEET

The Hi-Q "Six" with Push-Pull Amplification



THE WIRING OF THE IMPROVED RECEIVER

FIGURE 2: *The wiring of the Hi-Q "Six" with push-pull amplification is shown above in solid* RED *lines, where it runs above the sub-panel, and in dotted* RED *lines where it runs below the sub-panel. The instruments are outlined in* BLACK. *Condenser H, shown in dotted* BLACK *lines, is mounted under the sub-panel. A comparison of this diagram with that on page 315 of the November number of* POPULAR RADIO, *which gives the wiring of the standard Hi-Q "Six," will show how few and simple are the changes necessary for incorporating push-pull amplification in the receiver. The wiring of the high-frequency amplifier and detector remains the same; the last-stage low-frequency transformer of the old model is replaced by the push-pull input transformer, B1; the output push-pull transformer, B2, and an extra valve socket, N7, are added to the layout, and the wiring of the low-frequency amplifier made as shown above.*

List of Parts for Building This Receiver

Cost of Parts—*Not over $110.00*

A—Samson symphonic transformer;
B1—Samson push-pull transformer, type Y;
B2—Samson output impedance, type Z;
C1, C2, C3 and C4—Hammarlund mid-line variable condensers, .0005 mfd.;
D1, D2, D3 and D4—Hammarlund auto-couple coils, HQ-64;
E1, E2, E3 and E4—Hammarlund chokes, type RFC-85;
F—Hammarlund illuminated drum dial;
G—Sangamo mica fixed condenser, .00025 mfd.;
H—Sangamo mica fixed condenser, .001 mfd.;
I—Sangamo grid-leak clips;
J—Carter Imp rheostat, 6 ohms, type 1-R-6;
K—Carter Imp battery switch, type 2-A;
L—Durham metallized resistor, 2 meg-ohms;
M1, M2 and M3—Acme Parvolt by-pass condensers, .5 mfd., series A;
N1, N2, N3, N4, N5, N6 and N7—Benjamin Cle-ra-tone vibrationless sockets, No. 9040;
O1, O2 and O3—Eby engraved binding posts, marked *Speaker plus, Speaker minus* and *Antenna,* respectively;
P1 and P2—Amperite automatic filament adjusters, No. 1-A;
Q—Yaxley cable connector and cable, No. 660;
R—Hi-Q "Six" foundation unit, containing the following instruments and hardware:
R1—Drilled and engraved Micarta bakelite panel, 7 by 21 by 1/8 inch;
R2—Drilled metal chassis;
R3 and R4—Two-stage aluminum box shields;
R5 and R6—Brass extension shafts for variable condensers;
R7 and R8—Cam-operating assemblies;
R9, R10 and R11—Grid-biasing resistors;
R12 and R14—Grid suppressors (black);
R13—Grid suppressor (red);
R15—Bakelite grid-leak mounting block;
R16—Bakelite binding-post strip;
Wires, screws, nuts, washers, spacing collars, etc.

diagram in Figure 2. In this diagram the wiring is shown in heavy red lines; the solid red lines indicate wiring above the chassis, while the dotted red lines indicate the wiring that is done beneath the chassis.

The changes in this push-pull arrangement are so clearly indicated in the illustrations as to need no further explanation. It will be wise to check over all of the revised wiring before the push-pull set is placed in operation, being sure to correct any wires mistakenly connected or to add any connections that have been left out.

When the set has been fully constructed and wired up, as shown in Figures 2 and 3, it is ready to be installed and placed in operation.

Installing the Hi-Q Push-Pull Receiver

First of all, the receiver itself may be placed in its cabinet or console; then the recommended accessory apparatus, shown in the combination diagram in Figure 1, may be connected to it. The Balkite "A" power-pack should be installed in the radio cabinet or in one of the compartments of the console and connected up, as shown in Figure 1.

The official Hi-Q power-pack, for the plate supply, should then be placed in a similar position. As stated before, the power block, No. 713, in the official Hi-Q power-pack will have to be replaced by a new No. 718 type. The converted Hi-Q power-pack should be connected up to the Yaxley cable as shown in the diagram in Figure 1. Notice that the middle binding post on the left-hand side is not used, nor is the brown wire of the Yaxley cable used. A small "C" battery should be connected between the black and the green cables with the negative end connected to the green wire.

A length of double, twisted lamp-cord is to be connected from the two outside left-hand binding posts on the Hi-Q power-pack to the filaments of the two push-pull valves in the set.

The Ferrand oval-cone reproducer is also shown connected, as well as the connection to the light-socket antenna. Of course, a regular outdoor antenna may be used if desired. It is always desirable to install the reproducer on the other side of the room from the receiver, and for this purpose a Belden extension cord is recommended. The two "input" power connections to the Balkite "A" and the Hi-Q "B" power-packs may be spliced in parallel and connected to a plug that is to be inserted into a socket of the 110-volt AC lighting lines.

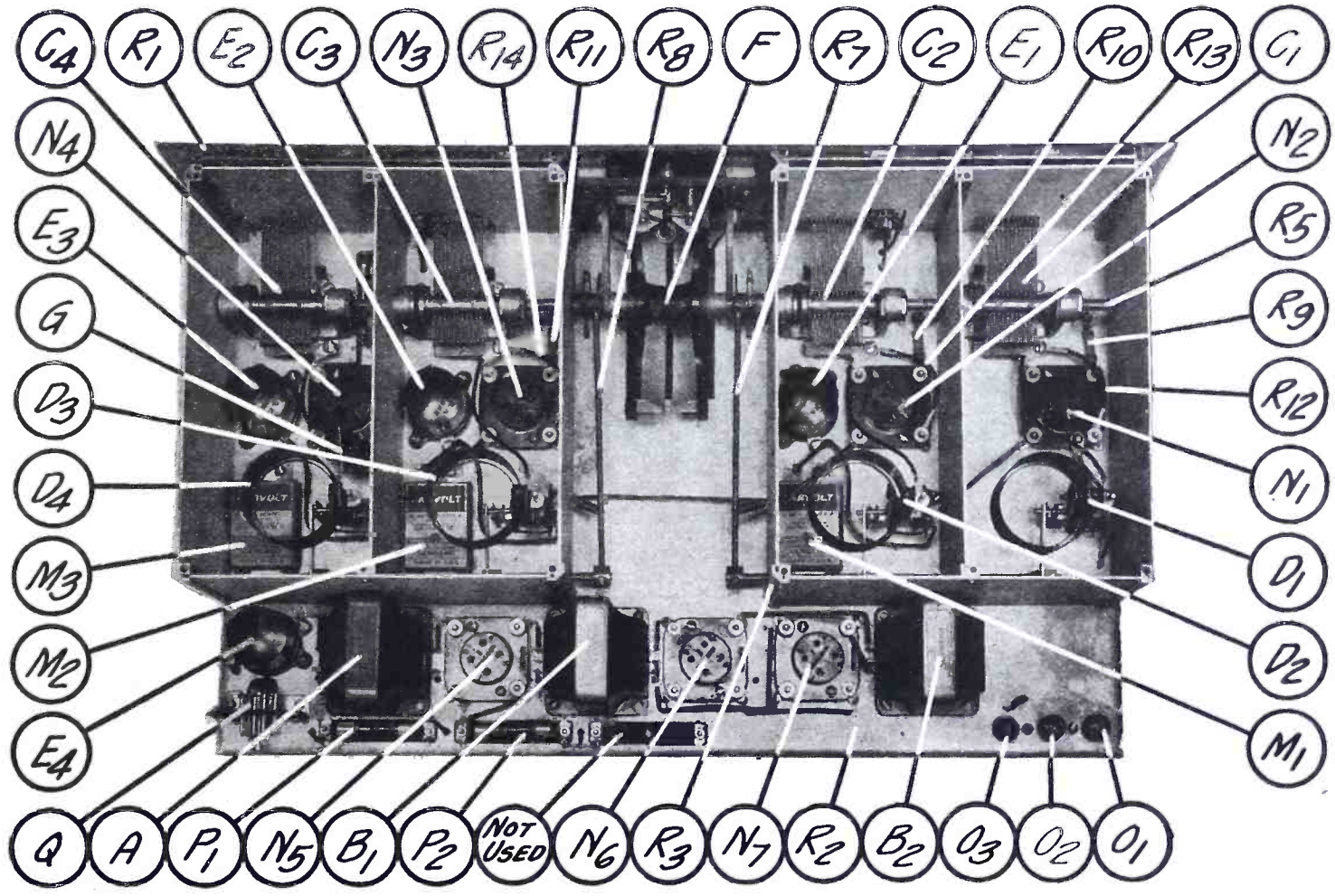
For the adjustment of the official Hi-Q power-pack voltage controls see the article in the January, 1928, issue of POPULAR RADIO.

In operating this receiver, it is also recommended, by reason of the further experimental work done in the POPULAR RADIO Laboratory, to use the new Zetka ZRF type valves in the three high-frequency stages. The new type Zetka ZD detector valve should be used in the detector socket. In the first low-frequency stage a Zetka ZAF valve may be used and the new type Zetka ZO last-stage amplifier valves are strongly recommended for the push-pull arrangement.

These new valves have been found to "pep up" the results obtained from the receiver to such an extent that much greater distance reception and more powerful and better-balanced reproduction will be obtained.

To turn "on" the receiver all that is necessary is to switch "on" the lamp socket that is feeding the "A" and "B" power-packs.

This combination should give the owner of such a set an added pride of ownership, as well as an added appreciation of the many new and excellent program features that are being broadcast from the leading stations.



THE RECEIVER VIEWED FROM ABOVE

FIGURE 3: *The new instruments necessary for the addition of push-pull amplification to the Hi-Q "Six" are shown in the picture above on the lower side of the sub-panel. They are B1 and B2, the input and output push-pull transformers, and valve socket, N7. The filament control which is not used in the new circuit is also indicated above.*

IN THE PROFESSIONAL SET BUILDER'S SHOP

Practical pointers and kinks to increase the efficiency and earning power of those who construct, repair or service receivers for profit. If there is a better and easier way to do it, this department of POPULAR RADIO, *aided by a well-equipped Laboratory, will find it and present the details here to our readers in a practical and concise manner.*

Milliamperes, Volts, Ohms and Watts in Fixed Resistors

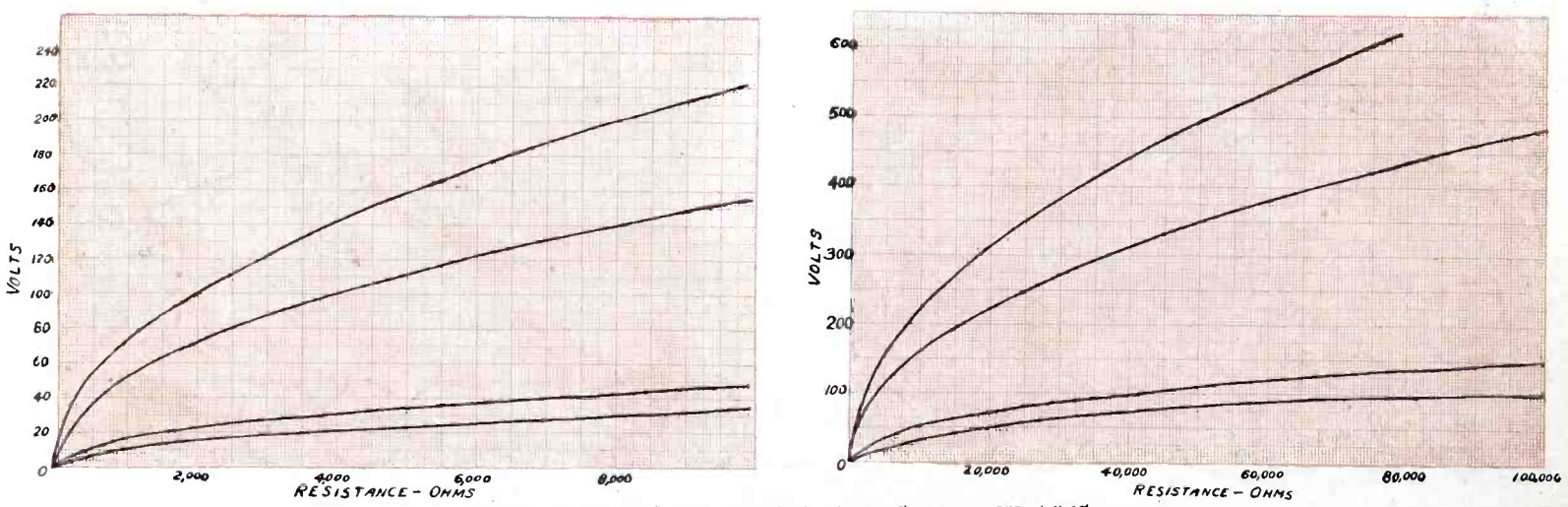
JUST so long as fixed resistors existed only for the purpose of grid-leaks and coupling resistances in radio applications, the matter of current-handling capacity meant little or nothing to the radio engineer and enthusiast. We were then dealing in minute currents. Today, however, with the present extensive use of radio power-packs in which the energy runs as high as an ampere, particularly in the new "ABC" high-voltage power-packs, the radio experimenter may well begin to think in terms of temperature coefficient, impressed voltage and current-carrying capacity in watts rather than in micro-watts.

In an effort to bring home the relationship between volts, ohms and watts, and between milliamperes, ohms and watts, in the application of fixed resistance values, the Engineering Department of the International Resistance Company has worked out the accompanying graphs, which permit anyone to solve problems in fixed resistors without having to resort to intricate formulas and extensive mathematics. These curves, shown in Figure 1, therefore make it simple and expeditious for the engineer or layman to determine the maximum safe voltage which may be applied directly across a resistor of given resistance and power rating. Similar curves, given in Figure 2, deal with the relationship between milliamperes, ohms and watts.

It will be noted that two graphs for each relationship are included for the purpose of covering a wide range of resistance values with accuracy. The left-hand chart in Figure 1 covers the range from 0 to 10,000 ohms, while the right-hand chart covers the range from 0 to 100,000 ohms. By dividing the ohm scale by 1,000 and the voltage scale by 100 we may read the relationship in volts, watts and megohms. The graphs in Figure 2 cover similar ranges. Hence the entire range of resistances encountered in ordinary radio work is covered in these graphs.

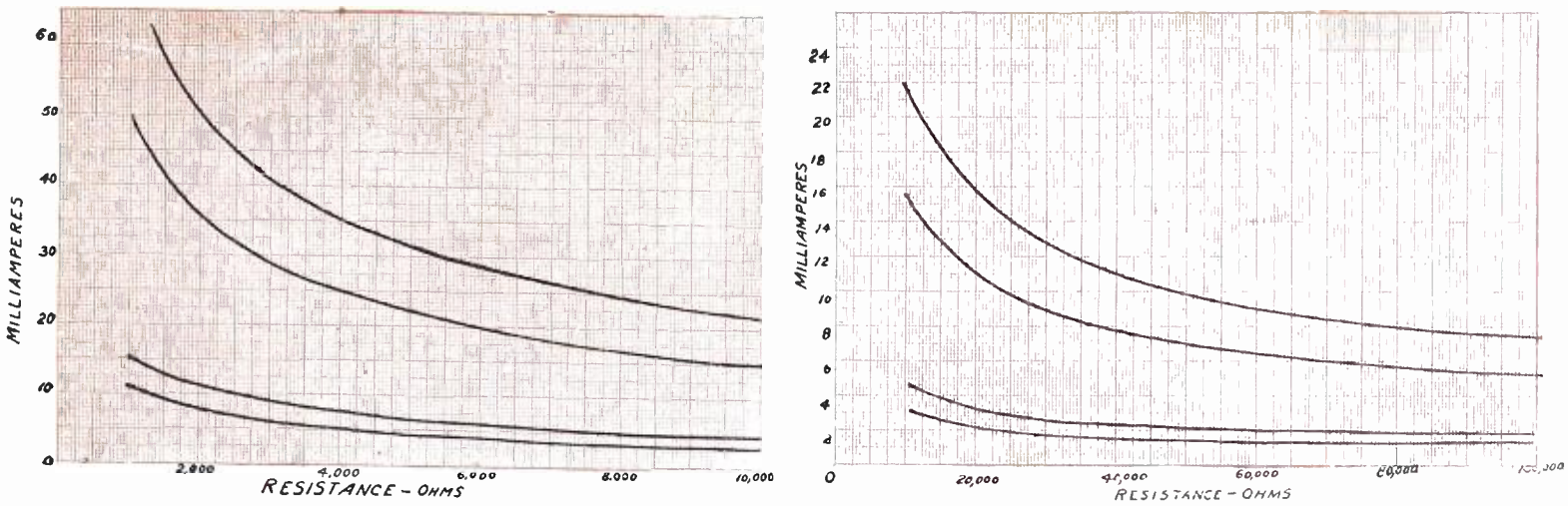
Four curves are given in each graph, namely, that for a 5-watt, a 2.5-watt, a 0.25-watt and a 0.125-watt resistor.

By means of these curves the experimenter can determine just how much energy each class of resistor will handle for a given impressed voltage across its terminals. For example, let us deal with the voltage that might be safely impressed across the terminals of a 10,000-ohm standard 5.0-watt metallized resistor. The answer is



TWO GRAPHS OF VOLTS, OHMS AND WATTS

FIGURE 1: *The curves in these two graphs are, from top to bottom, for resistors of 5, 2.5, .25 and .125 watts current-handling capacity, respectively, and indicate the voltage that can be safely handled by resistors of from 0 to 100,000 ohms. By dividing the ohm scale by 1,000 and the voltage scale by 100, we may read the relationship in volts, watts and megohms.*



GRAPHS FOR MILLIAMPERES, OHMS AND WATTS

FIGURE 2: *The curves in these two graphs are, from top to bottom, for resistors of 5, 2.5, .25 and .125 watts current-handling capacity, respectively, and indicate the current that can be safely handled by resistors of from 0 to 100,000 ohms. By dividing the ohm scale by 1,000 and the milliampere scale by 100, we may read the relationship in milliamperes, watts and megohms. Thus the whole range of resistances may be covered.*

found to be 224 volts. In the case of the 2.5-watt resistor, on the other hand, it is 158 volts. With this example, the radio engineer or layman can figure out how high a voltage may be impressed across the terminals of any resistor, if its wattage capacity is known, or, looking at it from the other angle, what capacity resistor, for a given resistance, is required to take care of a given voltage or current.

These curves have been worked out for the Durham resistors and the Durham power-ohms, which are conservatively rated as to their current-carrying capacity.

—F. R. EHLE

Hints on the LC-28

CONTINUED operation of the LC-28 receiver has brought to light some points which will be of interest to the many constructors of this remarkable receiver. Among these are some suggestions which have been passed along to POPULAR RADIO Laboratory by readers who have constructed the receiver, so that this article really serves as a sort of closed forum for LC-28 fans.

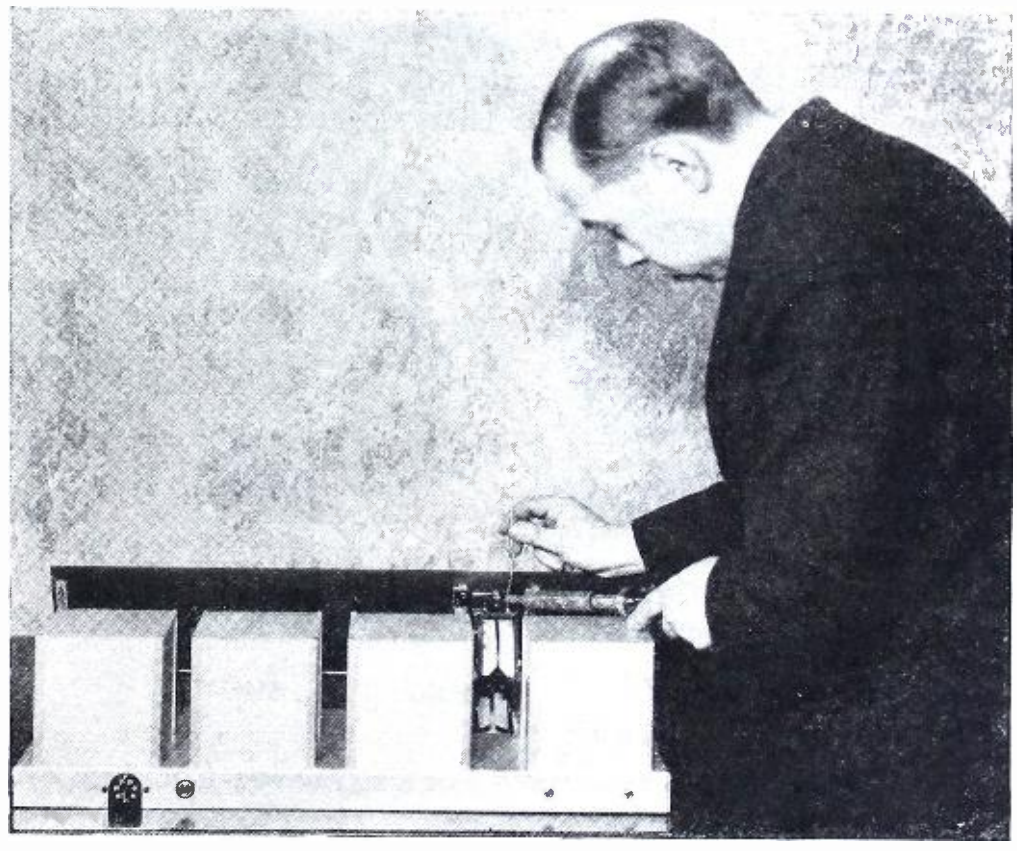
During the construction of the receiver it is extremely important to make sure that the terminals of the various parts be kept well clear of the chassis in order to avoid any chance for short-circuits later. Several constructors found difficulty in this source, particularly in connecting the positive filament and the plate terminals of the valve sockets. These connections were left projecting out beyond the soldering lugs on the sockets, and when the sides of the shields were put in place a contact was made between the socket terminals and shields, with the result that the receivers would not operate, and in some cases the volume-control rheostat or the choke coils were damaged, due to the short-circuiting of the "A" or "B" supply respectively through these instruments.

Another cause for short-circuits has been the use of resistor mountings in which the metal contact clips extended down under the base in such a manner that they made contact with the metal chassis when fastened in place. The result of this error is an inoperative receiver or one which operates poorly. No real damage can result from this source, however.

Wiring the Dial Light

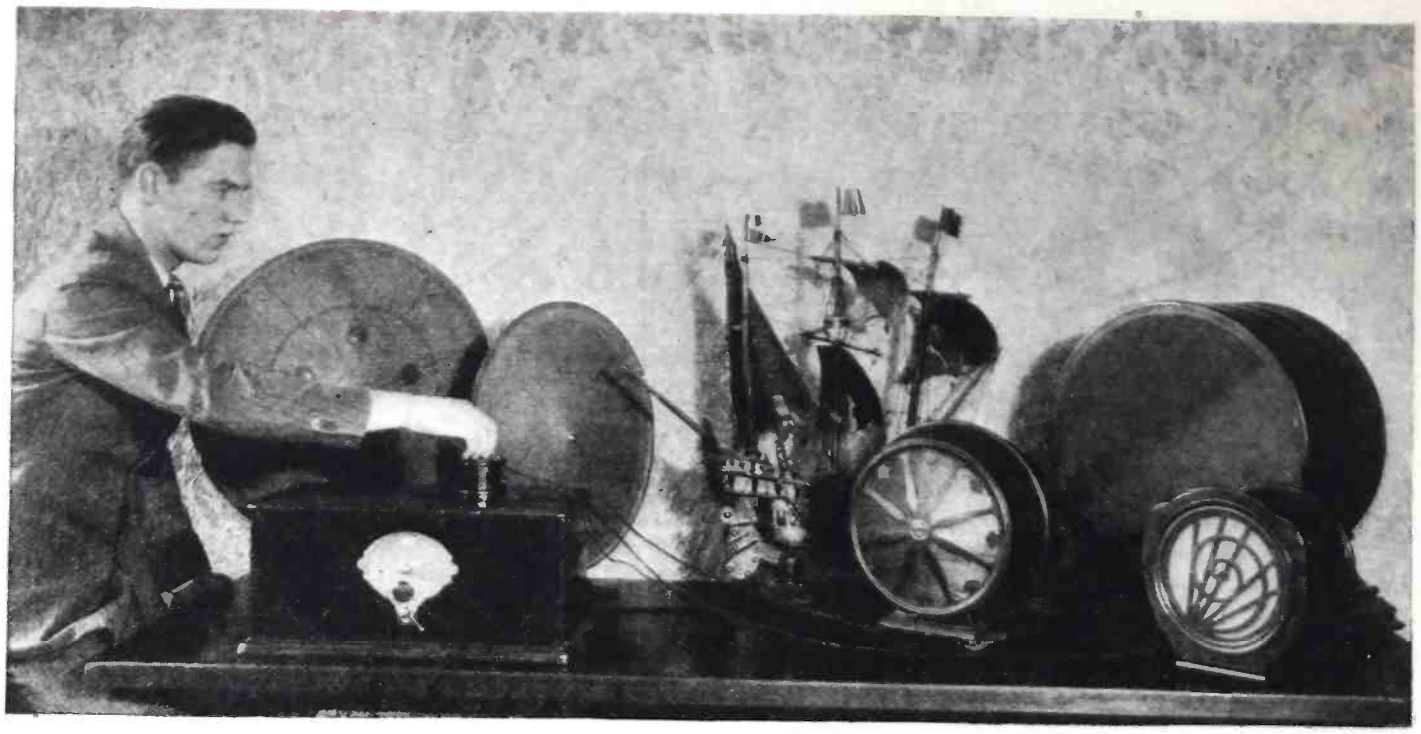
The wiring of the dial light was omitted in both the schematic and picture-wiring diagrams in the October issue. The proper connections are easily made by connecting a piece of insulated wire from the lowest of the three terminals on the rheostat to the left-hand terminal of the dial light (left hand when looking over the top of the front panel). The other side of this circuit need not be wired, as it is connected through the metal panel by removing the insulating washer which is under the lock-nut at the top of the bronze plate on the front panel. When connected in this manner, the

(*Continued on page 153*)



CONNECTING THE PILOT LIGHT

The connections for the pilot light on the LC-28, which were omitted in the constructional article in the October number, are described in the article on this page.



ARISTOCRATS OF THE TONE WORLD

This picture shows a corner of the POPULAR RADIO *demonstration room where some of the new reproducers are being given a competitive try-out. Such "actual practice" tests as this supplement the electrical tests and physical examination that these units must submit to in order to be included in these columns.*

What's New *in* Radio

Conducted by

THE TECHNICAL STAFF

The material listed in these columns has been carefully tested in the POPULAR RADIO Laboratory, which is acknowledged to be one of the most completely equipped institutions of its kind. Mention in the following pages signifies that the apparatus illustrated has met the approval of the POPULAR RADIO Engineering Staff.

A Triple-Rate Trickle Charger Unit

Name of instrument: France "dry" trickle charger.

Description: This trickle charger has an advantage over most others in that it will provide any one of three values of charging current. For use with a battery that is under heavy service, as with a receiver that draws 2 amperes per hour or more for a period of 8 hours per day, the high charging rate of this charger will keep the battery fully charged. Where the requirements are less strenuous, one of the two lower current taps may be used to provide a charging rate of either ½ ampere or ¾ ampere per hour. The charger employs a dry type of rectifier which requires no attention. This rectifier, together with the transformer and other parts, is inclosed in a perforated metal case on the front of which are four insulated binding posts. One of these binding posts is for connection to the "A" positive (+) terminal of the "A" battery, while the "A" negative (—) terminal of the battery is connected to any one of the other three binding posts, depending on the amount of charging current desired.

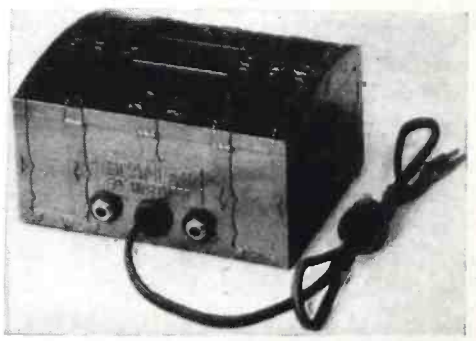
Outstanding features: Requires no upkeep attention. Provides an adjustable charging rate.

Maker: France Mfg. Co.

An Attractive-Looking Output Transformer

Name of instrument: Speaker "Chest" output transformer.

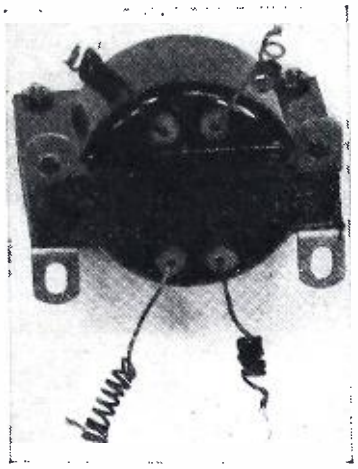
Description: This unit consists of an output transformer which is inclosed in a metal case and has the appearance of a small strong box or chest. It



is intended primarily for use with a receiver which does not contain an output transformer, or filter, and which therefore requires that such a device be located outside of the receiver proper. This explains why such care has been taken in the appearance of this unit. It is equipped with an extension cord for connection to the output terminals of the receiver, and has two tip jacks to accommodate the tips of the reproducer cord.

Outstanding features: Protects the reproducer windings from high DC currents present in the plate circuit of power amplifier valves. Fine appearance. Readily installed without any tools.

Maker: Scanlan Electric Mfg. Co.



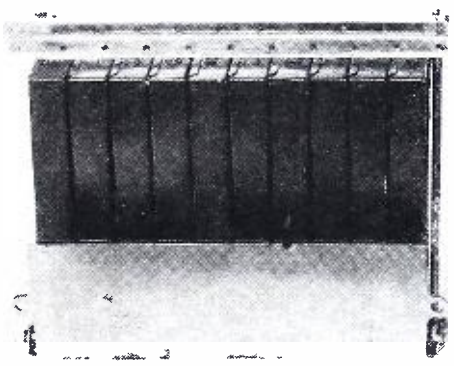
A Transformer for the Home Set Builder

Name of instrument: F M C, type 10693, low-frequency amplifying transformer.

Description: For the first time a low-frequency transformer of the style used in most commercial made receivers is made available to home set constructors and the professional builders of custom made receivers. Outside of it being a transformer of good quality, it is so constructed that it is easy to install and wire. The terminals are in the form of five-inch wire leads which may be cut to the desired length as the transformer is connected into the circuit. It is a plain product in which all of its value is in the transformer itself and not in a fancy covering, etc. It may be mounted either on top or beneath sub-panel.

Outstanding features: Low cost. Easily wired. Small in size. Neat in construction. Completely inclosed in metal case, thus reducing the danger of damage to wiring.

Maker: Ford Radio & Mica Corp.



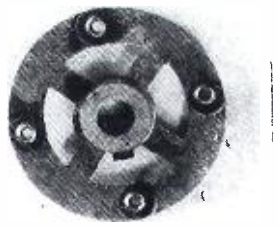
Make Your Own Condenser Assemblies

Name of instrument: "Farapak" condenser assembly rack.

Description: This device permits the experimenter or constructor to build a condenser unit with any combination of capacities required. It consists of metal fittings which form an adjustable rack. In this rack are placed a sufficient number of 1 mfd. condensers to make up the required total capacity. The two thumb nuts are then tightened and the condensers are held tight together in the form of a single block. Spring terminal strips are also provided to eliminate the necessity for soldering connections to the individual condenser terminals.

Outstanding features: For use in "B" power-packs, etc. Any desired combination of capacities can be readily made up in a single unit. When assembled, the condenser block may be easily mounted in any convenient position by means of the mounting holes provided in the base and back of the rack. The assembled unit is quite sturdy and substantial.

Maker: Globe Art Mfg. Co., Inc.



A Coupling for "Ganging" Condensers

Name of instrument: Insulated flexible coupling.

Description: The coupling consists of two "H" shaped pieces of phosphor-bronze which are fastened together in such a manner that they are insulated from one another and have their cross-arms at right angles. On each cross-arm is fastened a brass bushing equipped with two set-screws. If it is desired to couple two tuning condensers together, but still have their shafts insulated from each other, they are lined up with their shafts end to end, but with the coupling between the shaft ends. The bushings on the coupling are slipped over the ends of the two shafts. When the set-screws in the bushings are tightened, the two condensers may be operated together as one. In addition to coupling the two condensers together, the flexible feature of the coupling permits smooth operation, even though the two shafts may not be exactly lined up. These bushings find other uses also, as in attaching drum dials to shafts of condensers, etc.

Outstanding features: Insulation between the halves of the coupling. Flexible. Durable. Positive grip on the shafts of instruments assured by double set-screws.

Maker: Hammarlund Mfg. Co.

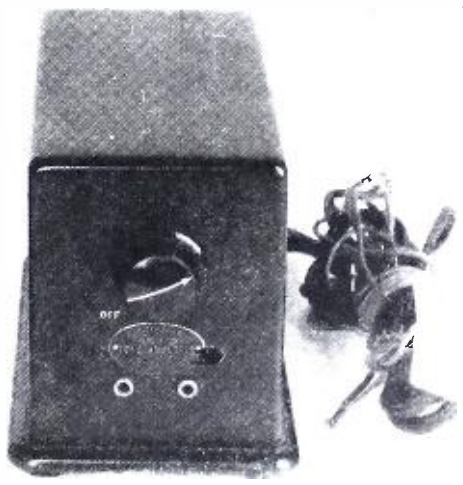
A Power Amplifier for the Output of the Receiver

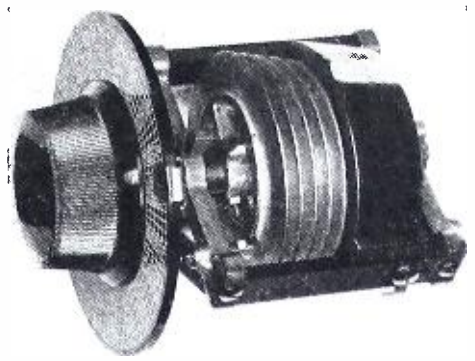
Name of instrument: Centralab tone amplifier, model 100 for storage battery operation or model 200 for dry cell operation.

Description: This unit consists of a complete stage of power amplification and an output filter, all inclosed in a neat walnut finished wood cabinet. It is to be connected to the output of any receiver and therefore does not replace the present amplifier. Connections are made without any rewiring and without any tools. The amplifier uses a 171 type power valve and includes a volume control which is operated by the knob on the front of the cabinet.

Outstanding features: Its use adds one stage of power amplification to any receiver. Can be installed in a few minutes. Increases the normal volume of a receiver and tends to improve tone quality. Includes output filter. For dry cell receivers the tone amplifier employs a 120 type power valve.

Maker: Central Radio Laboratories.





A Condenser That Requires No Vernier Control

Name of instrument: Helicon variable condenser with dial.

Description: This condenser is unusual in appearance, operation and control. Instead of consisting of two sets of plates, one set of which moves in an arc to mesh within the other, the rotor of the Helicon condenser is in the form of a large screw with a deeply cut thread. The stator corresponds to the threads inside of a nut. Five complete turns of the shaft, upon which the rotor is mounted, are required to completely mesh the rotor within the stator, as compared with a half turn in the case of the standard type of variable condenser. As the shaft of the Helicon is turned, the rotor screws into the stator, but with sufficient clearance between the two to avoid touching. The dial provided with the condenser is divided into 500 divisions and works in conjunction with a moving pointer. The marking of the dial is laid out in the form of a spiral, with zero at the outer edge and 500 at the inner edge. As the shaft is turned to increase the capacity, the pointer moves in toward the center of the dial. Thus when the condenser is turned to provide half of its capacity the pointer moves into the third row of calibrations on the dial, where the half-way calibration is found. At full capacity the pointer is over the inner side of the dial, where the calibration ends at 500.

Outstanding features: Smooth and gradual adjustment of capacity requiring five turns of the dial for full variation from minimum to maximum capacity.

Maker: Helicon Radio Condenser Corp.

No Batteries Are Required for This Receiver

Name of instrument: Monarch All Electric radio receiver, console model.

Description: This receiver is, first of all, an absolutely batteryless receiver, with all of its operating current drawn from the house lighting lines. Just turn the switch and off it goes, day in and day out, with absolutely no upkeep attention required.

The receiver is a six-valve unit and includes three stages of high-frequency amplification, a detector stage and two stages of transformer-coupled, low-frequency amplification. There are three tuned circuits so arranged as to be tuned by a single control knob on the front panel. The design of the tuning condensers, by means of which this single control is accomplished, is unique and most simple. The rotors of the condensers are actually a single unit, while the three corresponding groups of stator plates are disposed around the center shaft on which the multi-rotor is mounted. Direct coupling of the tuning condensers, as used in this Monarch receiver, does much to eliminate back-lash, slipping and misalignment.

The circuit employed in the high-frequency amplifier is the well-known Loftin-White balanced circuit. Oscillation is completely eliminated, together with the distortion which so often accompanies near oscillation.

In the low-frequency amplifier two transformers are used and their quality is evident in the deep, rich reproduction of music and speech. Provision is made for the use of a semi-power valve of either the 112 or 371 types in the last stage.

The operating voltages for filament, plate and grid supplies are obtained from a metal inclosed power-pack which employs a 400-milliampere rectifier valve of the gaseous type. All the operating voltages are drawn from this valve except the filament supply for the power valve, which employs alternating current from a 5-volt winding on the power transformer within the power-pack. The other five valve filaments are connected in series, thus drawing a total of 250 milliamperes (¼ ampere), which is readily supplied by this power-pack, with plenty left over for the plate supply.

The power-pack fits into the lower part of the console, with the reproducer. The top of its metal case may be removed when necessary to gain access to the rectifier valve, but is normally left in place, thus preventing any possibility of shock.

Connections between the power-pack and the receiver are simple and fool-proof. The connection cable is permanently attached within the power-pack and the other end terminates in a multi-tip plug which slips into a corresponding socket in the rear of the receiver unit. On one side of the console, where it is out of sight, is a neat toggle power switch, by means of which the power supply is turned "on" and "off."

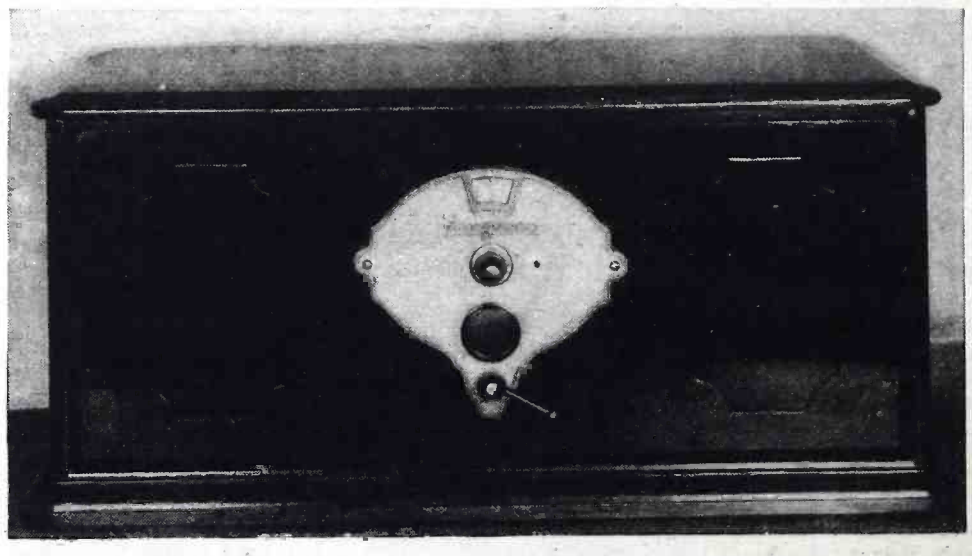
The reproducer has an air column 96 inches in length, which corresponds to a straight horn 8 feet long. But this one is so cleverly designed that it finds plenty of room in the lower part of this console. Acoustically it is excellent.

The antenna and valve requirements are the same as those of any normal 6-valve receiver. Any type of outdoor antenna may be successfully used, although in localities where there is a considerable amount of local interference a short antenna is to be recommended. The valves used are a semi-power valve, as mentioned above, and either five of the 301-a type or four of the 301-a type and a 300-a for the detector socket.

In addition to the console model described, the receiver unit is obtainable in a table mounting cabinet. The power-pack supplied with this table model is the same as that used with the console model, and the receiver itself is also identical.

Outstanding features: Fine appearance. Good tone. Ample volume for home use. Requires no upkeep attention, as it employs no water, acids, batteries or chargers.

Maker: The Monarch Co.



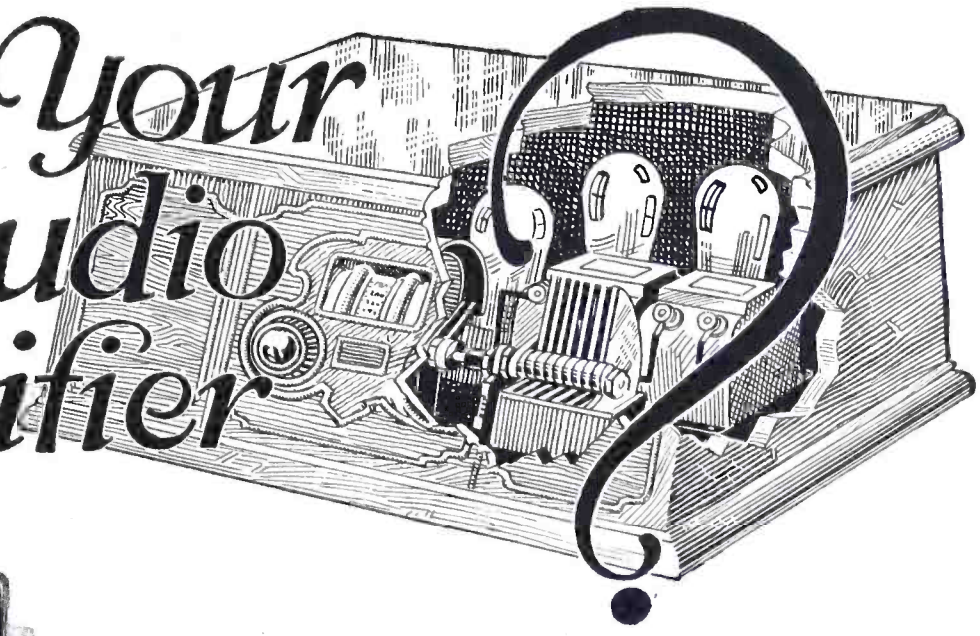
A Highly Selective 7-Valve Receiver

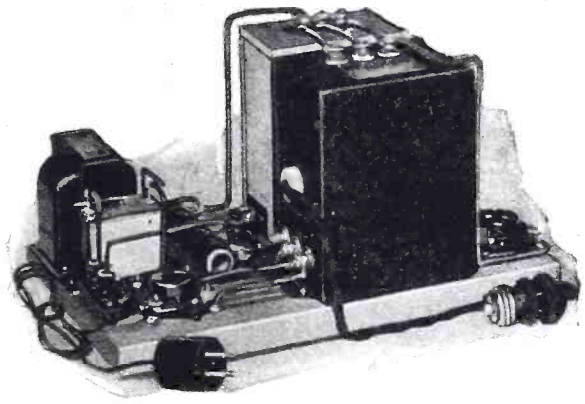
Name of instrument: Ferguson 7-valve receiver.

Description: The Ferguson receiver, so far as its operation and appearance are concerned, is one of the simplest receivers that has been placed on the market to date. The front panel carries a single plate on which is mounted a knob and a lever. The knob provides complete wavelength tuning, while the lever is the volume

(*Continued on page 158*)

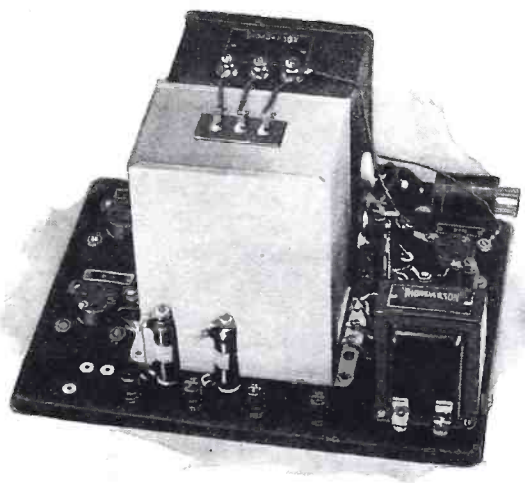
How's Your Old Audio Amplifier





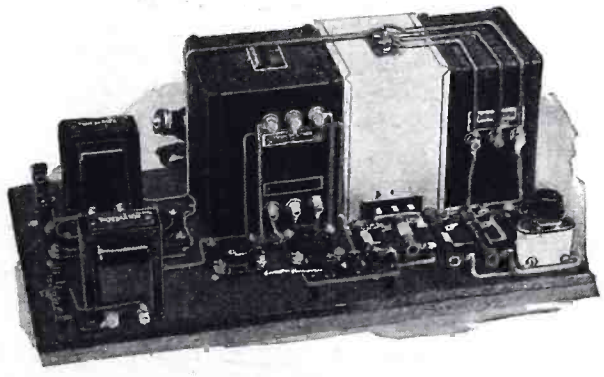
THORDARSON 171 TYPE
POWER AMPLIFIER

Built around the Thordarson Power Compact R-171, this power amplifier supplies "A," "B," and "C" current for one UX-171 power tube and B-voltage for the receiver. Employs Raytheon B. H. rectifier.



THORDARSON 210 TYPE
POWER AMPLIFIER

This amplifier, mounted on a special metal chassis, uses the Thordarson Power Compact R-210. Provides "A," "B," and "C" current for one UX-210 power tube and "B" voltage for the receiver. Employs one 216-B or 281 rectifier.



THORDARSON 210 PUSH-PULL
POWER AMPLIFIER

This heavy duty power amplifier operates two 210 power tubes in push-pull and has an ample reserve of power for "B" supply for the heaviest drain receivers. Built with Thordarson Power Transformer T-2098, and Double Choke Unit T-2099.

A Home Assembled Thordarson Power Amplifier Will Make Your Receiver

A Real Musical Instrument

IMPROVEMENTS in the newer model receiving sets are all centered around the audio amplifier. There is no reason, however, why you cannot bring your present receiver up to 1928 standards of tone quality by building your own Thordarson Power Amplifier.

With a screw driver, a pair of pliers and a soldering iron you can build any Thordarson Power Amplifier in an evening's time in your own home. Complete, simple pictorial diagrams are furnished with every power transformer.

The fact that Thordarson power transformers are used by such leading manufacturers as Victor, Brunswick, Federal, Philco and Willard insures you of unquestionable quality and performance.

Give your radio set a chance to reproduce real music. Build a Thordarson Power Amplifier.

Write today for complete constructional booklets sent free on request.

THORDARSON

3572

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

Everybody Wants a Push-Pull Amplifier

(*Continued from page 133*)

ment of it affects the plate voltage; consequently the final adjustment is more or less an arbitrary value for both grid and plate voltages. By making the plate voltage variable over a wide range, the valves may be operated at the maximum efficiency regardless of the load.

The direct current available from the rectifying system is approximately 150 milliamperes. A high current output makes for better voltage regulation and will easily supply sufficient current to operate a multi-valve set with a great reserve of power.

How to Construct the Amplifier

The mounting of the instruments on the wooden baseboard, M, is easily accomplished by reference to Figure 1, so that no further instructions are necessary. The wiring is straightforward and simple, and is shown clearly in the picture wiring diagram in Figure 2. The only precaution necessary is to place some sort of guard over the high-voltage side of the power transformer and to use rubber-covered wire for all connections.

For convenience the 2,000-ohm variable resistor, H, is mounted by means of a metal bracket directly to the "B" negative (—) binding post of the push-pull amplifier, A. When AC current is used to light the filaments of the vacuum valves used in this amplifier, it is a simple matter to utilize part of the plate current to obtain a grid-bias voltage. This is accomplished by connecting the "C" negative (—) binding post directly to the "B" negative (—) post and inserting a resistance, which in this case is the variable 2,000-ohm resistor, H, between the "C" negative (—) and the "B" negative (—) binding posts. By-passing this resistance by a condenser is sometimes helpful in reducing hum.

The filaments of the rectifier valves, together with those of the amplifier valves, are lighted from the low-voltage secondaries of transformers B1, B2 and B3. In the case of the CX-326 type valve, a fixed resistance of 6 ohms, G, capable of carrying at least 1 ampere, is inserted in one of the filament leads underneath the baseboard. These connections are all shown clearly in the picture wiring diagram in Figure 2.

How to Install the Amplifier

To operate this device, it is simply necessary to connect the primary transformer, D, to the output of the detector valve of a high-frequency pack, such as the LC-28 or the Browning-Drake, or to a phonograph magnetic pick-up. The reproducer is connected to the terminals marked "output" on the push-pull amplifier.

Under normal operating conditions, the vacuum valves, especially the two CX-381 rectifying valves and the two CX-310 type power valves, together with the resistance unit, should get decidedly warm. If the plates of the two CX-310 power valves should get "red" after a period of use, it is an indication that the grid-bias voltage used is improper and the biasing resistance should be adjusted until this condition disappears. It is almost a positive indication that one or more filter condensers are defective if the plate of the rectifier valve suddenly turns "orange" color.

Under operating conditions, with the primary of transformer D open, a hum should be heard in the reproducer. This, however, should almost disappear when the two input terminals are connected to a set or a phonograph pick-up unit.

In an AC-operated device of this sort it is extremely important that the plate and grid voltages of the amplifying valves be adjusted properly, as this helps materially in reducing hum; also the cases of the various parts should be grounded to the "B" negative (—) line. When using a phonograph pick-up with this device, it is sometimes helpful, in removing the sound of the needle scratch, to shunt the input terminals by a small fixed condenser. The proper value can only be determined after experimentation, but will usually be somewhere around .01 mfd.

A Battery-Operated Browning-Drake

(*Continued from page 126*)

purpose. The "A" supply is obtained, in this combination, from the new Knapp "A" power-pack, that was also fully described in the January, 1928, issue. The new Pacent cone reproducer is recommended for use with this group of radio receiving apparatus.

The combination works excellently from a light socket antenna, although a regular outdoor antenna may be used if so desired.

For the maximum results, in both distance and quality, place a Zetka ZRF type valve in socket N1 and a Zetka ZD type high-sensitivity detector valve in socket N2. These valves, of course, are the ones recommended for the two-valve tuner itself.

In the amplifier the valves recommended are a 240 type Hi-Mu valve for the first socket on the left. (The valves must be inserted with the amplifier turned upside down.) In the second socket from the left place a type AX Ceco valve, and in the third socket place a Ceco type L-10 valve. The Ceco type R-81 rectifier valve is recommended in the last socket on the extreme right.

An ideal way for mounting the various units of this combination receiver is to place the receiver itself in the upper portion of the console cabinet chosen for it with the amplifier and the "A" power-pack in the compartment underneath the receiver. All of the wires running between the units may then be kept neatly inside of the cabinet and no external wiring will be in view when the set is in operation.

The operation of the receiver will be accomplished in exactly the same manner as in the case of the AC model of the receiver.

The primary leads for the "A" power unit and the amplifier should be spliced together and connected to a plug that is to be inserted in a socket of the 110-volt, 60-cycle AC lighting lines. With this combination the switch on the receiver may be left turned "on" at all times and the receiver operated completely from the switch on the lighting socket.

In actual operation it will be found that the results that may be obtained will be considerably in advance over the results obtained with the older styles of Browning-Drake receivers. The set will be more selective and have a greater sensitivity and at the same time be much more stable in operation.

The high-quality resistance-coupled amplifier in the National amplifier insures a tone quality and volume that will please any listener. In fact, the total result will be of an order never obtained before with any of the models of this popular receiver.

The Teletrol Wave Lifter

(*Continued from page 116*)

characteristics that may be operated from the same power source as the receiver to which the unit is used.

How to Construct the Teletrol Wave Lifter

In constructing the unit the first job will be to prepare the wooden baseboard, U, which should be made out of ½-inch hardwood, cut to a size of 9 by 16 inches. The next work is to mount on the baseboard all of the parts that go to make up the receiver. The relative positions for the various instruments are shown in Figure 1, which shows the top view of the set, and also in the picture wiring diagram in Figure 2.

As all of the parts simply need to be screwed down to the wooden baseboard, the mounting of the instruments is easy. It is probably best to set out the parts in about their correct positions before fastening them down, so that no mistakes will be made. A careful study of the wiring diagram will show the approximate spacing necessary for running the wires between the instruments.

The next job is to drill the holes for the instruments that are to be fastened onto the front panel, T. This had best be done by standing the subpanel and the baseboard in their correct relative positions and "spotting" the holes necessary for the shafts of the three condensers with a punch-prick. When these are drilled, the spacing for the tuning dial, V, can be laid out with the template that comes packed with the dial. The panel, T, may then be fastened to the baseboard, U, by means of three screws fastened to the panel and into the edge of the baseboard.

How to Wire the Teletrol Wave Lifter

The wiring of the unit should be done with flexible Braidite, and each wire should be run as shown in the picture wiring diagram in Figure 2. If the exact information is carried out, the theoretical circuit shown in the schematic wiring diagram will be fulfilled. A careful check should be made, once this work has been completed, and it would be well to do this checking from both the schematic and the picture wiring diagrams. Notice that some of the leads should be twisted together.

How to Install and Operate the Teletrol

The installation of this unit may be simply made to any radio receiver employing tuned-high-frequency amplification. The unit may be placed in a standard Corbett cabinet, 7 by 18 inches. The antenna wire is taken off the receiver and applied to the antenna post of the Teletrol. This is shown clearly in the combination diagram in Figure 3. Also notice that the antenna terminal of the receiver is to be connected to the output terminal of the Teletrol. The regular ground connection on the receiver is left as before. The Yaxley plug and cable on the Teletrol should be connected up to the "A" power-pack and to the "B" and "C" batteries, as indicated by the dotted wiring in this diagram. The black wiring, of course, refers to the connections for the receiver with which it is to be used.

The vacuum valves recommended for the Teletrol are a radically new type that have a lower internal capacity and also a much lower plate impedance, giving added results in pick-up and amplification. These valves are known as type DA-2 Donle valves and are manufactured by the Donle-Bristol Company.

In using the receiver for short-wave reception, the particular short-wave Aero coil needed for the wavelength desired to be received should be inserted in the socket at "A," shown in the picture wiring diagram. Then the switch on the receiver itself should be turned "on," as well as the filament switch on the Teletrol. All the valves in both sets should then light up. The oscillator of the Teletrol is controlled with the right-hand dial, and this should be revolved until the oscillator frequency lies within the wavelength range of the receiver. It is best to set the receiver somewhere towards the top end of the tuning scale, round a dial set of 90, and then to tune the oscillator dial in the Teletrol until it falls on the same wavelength. This is indicated by a sort of rushing sound or clicking sound when it is set correctly. The small variable output coil of the coil, B, in the Teletrol should then be adjusted so that this effect is most strongly marked Then the tuning control of the Teletrol should be revolved with the left-hand control turned all the way "in." As the tuning dial, V, is rotated a series of whistles should be heard in the reproducer. The left-hand dial on the Teletrol should then be rotated to a lower setting until the whistling sounds stop and voice signals are heard. This adjustment is rather critical, but can be stabilized by the proper adjustment of the primary coil shown at "A" in the Teletrol.

Of course, all of the short-wave signals that are picked up will not be broadcasting. A great many will be amateur code transmissions that utilize the whistling sounds caused by continuous waves for sending Morse signals, but on going "up" and "down" the range the broadcasting signals can be picked out and dial settings jotted down for each one, also noting which size of antenna coil is used for each particular station, as well as the settings of each of the Teletrol's dials.

The AC Equamatic

(*Continued from page 120*)

switch. This allows the receiver to be turned "on" and "off" directly from the main panel.

When the wiring is finally completed and rechecked, the set is ready to be installed and placed in operation.

How to Install the AC Equamatic

The receiver itself is first to be placed in the cabinet or console chosen for it and set up in the place where it is to be used.

The installation is such a simple matter that it can be done inside of a quarter of an hour's time. Simply attach the reproducer to the two tip-jacks, as shown in the combination diagram in Figure 1. A light socket antenna may be used with this receiver and it should be connected to the antenna post, as illustrated in the same diagram. The connections from the Yaxley cable to the Majestic "B" power-pack are clearly shown, as well as the connection to the ground, which may be made on any nearby water-pipe or radiator, or other well-grounded connection.

The 110-volt plug and extension cord of the "B" power-pack should be inserted in the socket on top of the power transformer in the receiver, and the input plug and extension cable of the power transformer should be connected direct to the 110-volt, 60-cycle AC lighting line.

The vacuum valves should be set in the sockets, as explained at the beginning of this article.

The apparatus recommended in the combination diagram in Figure 1 has been used successfully in the POPULAR RADIO Laboratory and produces excellent all-around results. Of course, a regular outdoor antenna may be used if extreme distance reception is required.

To turn the set "on," all that is necessary is to flip the switch on the panel, and after a period of about 40 seconds the receiver will be ready to operate. The two main dials, U1 and U2, should be rotated until the station is tuned in; then the dials and rheostats may be adjusted for the best results. The two balancing condensers should be adjusted so that the circuits are stabilized and oscillation is eliminated. To do this, rotate the knob on the top of each balancing condenser, one at a time, with a signal fully tuned in, while rotating the first tuning condenser, U1, past the wavelength of the station being received, until the point is found in the setting of the balancing condenser where the set no longer squeals. No further adjustment will be necessary, and from then on the set may be tuned with the two dials and the volume controlled by the small volume control knob on the front of the panel of the receiver.

HARRY NOLTE AT WORK

The dark basement where he builds his radio sets has hardly any light —because he needs none. With nimble fingers he mounts and wires the parts of the receiver in their proper places; only his keen hearing helps him to gauge how well he has built.

A Blind Builder of Sets

By HAL HAZELRIGG

FOUR years ago, Harry Nolte of Evansville, Indiana, went blind. Blindness came to him with the suddenness of a scourge. There was a strange weakening of the sight, whispered sidelong conversations by physicians—the dread word "glaucoma"—then darkness, black and impenetrable.

Nolte had been a traveling salesman, happy and popular and a good mixer. He had two hobbies, photography and radio.

Of course, this swift tragedy struck the camera from him but it left him radio.

His nimble fingers soon learned every inch of the complicated construction of his radio set. He began to make his own repairs and improvements upon it. Then came the thought which brought hope into his life; why not make a set of his own?

Amazed at his own facility, Nolte fashioned a complete set, better than the first. Then he made another; then a fourth. He fitted up a workshop in the basement of his home in Evansville, Indiana, a shop which had scarcely any light, because Nolte needed no light.

That workshop became a marvel of precision. With the assistance of his wife, Nolte arranged a place for every bit of wire and every vestige of material. The blind man now reaches out with his hands and in the course of a few days a jumble of wires, metal, wood and screws becomes a radio set.

Nolte knows the joys of the inventor. He has designed a radio set for the blind. Its dial numbers are on tin, raised in the Braille fashion, and he has originated a card index of stations, also done in the Braille lettering, at which he is an adept.

In Evansville, Nolte's sets have gained a reputation; he has sold nearly two score sets, and now he has on hand more orders than he can fill. He also works on other sets, making improvements and repairs.

Nolte's many friends keep him posted on all new developments printed in POPULAR RADIO and other publications. As soon as one hears or reads of an innovation in the radio industry, he hurries to the blind man and tells him the news.

On the ground floor of the little house above Nolte's workshop, is his "finishing room." Here, Mrs. Nolte helps, staining and painting the sets after her husband has completed the mechanical parts.

"It takes me a week to make a set," Nolte will tell you apologetically; "if I had eyes it could be done in two days. But I get a perfect set, because my more acute hearing detects fallacies in sets, and I can locate the trouble which the sense of touch rectifies."

Nolte enjoys life. His chuckles and smiles prove that. Life in the dark must not be so bad after all. But he is happy because he can twist a few dials and listen to the music of the band and the cheers of the crowds.

In the Professional Set Builder's Shop

(*Continued from page 143*)

dial light will operate automatically as the receiver is turned "on" and "off."

Special Purpose Valves

There have been some inquiries as to whether the special Zetka valves specified in the descriptive article offer sufficient advantage to warrant their use. This question can best be answered by the statement that the use of the type ZRF high-frequency amplifier valves and the Zetka ZD (the new type number for the Zetka 200-a valves) detector valve provide an increase of 30 per cent in the overall high-frequency amplification over that obtained with valves of the 201-a type when used in this receiver.

Valves of the 112-a type may be used in the three high-frequency stages if desired, but their use is not recommended because of their high plate-current consumption when used without a higher "C" bias.

To Operate Without an Antenna

Under most conditions it is possible to operate the LC-28 receiver without an antenna of any sort. This is accomplished by disconnecting the ground from the "ground" tip jack at the rear of the chassis and connecting it to the "antenna" tip jack. When this is done the electric light lines which supply the alternating current to the power-pack and the water pipe or whatever medium is used for the ground form what practically amounts to a large loop circuit, because of the fact that both are grounded at their far ends. This plan will work only when a power-pack is employed; otherwise there will be no connection to the light lines. In battery-operated receivers approximately the same results may be obtained by connecting the ground as usual and employing a light-socket antenna for the antenna.

Naturally the effectiveness of these types of antennas varies according to several factors over which the receiver owner has no control, such as the length of the lighting lines from the receiver to the point where they are grounded and the length of the water pipe above ground. There seems to be little way of determining in advance how this system will work in any particular location. In private houses where there is a long stretch of line outside this antenna system seems to be very effective and also on the upper floors of apartment houses. In some cases reception is better than with a good outdoor antenna, while in others it is comparable with only a short outdoor antenna. If the "pick-up" with this system is great, it may be well to experiment with different sizes of series fixed condensers in the ground lead. A capacity of .00025 mfd. may be

suitable, while in other cases the required capacity may run as low as .0001 mfd.

Adjusting Condensers for Maximum Sensitivity and Selectivity

In order to make sure that the three grouped tuning condensers are exactly in step, it is advisable to loosen their set screws and then adjust each one separately to a given station, after which they may again be tightened on the shaft and will require no further attention.

The best method for doing this is to first adjust the three condensers so that their plates are entirely meshed at a dial setting of 100. Then tighten them on the shaft and tune in some high wavelength station. The rotors of condenser J3 and J4 should then be loosened by turning the two set screws which make each fast to the long shaft.

Starting with condenser J1, which is the first one to the right of the drum dial, grasp the tips of its rotor plates with the fingers and thus tune it to the point of maximum signal strength.

Now adjust the drum dials for maximum signal volume from the station. The right-hand dial will tune only the condenser J2, inasmuch as the other two condenser rotors are no longer attached to the shaft. Now, leaving the drum dials strictly alone, tune each of the remaining condensers individually by grasping the tips of their rotor plates with the fingers and moving them slowly until the best setting of each is found, as judged by the strength of the signal from the station. Finally tighten the set screws again and the job is completed.

With this done, the adjustment will hold good for other wavelengths and the result of the three circuits being in exact resonance will provide a surprising degree of sharpness in tuning and added sensitivity. It is a good plan at this point to firmly tighten the screws which attach the condensers to the chassis.

Synchronizing the Dial Settings

The reason for not controlling all four tuned circuits with a single dial is that the value of the antenna has some effect on the settings of the tuning condenser of the first circuit. It naturally follows that when the first circuit is tuned by a separate condenser the dial settings will in some cases not agree exactly with the setting of the dial which controls the grouped condensers. The difference between the dial settings will remain practically the same throughout almost the entire range of the dials, however.

In view of these facts, it will be found convenient to loosen the set screws of the antenna tuning condenser, J1, and with a station tuned in set its control dial to agree with the setting of the other dial. Then tighten the set screws again and thereafter the two dials will tune alike as long as the same antenna is used.

ADJUSTING THE CONDENSERS

By a proper adjustment of the variable condenser of the LC-28, the tuning may be sharpened to a great degree, and the two dials may be made to read the same for any station tuned in.

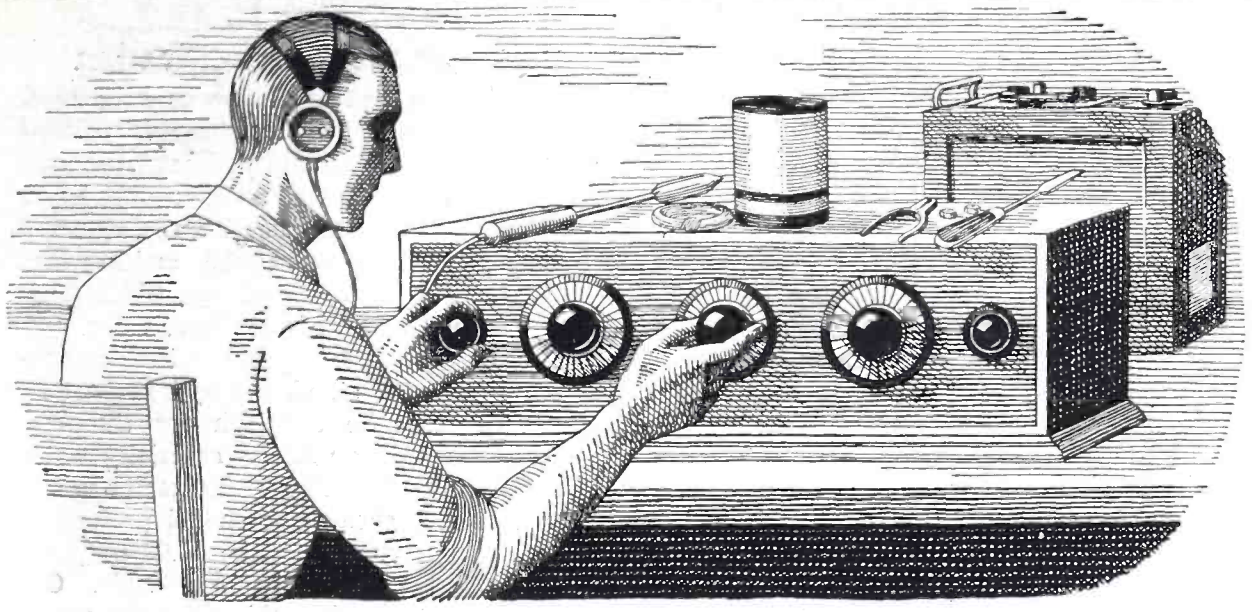
Tighten All Mounting Screws

Before putting the receiver into permanent use, all of the mounting screws should be gone over with a screw driver. This applies particularly to the screws at the top and bottom of the shield corner posts. This will insure against the screws working loose at some later date and also will provide the maximum effectiveness of the shielding.

High-Frequency Plate Voltage Not Critical

The voltage for the "B" supply for the three high-frequency valves was specified in the descriptive article as 90 volts. The use of 67½ volts or thereabouts will provide practically the same results. It is worth while to experiment a little with this, as there is nothing gained by using higher voltages here than the lowest that will provide maximum results. The current drain for the high-frequency valves is reduced 50 per cent when the plate voltage is reduced from 90 to 67½ volts. Where batteries are used for the "B" voltages, and even with some power-packs, this saving of current is worth while, particularly as it means that in the case of most power-packs the saving of current at the 90-volt tap results in somewhat higher voltage being available for the operation of the power valve.

POPULAR RADIO will welcome pointers from other builders of the LC-28.



If all the Radio sets I've "fooled" with in my time were piled on top of each other, they'd reach about halfway to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything —that was all I could see in it for me.

I Thought Radio Was a Plaything

But Now My Eyes Are Opened, And I'm Making Over $100 a Week!

$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages, just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job—while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making $100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not because I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

When broadcasting first became the rage, several years ago, I first began my dabbing with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination—something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away! Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler —I thought Radio was a plaything. I never realized what an enormous, fast-growing industry Radio had come to be—employing thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I'd seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over $100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest-growing businesses in the world today. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation —the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President National Radio Institute, Dept. 2K, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. 2K, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

Name .....

Address .....

Town ..... *State* .....

Improving Resistance-Coupled Amplification

THERE are two places where the usual resistance-coupled amplifier is susceptible of improvement, namely, the first plate-coupling resistance, which is in circuit with the plate of the detector valve in the usual circuit, and the last grid resistance or grid-leak, which is in the grid circuit of the power valve.

The usual .1 megohm resistor recommended for all plate-coupling resistors will often be too high for the first plate-coupling resistor, especially when using the UX-200-a type detector valve. The resistance valve should preferably be much lower, say about .02 megohm if less than 180 volts is available. Or, in order to adjust this value for maximum efficiency, a variable high resistance may be used in place of the fixed resistor.

In the grid circuit of the power valve the usual ¼-megohm value recommended is also much too high, except in the case of the lower rating power valves, or those of the UX-112 or smaller types. For the UX-112 and especially for the UX-171 and UX-210 types, the value should be from 25,000 to 100,000 ohms, and this value is best determined by using a reliable variable high-resistance unit, which is capable of handling the heavy current without resistance change or noise. Otherwise, in the balance of the resistance-coupled amplifier, the usual fixed resistors can be used, although it is well to try different values for best results.

—CHARLES GOLENPAUL

Socket Antenna Becoming Increasingly Popular

DUE to the vastly augmented power of broadcasting stations, the replacement of the regenerative circuit by the tuned-high-frequency amplifier, and the greatly increased amplification of the average receiver of to-day, the socket antenna is now coming into favor, especially in congested areas.

In principle, the socket antenna is a coupling device that permits radio signals, induced in the electric light line, to pass through a special plug and into the receiving set, while the lighting current itself is held back by a condenser barrier.

With former regenerative circuits this device did not always perform satisfactorily. To-day, however, with the non-regenerative receivers, or at least receivers in which regeneration is merely an accessory rather than the main means of gaining sensitivity and volume, this device performs surprisingly well. In the suburbs and rural sections it will often out-perform the usual antenna, because of the ideal antenna in the form of exposed electric light wires which it makes available.

—HARRY HOUCK

Hints on Volume Control

THE cardinal principle in controlling volume is to begin as soon as possible in the receiving process. In other words, the nearer the antenna end that the control is put into effect the better the results and the simpler the control; and, conversely, the nearer the reproducer end, the more energy must be handled by the variable resistance.

The simplest volume control is a variable high resistance in the antenna lead, which serves to cut down the signal energy, and is of real value, especially in the reception of powerful local stations. Sometimes the variable high resistance may be shunted across the antenna and ground binding posts of the set. At any rate, with a suitable variable resistor, such as the standard type Clarostat or the Clarostat volume control, a simple volume control is obtained for any receiver. The resistance range must be from practically zero to several million ohms.

Now if we do not control the energy at the entrance to the radio set, the next best expedient is to control it as soon as possible in the high-frequency stages. Here the best practice is to place the variable resistor in the 90-volt "B" positive (+) lead, so as to control the plate current of the high-frequency vacuum valves and therefore the energy passed on to the detector valve. The resistance must be of the order of practically zero to approximately 500,000 ohms.

With a volume control in the plate circuit of the high-frequency valves, it becomes possible to employ coils which will normally oscillate with 90 volts on the plates of the vacuum valves, with whatever stabilizing method may be used. Then, with a variable plate voltage, the receiver can be worked at top efficiency, right on the verge of oscillation, as well as brought down to a low efficiency in reducing volume without distortion. We have, therefore, a sensitivity as well as volume control.

If the set is of the regenerative variety, the regenerative action is the obvious thing to control, and this may be readily done without having to fuss with the critical tuning means, which can be left fixed at the desired point of maximum efficiency. The volume control may consist in this case of a variable resistor shunted across the terminals of the tickler or feed-back coil. Needless to say, the non-inductive type of resistor should be used. If desired, the set may be tuned with the variable resistor serving to by-pass more or less of the feed-back energy in getting down below the oscillating point with precision. This is a popular method of controlling regeneration, and likewise volume, especially in critical short-wave receivers.

—CHARLES GOLENPAUL

What's New in Radio

(*Continued from page 146*)

control adjustment. There are no auxiliary tuning knobs or levers and there are absolutely no other adjustments to be made.

At the top of the escutcheon plate is a window behind which the calibrated scale moves, showing the exact wavelength to which the receiver is tuned. A small incandescent lamp is mounted within the receiver in such a position that it illuminates the wavelength scale, which is of translucent material, thus making the wavelength settings easily readable, even in a darkened room.

The cabinet in which the receiver is mounted is of two-toned walnut, carefully blended to present a pleasing and dignified appearance. The front panel is of the same material as the rest of the cabinet and in its center bears the bronze escutcheon plate already mentioned. Flanking this plate on either side are two inset panels of darker-toned walnut, which successfully lend variety to the otherwise plain surface of the panel. The table-mounting cabinet shown above has overall dimensions of 19 inches by 10 inches by 8½ inches.

The circuit employed is the Technadyne circuit. This is a circuit which lends itself unusually well to compact construction, which explains how it is possible to make a 7-valve receiver with the dimensions given above. The receiver proper is shielded and the selectivity is unusual, partly as a result of this shielding and partly due to certain inherent characteristics of the circuit itself.

One of the unique features of the receiver is the fact that the volume control is neither a rheostat nor is it a variable high resistance. Instead it is a variable coupling arrangement which provides a smooth regulation of volume from inaudibility to maximum volume. This arrangement permits the use of any type of antenna and also makes for high efficiency on a short antenna.

As is usual with a receiver employing seven valves, this one is recommended for use with a suitable "B" power-pack or with "B" batteries of the heavy-duty type.

Outstanding features: Small size. Neat appearance. Highly selective. Smooth control of volume. Extremely simple to operate.

Maker: Homer Products, Inc.

A Light-Socket "A" and "B" Power-Pack

Name of instrument: Balkite model AB-135 power unit.

Description: This device is designed to supply both the "A" and "B" operating voltages for standard receivers which require not more than 2 amperes at 6 volts for the filament supply and not more than 40 milliamperes at 135 volts for the plate supply.

The "A" power portion of the unit consists of an electrolytic filter system and employs no batteries whatsoever. It does employ an alkaline solution in the filter which leads some fans to believe that it employs a storage battery-trickle charger combination. Such is not the case, however, as is proven by the fact that the unit furnishes no current when turned "off." The unit also draws no current from the AC lighting lines when turned "off."

The "B" power portion employs an electrolytic rectifier with suitable filter. It will supply four different output voltages, namely, 22½, 67½, 90 or 135 volts, or by a simple adjustment the 22½-volt tap may be made to provide 45 volts if desired.

The entire combination is inclosed in a ventilated metal container with a removable cover. Once it has been put into operation, the cover may be placed in position and not removed, except for an occasional inspection of the water level in the "A" and "B" portion of the unit. Additional water is required two or three times a year; this is the only attention required by the device. It is equipped with an extension cord and plug and also a toggle switch, by means of which the power is turned "on" and "off." This switch operates both the power-pack and the receiver. The switch on the receiver with which the device is to be used is therefore left "on" at all times.

Outstanding features: Compact. Obtainable in various types, for use on 110-volt, 60-cycle lighting lines, or on 220-volt, 60-cycle lighting lines, or 110-volt, 25-cycle lighting lines. Completely inclosed. Fool-proof. Employs no batteries.

Maker: Fansteel Products Co., Inc.

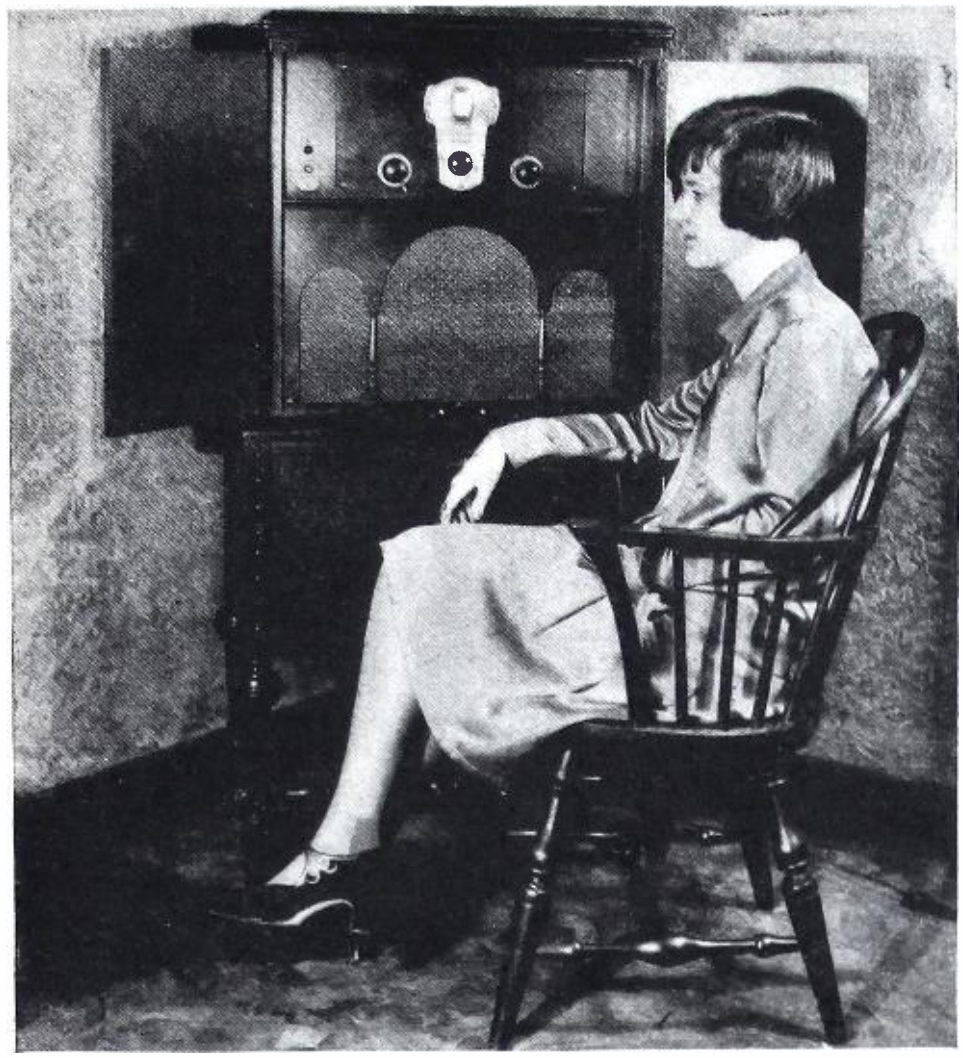
A Reproducer Unit for the New Exponential Horns

Name of instrument: Double-action reproducer unit.

Description: This new unit is especially designed to reproduce all tone frequencies in proper proportion to provide a natural reproduction of music and speech. It has a double-action mechanism and is completely inclosed to protect it from injury. In order not to interfere with reproduction of the higher frequencies, the case of the instrument is open at the back, but is protected with screening. It is equipped with an 8-foot extension cord.

Outstanding features: Especially designed for use with the larger exponential-type horn reproducers. Good quality of reproduction. Handles large volume without rattling.

Maker: Temple, Inc.



A Receiver That Features Tremendous Volume with Superlative Quality of Reproduction

Name of instrument: Kolster model 6-H receiver, with Kolster model "A" power cone reproducer unit.

Description: The accompanying picture will convey a good idea of the appearance of this combination receiver and power amplifier, although no illustration can really do justice to the soft beauty of finish and the refinements of the cabinet maker's art incorporated in this receiver.

The receiver proper consists of three stages of tuned-high-frequency amplification, a detector and two stages of low-frequency in which are employed transformers of special design. The high-frequency amplifier circuit is one for which the Kolster receivers are justly famous wherever radio is known. It combines extreme sensitivity with the maximum permissible selectivity and yet is simple to operate and tune. The wavelength tuning is accomplished by means of a single knob which is mounted on the bronze plate in the center of the front panel of the receiver. To the right of this is another knob which provides a highly flexible control of volume. At the left is a third knob, which serves as a sensitivity control. This control is particularly useful when tuning for distant stations, as it permits exact tuning of the antenna circuit. This and a small lever set just beneath this knob provide the means for adapting the receiver to any antenna, thus permitting full efficiency, which could otherwise not be obtained when using a single control knob to tune all circuits simultaneously.

The output of the receiver proper provides the input for the power cone, which is mounted in the compartment immediately below the receiver compartment. The power cone unit consists of a special cone reproducer mounted on a chassis, which also mounts a complete high voltage power-pack that provides all "B" and "C" voltages not only for the receiver, but for the single stage of power amplification contained in the power cone unit. This stage of power amplification employs a 210 type power valve and, together with the low-frequency amplifier in the receiver, provides a wealth of undistorted volume with great fidelity.

The power-pack employs two rectifier valves of the 216-b or 281 types in a full wave rectifier circuit. This not only provides an abundance of power, but tends to eliminate all traces of hum. A voltage regulator valve is also incorporated in the power-pack to maintain constant voltages.

The receiver is turned "on" and "off" by the volume control knob, which really operates a combination volume control and battery switch. The AC supply to the power cone, from the house lighting lines, is controlled by a switch mounted on a panel at one end of the receiver proper. This push-pull type power switch is surmounted by a colored window, behind which a pilot light is mounted.

The filament supply current for the receiver is obtained from a combination storage battery and trickle charger or an "A" power-pack; this represents the only part of the equipment not included with the receiver. A compartment is provided for the "A" supply unit that may be selected. This compartment is in the cabinet below the one provided for the power cone.

The compartment at the top, in which the receiver proper is mounted, opens from the top to permit easy access for the installation of valves and for the connection of the ground and antenna leads to the binding

posts provided at one end of the receiver chassis.

Not the least notable feature of this receiver is the special "floating" mounting provided for the power cone. The entire power cone chassis, including the power-pack, is suspended on rubber cushions. This eliminates any tendency toward microphonic howling which might otherwise be encountered where a powerful reproducer such as this one is mounted in the same console with the receiver. The detector and first low-frequency valves are also cushion mounted for this same purpose.

Outstanding features: Fine tone quality and a happy combination of extreme sensitivity with correspondingly great selectivity. Single control tuning. Full control of volume. Special sensitivity control for long distance reception. Unusual volume, without distortion, obtained through the use of the power cone with a stage of power amplification.

Maker: Federal-Brandes, Inc.

A Filter Condenser That Is Easy to Mount

Name of instrument: Filter condenser.

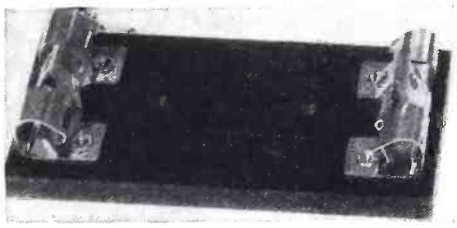
Description: Pure linen paper, a high grade of tin foil and special impregnation wax are the materials that go into this condenser. After the alternate layers of paper and tin foil are rolled into final form the moisture is carefully removed and the condenser is impregnated with wax. The assembly is then given a coating of moisture-proof wax pitch as a double protection against the absorption of moisture. The condenser is sealed in a metal can. The terminals of the condenser are flexible leads which are brought out through an insulating strip near the bottom of the can. The bottom of the can extends out a short distance on either side to provide mounting holes. This type of condenser is obtainable for different working voltages from 200 to 1000 DC, and in capacities from .1 mfd. to 10 mfd.

Usage: Wherever high-capacity condensers are required in high-voltage circuits, particularly for the filter in "B" power-packs.

Outstanding features: Carefully made of

good materials. Accurately rated as to capacity and conservatively rated as to voltages allowable. Well protected against the effects of moisture by a special wax impregnation.

Maker: Aerovox Wireless Corp.



Automatic Filament Supply for Old Receivers

Name of instrument: Amperite adapter system.

Description: The adapter consists of a composition base with accommodations for mounting two amperites in parallel, with two spring terminals for the wire connections. It is for use in conjunction with an old receiver which employs hand-operated rheostats to control the valve filament supply. With this adapter connected between the "A" battery and the receiver, the rheostats in the receiver may be turned up all the way and will require no further attention, as the amperites, when used in the proper combination, will provide just the right voltages for all valves. This system is not for use where one of the rheostats serves as a volume control, because it is imperative that all rheostats in the receiver be turned up full for proper operation. By choosing the correct amperites for use with these adapters, valves may be grouped in series, with one adapter to control their filament current. However, best results are obtained using one adapter for each valve in the circuit.

Outstanding features: Provides automatic filament control for receivers which are not so equipped. Prevents overloading of valve filaments, thus prolonging the life of the valves.

Maker: Radiall Company.

A "B" Power-Pack with Adjustable Plate Voltages

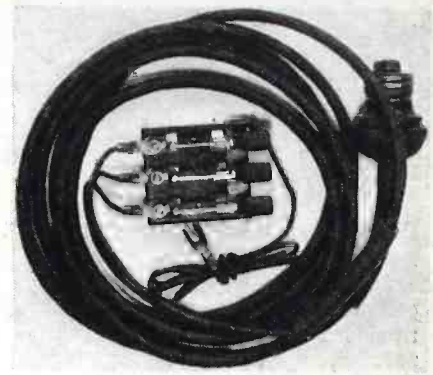
Name of instrument: Duo-Power model 28-A "B" power-pack.

Description: This is a power-pack that offers a number of good features. It provides six output voltages, from 22 to 180 volts, and is equipped with a rheostat in the input circuit to the power transformer, which permits the unit to be adjusted to supply maximum output voltages of either 135 or 180 volts. Thus the high-voltage output may be regulated to accommodate the power valve used in the receiver, and the five intermediate voltages are obtainable for the detector, high-frequency and first low-frequency valves. The unit employs a QRS gaseous rectifier valve and is

completely inclosed within a ventilated metal case. It is provided with an extension cord and plug to make connection with the 110-volt, 60-cycle lighting lines.

Outstanding features: Adjustable to the proper "B" voltages required by any receiver. Compact.

Maker: R. C. E. Sales Co.



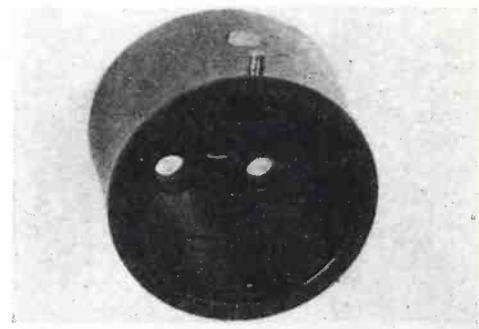
A Novel Socket Antenna

Name of instrument: "Sock-Antenna."

Description: This device consists of a multi-wire cable which terminates at one end in a standard plug for insertion in the light socket, and at the other end in a group of three single-pole, single-throw switches. The output sides of the three switches are connected together and a wire is provided for connection from this point to the receiver. The purpose of the device is to permit the use of the electric light supply lines for an antenna. This is accomplished through capacity coupling within the cable and the coupling is varied to fit the individual requirements of any receiver or any location by closing one, two or three of the switches.

Outstanding features: Permits the use of the light socket for an antenna. Entirely safe. Effectiveness of this antenna may be varied by means of the three switches.

Maker: Tidmarsh's Radio Supply.



A Handy Valve Adapter

Name of instrument: Valve adapter.

Description: This adapter consists of a composition cup with four holes in the bottom to accommodate the prongs of a UX-199 type valve. There is a set screw in the adapter by means of which it is firmly clamped on to the base of the valve. It is also equipped with a pin on the side to correspond with those on UX-201-a type valves. Thus, when this adapter has been placed over the base of a UX-199 valve such a valve may be used in any of the old sockets.

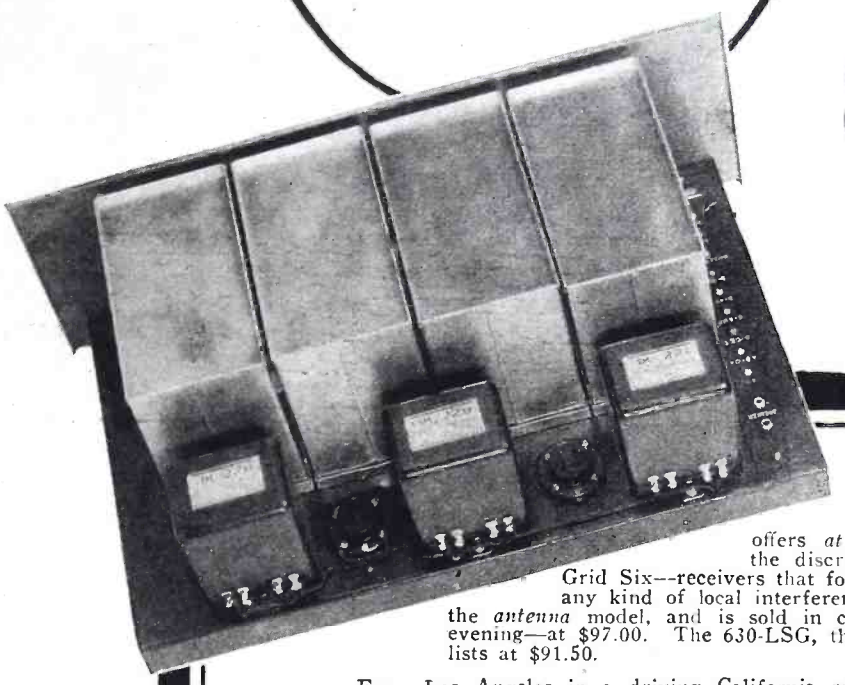
Usage: Where it is desired to use UX-199 or UX-120 valves in a receiver that is equipped with the old standard 5-volt valve sockets.

Outstanding features: Well made. Simple.

Maker: Herbert H. Frost, Inc.

SM *New!*

Shielded Grid Six



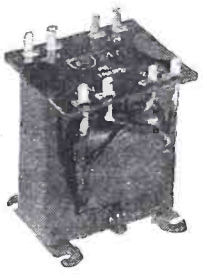
Do you realize that for less than $100 for parts you can now build yourself a receiver that will out-perform anything the market offers *at any price?* Silver-Marshall now offers to the discriminating buyer two models of the Shielded Grid Six—receivers that for distance, tone and an ability to break through any kind of local interference have never been equalled. The 630-SG is the *antenna* model, and is sold in complete kit form—ready to be wired in one evening—at $97.00. The 630-LSG, the popular and generally preferred *loop model* lists at $91.50.

From Los Angeles in a driving California rainstorm—with terrific static and interference from power lines, the Shielded Grid Six brought in 2BL, Sydney, Australia, on the loud speaker. From Kansas City, *without an antenna of any kind*, the Shielded Six brought in stations from both the east and west coasts. Where can performance like this be equalled and at such a low price!

The Shielded Grid Sixes are easy to tune—they are receivers for the whole family—nothing "tricky" anywhere. Turning the two dials will bring in a new station on practically every dial degree—no repeats anywhere—and with powerful locals never spreading over from 2 to 4 dial degrees. Stations one, two and three thousand miles away will literally pour in—and with an ease that is amazing.

And remember—S-M unconditionally guarantees that you'll get more genuine satisfaction out of the Shielded Grid Six than out of any other set you can build or buy—whether you're a DX hound or a lover of fine tone.

All Your "A" Power for $5.00!

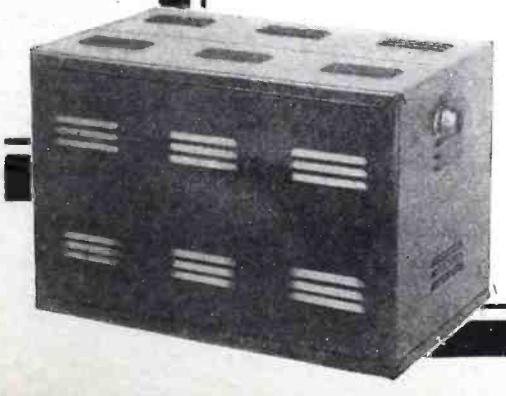


That's the story—no matter what your set, you can drop your "A" batteries and charger today and completely replace it with an S-M 247 filament transformer, listing at $5.00. This transformer supplies all "A" power *to your present set* by using a Naald, Eby, or Carter, A. C. tube harness, which enables you to insert A. C. tubes in your present battery set *without a single change to the set.* Then the 247 transformer supplies all "A" power for any 5, 6 or 7 tube set for years to come—no run down batteries, no hum, just positive, sure operation, costing less than half a cent an hour! The S-M 247 filament transformer supplies 5 volts for one to three 112-A or 171-A power tubes, 1.5 volts for one to five 226 A. C. amplifiers and 2.25 volts for one or two 227 A. C. detector tubes. You can use it with any combination of A. C. tube harnesses or adapters or A. C. tube equipped set. It's the biggest "A" power value you ever saw!

S-M Unipacs—Socket Powered Amplifiers

Two new Unipacs are now ready for those who demand the finest in tone quality. Each model contains the famous push-pull 210 amplifier stage, as well as its own A, B and C power plant operating from any 110-volt, 60-cycle lamp socket.

Model 681-210 is a single stage push-pull amplifier using two UX-210 power tubes with an undistorted power output of over 5,000 milliwatts—up to several hundred times clearer than that of ordinary receivers. It can be used to boost volume, with any set equipped with at least one stage of audio amplification, eliminates B batteries and gives finer quality than you can get from any other power amplifier or receiver on the market. Uses one or two 281 rectifier tubes and a UX-874 voltage regulator to hold B voltages absolutely constant. Price 681-210 KIT $83.25, or 681-210 WIRED Unipac ready to use $93.25. Model 682-210 is a complete two-stage amplifier for phonograph or radio, same as the 681-210 plus a first stage using a UX-226 tube and the S-M 220 transformer. Type 682-210 will furnish A, B and C power to an A. C. tube equipped set, as well as complete audio amplification of the finest imaginable quality. Price 682-210 KIT $97.75, or 682-210 WIRED Unipac. $107.75. Both models suitable for new UX-250 tubes as explained in Unipac Instruction Sheets.



Silver-Marshall

Incorporated

844 West Jackson Blvd., Chicago, Ill.

SILVER-MARSHALL, Inc.
844 West Jackson Blvd., Chicago

I enclose 10c for which please send me full information on quality audio amplification, power supply equipments, Unipacs, the new Shielded Grid Sixes and Universal All Wave Tuners.

☐ I enclose 25c for complete instructions and blueprints for the Shielded Grid Sixes.

☐ I enclose 25c for instructions and blueprints for building the All Wave Tuners.

Name.....

Address.....

The BEGINNER IN RADIO

CONDUCTED BY ARMSTRONG PERRY

How to Learn the International Morse Code in Half an Hour

SCOUT Executive C. B. Stanford of Lancaster, Pennsylvania, has pictured the International Morse Code so that it sticks in the memory as easily as it used to escape. His picturization of the code is shown below.

This is the code that is used for sending radio messages. It is employed also in signaling with flags, whistles, bugles, buzzers, lights, heliographs and other apparatus.

No one can secure a license for operating an amateur or professional radio transmitter until he is able to send and receive this code at the rate of at least ten words per minute, so it is well to acquire a working knowledge of the code.

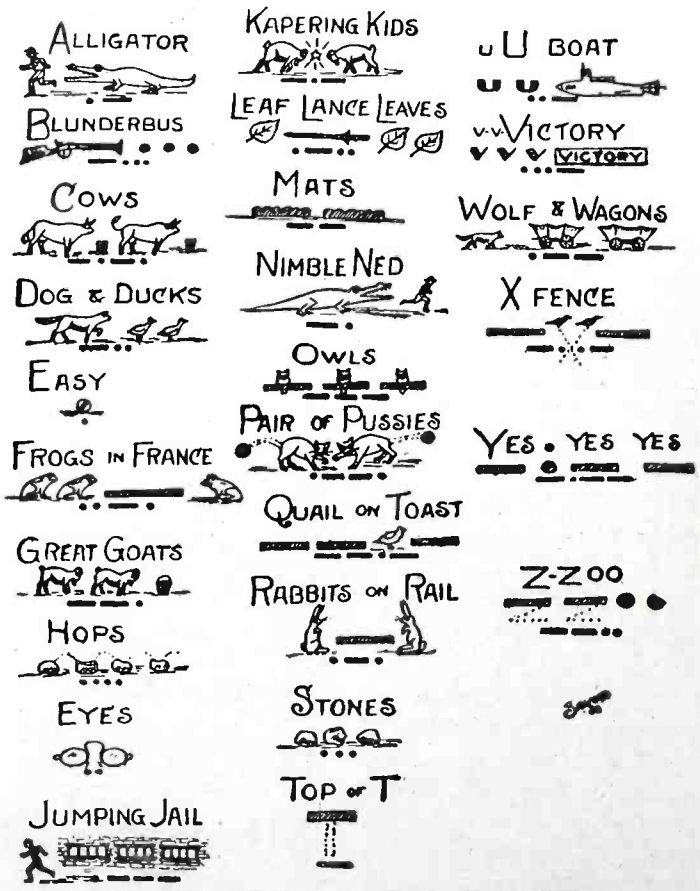
Mr. Sanford has taught the code to hundreds at a time by broadcasting a description of the pictures and asking the listeners to draw them. Half an hour usually is sufficient for learning it.

Copies of the code for distribution to troops of Scouts and other groups may be secured at cost by writing to Delaware and Montgomery Counties Boy Scouts of America, Philadelphia, Penn.

* *

The Realm of the Short-Wave Receiver

THE beginner in radio may as well begin in the field that promises the best results. Just now that seems to be short waves, under 100 meters.



A PICTURED KEY TO THE CODE

By remembering these comic pictures which the letters of the alphabet suggest, it is quite easy to learn the code in short order. If these pictures don't help you, make up a set of your own.

The broadcasting wavelengths are hopelessly crowded. The wavelengths from 600 meters up are used for commercial and government traffic; in that region the necessary separation is so great that it would be futile to move up the broadcasting band even if America had all of it instead of being under obligation to share it with other nations. Only a few stations could be accommodated in the higher wavebands. There is nowhere for broadcasting to go but down—or out!

At the beginning of the broadcasting era the amateurs were among the few men available to operate stations and design and build apparatus. Amateurs develop rapidly because they are free to experiment, while professional radio men are tied down to the details of their regular jobs. If the broadcasting stations enter the shorter wavebands, where there is room for thousands, the amateurs again will be in a position to fill some very good jobs. A few already have had experience in short-wave transmission and reception.

There are good short-wave receivers on the market. These will pick up a number of broadcasting stations that are experimenting with short waves; also they will bring in no end of amateur code traffic. A short-wave receiver can be built without great expense. Fifty dollars will cover the cost, because the number of parts must be reduced to the minimum, and there seldom is more than one stage of audio-frequency amplification. Such receivers cover tremendous distances. American amateurs maintain two-way communication with Australia—direct, not through relays.

It is worth while to read up on short waves, build or buy a receiver, plan for a transmitter and get into the amateur game.

* *

Adventures of Radio Operators

THRILLING tales of achievement and adventure could be told by John B. Duffy, superintendent of the Eastern Marine Division of the Radio Corporation of America. Every day he sends a dozen young operators off on voyages to distant ports. Some never return, and Mr. Duffy has to break sad news of shipwreck and death to parents and sweethearts. But usually the operators come back full of yarns to spin.

Mr. Duffy took up radio in its early days. From operators' jobs on tankers and passenger ships he rose to a chief's position at a coastal station of the R. C. A. Someone was needed for an important mission to South America, involving a large sum of money. Duffy was chosen. He succeeded, and now he is a superintendent.

Edward Adler joined the navy at fif-

teen. After six months' training, he visited Turkey, Italy, France, Russia, the Balkans and every important port in the West Indies as radio operator on *U. S. S. Arizona.* He was transferred to the Naval Communication Service, in Washington, where the men with whom he worked were experts. He decided to make his sign, AC, stand for Ability. A year of hard work and study made him as good as any of them.

One evening in Yokohama harbor, Japan, he was on watch in the radio cabin of *U. S. S. Huron.* The crew were seeing movies on deck. Suddenly there came a terrific crash. The city quivered, the houses fell and flames shot heavenward. An earthquake had passed, leaving the city in ruins. The *Huron* was the flagship of the Pacific fleet. She had the only high-powered radio apparatus available in the whole region. Adler transmitted the admiral's orders to establish relays of American destroyers to handle the calls for help, and had the pleasure of seeing the relief ships come into port in response to his messages, with food, medicine and other supplies that saved many lives.

In 1926, while serving as an operator for the R. C. A., he won the world's speed championship by receiving fifty-eight words per minute by ear.

E. N. Pickerill once operated the highest telegraph station in the world, on Pike's Peak. He has been an operator on many ships, at a transoceanic station in Honolulu, and on many airplanes. He earned the first "extra first-grade" operator's license ever issued.

When the *Leviathan,* the world's largest and finest ship, went into commission under the Stars and Stripes, "Pick" won his berth on her in the hardest examination ever given to a host of applicants for an operator's job. He has crossed the ocean in her a hundred times and his souvenirs include autographed photographs and other gifts from scores of her famous passengers.

* *

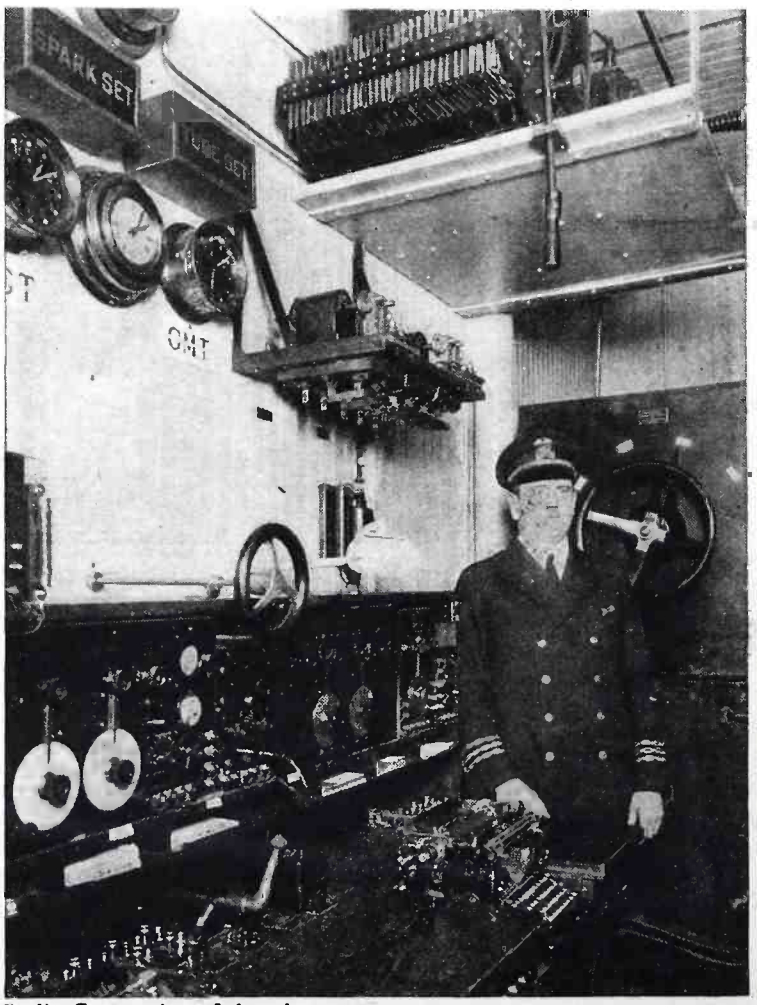
A Radio Amateur Advertises His City

AMATEUR 1-AMU, whose name was Franklin B. Rowell before he became wedded to radio and exchanged his name for call letters, saved a printing bill and helped his city by making the Chamber of Commerce in Pawtucket, Rhode Island, this offer:

If the Chamber would supply him with "QSL" cards, they could print on them the city's slogan, a picture of some historic building, and a credit line.

The Chamber accepted the offer. The card reads:

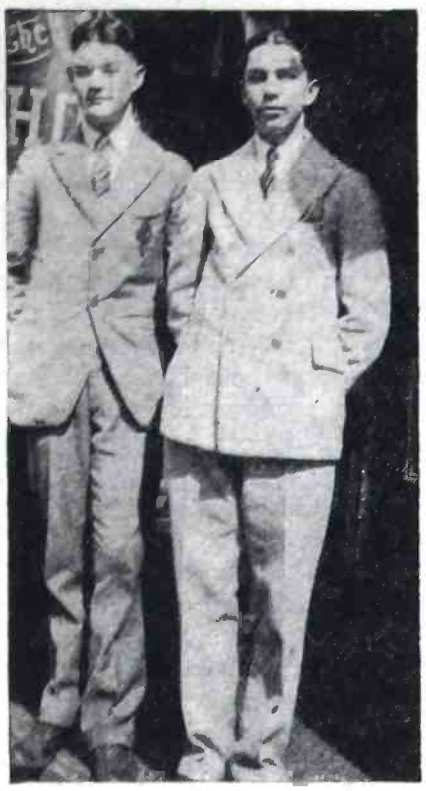
"Pawtucket, Rhode Island. The Birthplace of the Cotton Industry.
1-AMU
Courtesy of Pawtucket Chamber of Commerce
Radio..... I was vy gld to wrk U on.....at .....E.S.T. U were R.....hr. with a..... QSB on the.....meter band. Receiver Reinartz one step. Transmitter Hartley Crkt.....Watts Input. Hertz Ant. Remarks.....



Radio Corporation of America

THE MOST COVETED OF RADIO OPERATORS' JOBS

Here is E. N. Pickerell in the radio room of the LEVIATHAN*—the best equipped radio room on any American vessel. He was placed in charge after passing the hardest radio examination ever given in this country.*



TWO CHAMPIONS IN THE AMATEUR WORLD

Franklin B. Rowell, at the right, devised the unique scheme of getting the Chamber of Commerce of his home town to pay for his QSL cards in return for free advertisement. He also sent an amateur radiogram to the Philippines and located a missionary from China whose American friends were worried about. At the left is W. R. Pierce, who reports that he has logged 625 broadcasting stations in 38 countries with a 2-valve receiver and that he has cards and letters to prove it.

A.R.R.L. O.R.S. O.B.S. R.C.C. DX World Wide. Please QSL. Tnx vy. Army Amateur Station. CUL. Best 73 OM."

For the benefit of the uninitiated, let us translate the radio lingo:

"I was very glad to exchange messages with you on.....at.....Eastern Standard Time. You were received here with a (fine, mushy, or what have you) tone on the.....meter band. Transmitter here has a Hartley circuit with a power input of.....watts. Hertz antenna. I am a member of the American Radio Relay League and operate an official relay station and official broadcast station. My long-distance messages cover the earth. Please reply. Thanks, very. My station is an official station in the Army-Amateur Net. See you later. Best regards, Old Man."

"OM," the classic appellation of telegraphers, radio men and amateurs, does not apply to all, however. The girls are "YL's," not "OM's."

Rowell's claim to world-wide range is no idle boast. He advertises in the papers that he will send messages by amateur radio to any part of the world free of charge. Recently he sent a message to the Philippines for a woman whose friend, a missionary, had escaped from China to the Philippines. The missionary was located and an answer returned via amateur radio in ten days.

Rowell uses his "QSL" cards to report to amateur stations throughout the world that he has heard them.

IF you feel inclined to doubt that the universe is in the hands of an all-wise creator, remember that the good radio weather starts about the time when the big college football games are broadcast.

Now You Can Be a "Looker-In"!

(*Continued from page 124*)

gas, neon, from Sir William Ramsay, to make a few of his lamps. Today neon can be produced in considerable quantity, and the neon lamp has become an article of commerce. This lamp is particularly sensitive to minute changes in current, and the light it gives fluctuates between comparatively wide ranges, if it is properly connected to a source of modulated current such as that which flows through it in the television receiver.

The photo-electric cells used in the present television transmitter are very large and exceptionally sensitive. This high sensitivity obviates the necessity of using exceptionally powerful beams of light for the scanning process. This has the advantage of subjecting the person to be broadcast to no undue discomfort or eye strain. As a matter of fact, these cells are so very sensitive that they are paralyzed if a match is struck closely to them. During the experiments at Schenectady, the person demonstrating the sensitiveness of the device to cigarette smoke had to take care not to light his cigarette within the range of the sensitive cells.

While it was stated at the beginning of this article that television was ready to receive the attention of broadcast fans, it must be understood that television is today in the same state of development that broadcast reception was six years ago. Television is really in the "earphone" period of development. This must not be taken to mean, however, that it is extremely crude; for it is not. Likenesses are immediately recognized and the photographic fidelity of the reproduction is simply amazing. Even the wink of an eye can immediately be discerned, and no movement by the person being broadcast can be too quick to escape the sensitive electric eyes that are being trained upon the object.

As a result of the announcement of this television device, newspaper writers have already indulged in the possibilities of receiving picture impressions of football games, prize fights, and the like. While there is no doubt that this development will eventually come about, the present equipment is not suited for this purpose. The objects that are to be transmitted must be scanned and explored with a rapidly moving beam of light, and the process must be carried out in a comparatively darkened room. If the objects to be broadcast were brilliantly illuminated with light of the same intensity as that being interrupted by the scanning disc, the photo-electric cells would receive a jumble of impressions, and it would be impossible to reproduce the likeness of the object at the receiver.

The receiver must, likewise, be used in a darkened room, since too much light has the same effect as it has today in the moving picture theater; the picture is dimmed, and if the light source is strong enough it will entirely fade from vision. The receiver is so arranged that the picture is reproduced in a chamber which is more or less guarded from the effects of an outside light source.

What will the effect of static be on the television receiver? Theoretically, a heavy discharge of static ought to increase the current flowing through the neon lamp, and this, in turn, should cause it for an instant to glow more brilliantly. Consequently, a heavy discharge of static should make its presence known by the appearance on the picture of an extra bright glow from the neon lamp.

An interesting example of television interference was witnessed during the demonstration at Schenectady, at which a dial telephone was employed in the same room. Dialing a number is always responsible for a certain amount of radio interference on broadcast receivers, and the engineers present watched carefully to see if the same effect was noticeable in the picture reception. It was. As the number was dialed, bright streaks swung across the picture at various spots. Perhaps the radio fan of tomorrow will come into the office in the morning, and instead of saying that static played havoc with the overture of "The Merry Wives of Windsor," he will lament the fact that it destroyed Al Jolson's face or Mary Garden's left ear.

Another unusual phenomenon observed at the demonstration in Schenectady was the presence of fine, hairlike black lines, spaced at regular intervals across the reproduced picture at the receiver. These imperfections were due to improper arrangement of the holes on the scanning disc at the transmitter. As a matter of fact, the arrangement of these holes is still one of the problems of television. It is evident that they cannot be arranged so that the beams will overlap. They must be exactly spaced to the hundred thousandth of an inch, or the reproduced image will suffer from distortion.

Within the next year, no doubt, broadcast fans throughout the United States will be building for themselves television receiving equipment. All of the devices used in reception are available and no great skill is necessary for the construction or the manipulation of the receiver. From time to time POPULAR RADIO will make known to its readers the various improvements in the art, and it is possible that within the next few months this publication will give the details of a practical working receiver that may be easily made by any broadcast fan.

Build a Powerizer in 2 Hours

(*Continued from page 128*)

When all the connections have been checked, the unit is complete, and the unit is ready to be installed.

Applying the Powerizer to the Atwater Kent Model 35

First, obtain five special Na-ald adapters, including four No. 926 Na-ald Connectoralds and the one No. 927-UY Connectorald, and a five-lead Corwico cable, which consists of a yellow, a blue, a black, a red and a gray lead. The gray lead is not used. These should be connected up into a cable, as shown in Figure 2. The cable should be arranged so that each of the Connectoralds will fit in the sockets, starting at the left with the set turned upside down, as shown in Figure 1. This same diagram shows the connections for the 400-ohm volume control, the light socket antenna, the Racon reproducer and the unit itself. When the adapters have been placed in the sockets and the transfer plug has been placed in the last socket on the extreme right, the vacuum valves may be put in place in the receiver and in the power unit.

Place three CX-326 type valves in the first three adapters at the left and place a CX-327 type valve in the fourth adapter with a CX-326 type valve in the fifth adapter from the left. The transfer plug, as stated before, is placed in the sixth socket. Then place a CX-310 type valve in socket F of the powerizer and place a CX-381 type rectifier valve in socket E in the powerizer. Notice that the leads of the Corwico cable must be twisted the entire length to the binding posts of the unit. This is done by taking off the outer covering of the cable.

Next fasten the attachment plug of the power unit to the 110-volt AC lighting lines. A standard electrical plug should be used for this purpose.

The set is now ready to operate, except that the volume rheostat on the receiver will not be used, and the volume control will be done from the external 400-ohm resistance. The set operates, otherwise, the same as before.

If all of these instructions and suggestions are carried out carefully, the owner may be proud of a modern, up-to-the-minute AC-operated receiver.

The whole set will turn "on" and "off" at the electric socket. It must, however, be remembered that it takes about 40 seconds for the AC valves to heat up to the proper temperature before they begin to operate properly.

Readers who do not care to build this unit at home may obtain it completely assembled and inclosed in a metal container; it is sold under the trade name of Powerizer. The completed unit comes ready to install and includes the necessary Connectoralds and cable, ready cut.

A Radio "Echo" That 5,000 Heard

(Continued from page 134)

mediately in front of Colonel Lindbergh. A telephone line carried his voice from the airport to the broadcasting station, about a quarter mile distant. The broadcast from station WGY was then received on a high-grade radio receiving set at the airport, and the output amplified in the Victrola reproducing equipment. The mammoth horn, which is eight feet square at the mouth and contains special loudspeaker units, was located on a 15-foot scaffold, about twenty-five feet to the side of the speakers' stand, and was pointed directly at the crowd assembled in front of the stand.

It seemed almost inconceivable, so natural and clear was the speaker's voice brought to the great crowd by this new apparatus, that radio transmission and reception had reached such a stage of perfection. Interference from static and line noises were not present; only the voice of the speechmaker was heard, and that hundreds of times louder than he himself was speaking.

Both before and after the ceremonies the crowd was entertained with phonograph records played directly on the Auditorium Orthophonic Victrola, which reproduces over the entire musical range and down to 30 cycles. Most appropriate to the occasion was the playing of the records which were recorded from the radio broadcasts when Lindbergh was received in Washington by President Coolidge, upon the former's return from Europe.

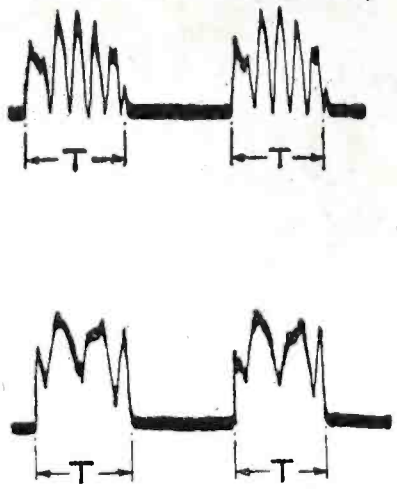
Direct radio receiving, and what might be called "indirect radio receiving" of this nature have possibilities which only the future can develop to their fullest extent.

A Unique Radio Census

AN interesting method of gauging the number of people who listen in on a radio broadcast was used recently by station WWNC at Ashville, N. C. The station offered prizes to those who estimated most accurately the number of persons within a one-hundred-mile circle of the station who listened in on the broadcasts. Entry blanks were published in the daily papers, and persons wishing to enter the contest clipped these blanks, filled in their estimate and mailed the blanks to the station. The blanks were also filled in with the contestant's address, model of receiver owned, and preferences in broadcast programs. When the blanks were checked up and counted, a fairly accurate census of the number of listeners was obtained. The prizes offered for the closest estimates were radio equipment and receivers.

The Earth's "Radio Roof"

(*Continued from page 113*)



HOW REFLECTED WAVES CREATE DISTORTION

FIGURE 6: *Above is the type of signal received when a steady signal (but not of constant frequency) was transmitted in the experiments, showing the distortion resulting at times when a reflected path occurred. The transmitted power was steady during the times marked T.*

rise of six miles per minute and a fall of twenty-five miles per minute were observed. This rapid movement of the refracting region at night appears to be the cause of rapid fading of those wavelengths which travel well at night. If the reflecting or refracting layer were fixed and the frequency of the transmitting station fixed also, fading would not occur, but because the refracting region is moving fading is produced.

Another effect is bad quality of received signals under certain conditions, as has been proved by Bown, Martin and Potter.* When the reflected wave as received is of the same order of magnitude as the wave which comes along the ground, and when the frequency of the transmitting station is not constant, the signals arriving at any receiving station over two paths will actually be of different frequencies. Traveling over different paths, two or more waves arriving simultaneously will have left the transmitting station at different times, and if the carrier-frequency of the station is not constant the waves will be of different frequencies. If the two waves are of the same order of magnitude, a beat note will result. For the large number of frequencies in a modulated wave, the correspondingly large number of beat notes results in noise which overshadows the speech or music being received. Experimental demonstration of this phenomenon is shown in Figure 6. Power of constant amplitude, but of varying frequency, was radiated from the transmitting station during the transmitting intervals; at the receiving station, the beats between the waves arriving over the two paths produced the distortion shown. For this reason constant frequency is essential in broadcasting.

* I. R. E. Proceedings, February, 1926.

An Unusual Radio "Dead Spot"

DURING the winter battle-fleet maneuvers of 1915-1916 of the United States Atlantic Fleet, I was attached to the *U. S. S. Delaware,* a superdreadnaught, as radio operator. During the course of the exercises, I came across one of the most unusually effective radio "dead spots" (i.e., an area in which radio communication is virtually impossible of accomplishment) I have ever encountered.

We were engaged in maneuvers in the Caribbean Sea off the coast of Cuba, and while this area of the world is more or less notorious for "dead spots" the one mentioned below is the winner when it comes to stopping communication. On this occasion the *Delaware* was operating in Guacanayabo Bay, about 150 miles (air line distance) from the Naval Base Radio Station at Guantanamo Bay, when I had a message to deliver to the latter station.

I "opened up" on about one and a half kilowatts power with the quenched gap spark transmitter and called the station—without results. This procedure was carried out at the correctly specified intervals. I gradually increased my power to full strength with forty amperes in the antenna—and still no answer could I hear! In an interval of listening I heard what I knew to be one of our destroyers calling me from a position that was nearby but to seaward and outside the point defining the entrance to the bay. The operator said he was in easy communication with the station at Guantanamo and would relay my message for me. This suited me fine, so I gave it to him on reduced power and then he gave Guantanamo a single call on the same strength of power he used in calling me. Evidently he got him on the first trial, for he relayed my message at once!

Yet I, with my forty amperes in the antenna, could not get the base after almost an hour's work! This *was* some dead spot, I concluded. After going off watch I went up to the chart house and looked up the geographical aspects of the situation. Ultimately I reached the conclusion that the innocent looking mountain range (The Sierra Maestra Mts.) extending between the point where I was located at Guacanayabo Bay to the base at Guantanamo Bay, was probably responsible for the difficulty. I further ascertained that there was known to be a considerable body of iron ore in the portion of the range adjacent to Guacanayabo Bay, and this doubtless was definitely responsible for the failure of the radio signals to get through from my station, while the comparatively low-powered transmitter of the relaying destroyer got the message through perfectly.

—LIEUTENANT H. F. BRECKEL.

Pacific & Atlantic

HOW IT'S DONE IN RUSSIA

These two radio fans, who appear to be as ardent as the American variety, are Russian peasants, listening in on the latest broadcast from Moscow. Note the Russian radio magazine that one of them holds.

BROADCAST LISTENER

Comments on radio programs, methods and technique —from the point of view of the average fan

By RAYMOND FRANCIS YATES

Memory Songs

HERE we are running into November with the sob song supply at the highest point in the history of the industry. It's strange how these sublime emotional assaults on the national heartstrings continue to be popular. Studio managers seeking sure-fire stuff never overlook the bet of a good old-fashioned quartette wailing sentimental ballads full of tender nothingness and ten-cent-store romanticism. In the whole range of vocal material nothing is more effective in the great American home, it would seem, than these mushy tear-wringers; and our broadcasters, always alert to the cravings of the morons of music, dish out the choicest morsels of doleful hash.

We are at present busily engaged in incorporating a new organization which we hope will, in some measure, stem the tide. We have called this organization the Society for the Conservation of Tears, and those in sympathy with the idea we ask to write a letter of protest to each broadcaster in the United States requesting the discontinuance of the twilight series.

* *

All Aboard

ALONG with the sob songs we have also suffered through a severe season of "musical tours"; a musical tour being an hour or so of the music of foreign lands, filled with colorful descriptions by announcers who have never visited them. Cook's tours at WJZ started this musical tour business several years ago and they have done splendidly at it—so well, in fact, that the studio Johnnies have ragged the idea until it is now one of the many common properties of broadcasting. Broadcasting is so hungry for new ideas that it devours a novel idea with an avidity that would be admirable were it not so monotonous.

If we have listened to one musical tour during the season, we have listened to a hundred of them, and we are all fagged out after having "covered" millions and millions of miles and having passed some of the most glittering announcerial landscapes ever painted.

Musical travelogues were once quite novel and entertaining, but we fear that we shall have to put our radio baggage away for a few months at least. Already we have made 187 trips to France, 149 trips to Italy, and 97 trips to Russia. Little wonder that we are all tuckered out and that we crave a few quiet evenings at the fireside listening to the sopranos and baritones that used to annoy us so much. After all, a radio soprano or a tenor is not so bad for a change. Perhaps we might suggest the formation of a "Stay-at-Home-and-Listen-to-the-Sopranos League." This is the last thing we would have thought of a year or so ago, but times have a habit of changing, you know.

The Individual Tube

ZO

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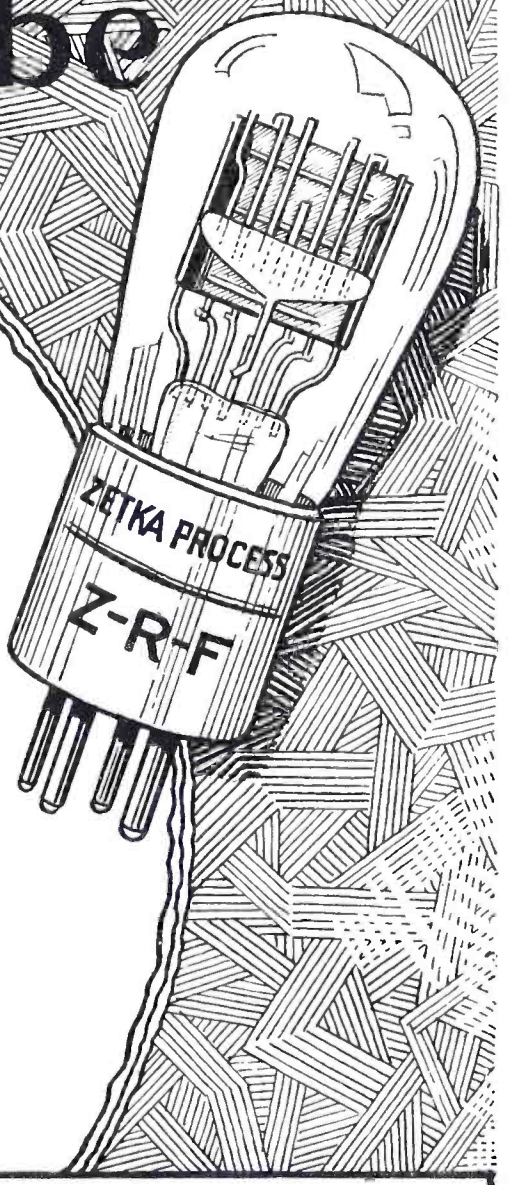
A Fit Companion to the New Line of Zetka Process Special Duty Tubes

A new output tube, developed in our laboratory, to handle the output volume of modern 6 to 10 tube receivers without overloading.

The new ZO tube is a 5-volt, ½-ampere tube, operating at 180 volts plate with 35 to 40 volts negative grid bias, and is designed to handle the tremendous volume delivered by a full set of Zetka Process Special Duty tubes without distortion.

For push-pull amplification, the ZO, used in both the input and output stages of a push-pull amplifier, will produce an enormous volume with almost unbelievable depth and clarity of tone. Write for details.



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Z-A-O—Audio Output, or Power Amplifier. 5 volts, ½ amp. For handling large output volume without distortion. Plate voltage 180, with 22½ volts "C".....**Price $4.50**

The Perfect Announcer; Where Is He?

WHO can lay down a code of instructions to broadcast announcers that will reflect the desires and wishes of five million devotees of the radio?

The task is hopelessly beyond the shadow of realization. Still this does not mean that a few generalizations cannot be put down, for, after all, there is nothing mysterious or deeply complex about this business of announcing; it still bends to logic and reason. The trouble is that we have a vast audience of mixed classes; an audience made up of all sorts of social stratums, of ignoramuses, learned professors, delicatessen dealers, coal heavers, society matrons, bankers, poorhouse inmates, schoolboys, and reformers. An announcement that might be perfectly acceptable to a poolroom tout—something loose and shockingly colloquial—would profoundly disgust an ecclesiastic; conversely, a gushy, sentimental bit of musical description might cause an ex-prize fighter to mutter ugly phrases and to wish that he could meet the perpetrator in some likely alley.

What is most needed is not harsh criticism, but a formula for action that will please the greatest number of radio listeners and at the same moment raise the intellectual standards of broadcasting in general.

The first question of importance that presents itself when the subject of announcers and announcing comes up in the forum is this:

Should announcers make plain, bald statements before and after each announcement or should they be more of a substantial part of the program, taking on the functions of a toastmaster?

Those who have had experience with the early phonographs and their tinny nasal proclamations concerning the subjects of the records, might shudder at the thought of introducing so banal a practice into the radio art. Still, which is more boresome, to listen to an obvious, almost mechanical announcement, or an awkward attempt at originality executed in bush league fashion?

Is there anything more nauseously boresome than the pathetic spectacle of a culturally nondescript person making false passes at nonchalant witticism?

The mechanical type of announcement, even though it tends to produce monotony, is to be preferred to the low-temperature, grade Z attempts to be interesting and learned. Nothing can be detected so quickly or detested so enthusiastically as the brazen pretender to intellectual attainment.

But this should not be taken as a sweeping commentary to the effect that all of our announcers are incapable of doing anything but reeling off sun-baked proclamations between numbers. Such an indictment would be eminently un-

fair to some very capable men (yes, and about two ladies) who handle themselves with admirable skill before the microphone. On the other hand, the most liberal supporter of broadcasting must agree that the rank of at least 50 per cent of our announcers should be reduced to that of mere call boys giving unimaginative accounts of program happenings. Of course, we cannot expect all our broadcasters to be able to afford the kind of talent necessary to create pleasant impressions in the minds of the more sensitive listeners.

The first essential in announcing is that the announcer shall be a man sufficiently versed in rhetoric and polite, scholarly expression to be able to forget his training.

As soon as he becomes conscious of an effort to interest his audience by the adroitness, subtlety and witticism that mark men of fair letters, he becomes a mere pretender with no more claim to sympathy and approval than a mere pretender should have. Good manners, be it known, cease to be good manners when the effort to push them into the foreground is painfully present. An announcer must be so sure of his ground that his politeness will be an invisible but intrinsic part of his make-up.

It is plain that an announcer, to meet the ideal of something akin to true art, may not be the announcer that would best please the lower classes, who still get a kick out of rowdyism, slapstick comedy and literary pie throwing. But we cannot afford to permit this class of people to set up our ideals in broadcasting. At least there is no possibility of a cultured announcer shocking the finer sensibilities of those who purchase radios for the sole purpose of drinking in nothing but the belligerent cacophonies of the more rancorous venders of this so-called American Folk Music. An announcer, under these conditions, might be tolerated but never acclaimed.

Announcing is far from a mastered art, but in the same breath we must fight against the notion that one man's opinion is as good as another's, or that it is impossible to concoct a formula that will serve the largest number of listeners in the best way. Such a formula must hold that successful announcing lies somewhere between icy formality and unmitigated prattle. *Otium cum dignitate* ("ease with dignity") seems to come pretty close to a code in itself.

It certainly is not right to admire many of our announcers for the studious manner in which they not only absorb but recite the contents of musical dictionaries and encyclopedias. This may permit them to turn a burnished surface microphone-wise, but in such cases they appear too conspicuously informed. Perhaps the writer would be a bit unkind to say that too many of our announcers are affectatious or that they are to be classed with pretenders. Still, not one

announcer has been heard making these "high-brow" announcements who could not be accused of soliloquizing.

An announcer, to approach an ideal, must permit his true natural self to reign.

It is edifying to note that the announcers who do this are those who are most graciously received by the public. Roxy (S. L. Rothafel) at the Roxy Theater, New York City, is a perfect example of the unaffected announcer. His appalling popularity, extending all the way from the White House to New York's East Side, is more than a fair index to the correctness of this theory. A man who cannot melt into a genial human being before the microphone should not be permitted to approach it.

Voice quality, although it has been little emphasized by the majority of our studio managers, is of first importance in announcing.

Few items are more obnoxious in radio than a voice that only mildly suggests the masculine gender. Such voices are usually associated with sentimental, flowery expression that can do little but disgust the more practical and virile members of the radio audience.

There is a technical similarity between the photographic requirements of the movies and the acoustic requirements of broadcasting, although the latter has not as yet become a generally recognized fact. In the early days of the movies, any "actor" who could throw a pie with fair aim was star material, regardless of the manner in which he photographed. Nowadays women with tantalizing beauty are turned away from the studios because the camera, for some reason or other, does not treat them with the greatest respect. The microphone, too, is a gay deceiver and a perfectly modulated voice of pleasing quality may be cruelly distorted; it simply refuses to "microphone" well.

The chronic devotees of the radio, those who take more than a passing interest in the trials and troubles of the baby art, have probably given painstaking attention to the matter of voice transmission and they know, better than many of our studio managers, the tragedy of poor voices that have to be listened to day in and day out. Some day, perhaps, we shall have some sort of a voice analyzer, similar to Dr. Miller's remarkable phonodiek. A visible record can then be produced that will form a scientific basis for voice success on the air.

WEAF's management has demonstrated a remarkable aptitude in the selection of amazingly perfect radio voices. The critical listener cannot help but notice the similarity in register, which shows that more than passing notice has been given to the matter of uniformity and that the selection of announcers has been based largely on scientific auditory tests.

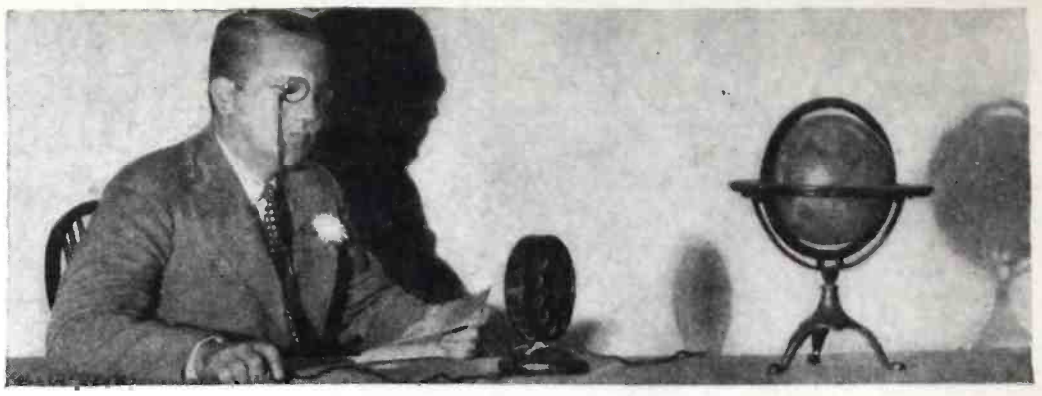
One trouble with many of our studios is that they expect an announcer to be a master of a situation that is hopelessly beyond the mastery of a single man. Take, for instance, an announcer who is called upon to officiate through the entire program of a well-nourished New York broadcaster. The evening holds many adventures for a man whose scope of learning does not take in a vast and widely diversified range of subjects. He may be called upon to comment intelligently in connection with such widely separated things as Tchaikovsky's "Symphonie Pathétique," or a lecture on the migratory habits of birds.

It has always seemed to the writer that smoother studio operation would result from the employment of two types of announcers, one with more than superficial knowledge of music and the other a well-rounded-out man of experience and worldly knowledge. As much of the matter broadcast is musical in nature, it is essential that we have an announcer who can supply the explanatory sketches and pronounce the many foreign names with comfort and authority. It usually happens that a man sufficiently grounded in music is lacking in other requirements, making him unsuited for use in general announcing. On the other hand, the man best suited to general introductions is usually distressingly ignorant of music.

The logic of this special announcer theory is given pretty substantial support by no less a person than J. Andrew White, *bel esprit* of sport assignments for the radio. While White is no doubt an amateur sport observer, his reflections are the more entertaining and edifying because of this. His accounts are accurate, yet he does not go to any great pains in drawing gorgeous pictures with lavender scented phrases. This writer has always preferred to look upon White as the "rough rider of the air," the Teddy Roosevelt of the announcing business. His descriptions are double-distilled of bunk and one may always listen to them in confidence and comfort.

It is, or should be, left to the announcer to establish an intimacy between the listener and the studio. He should be able, in a measure, to overcome the limitations of radio transmission and bring to the listeners a fair impression of what is actually taking place in the studio. For instance, a few words about the grouping of an orchestra before the microphone or the back-stage scenery of a Carnegie Hall concert not only help the radioist to visualize better the thing and draw him closer to the whole event, but they help him to become more intimate with the station itself, establishing a sort of invisible bond of understanding.

It is an easy matter for a sanguine, observing announcer to add these little touches that mean so much to fans.



BROADCASTS

A Year's Progress in Radio Direction Finding

PROGRESS in the new art of navigation by the use of radio beacons and the radio compass made great strides in 1927, according to Dr. F. A. Kolster, research engineer formerly with the U. S. Bureau of Standards, and inventor of the Kolster radio compass. The 30 radio beacon stations that were in existence in this country a year ago have been increased to 45, and 12 more are in the process of construction. Together with the beacons established on the Canadian coast, the North Americans continent now has a fairly complete chain of stations from the Gulf of Mexico to Alaska, and along the Great Lakes. The leadership of the United States in this field is indicated by the fact that the total number of beacons in the world at present is 81, of which 45 are in this country.

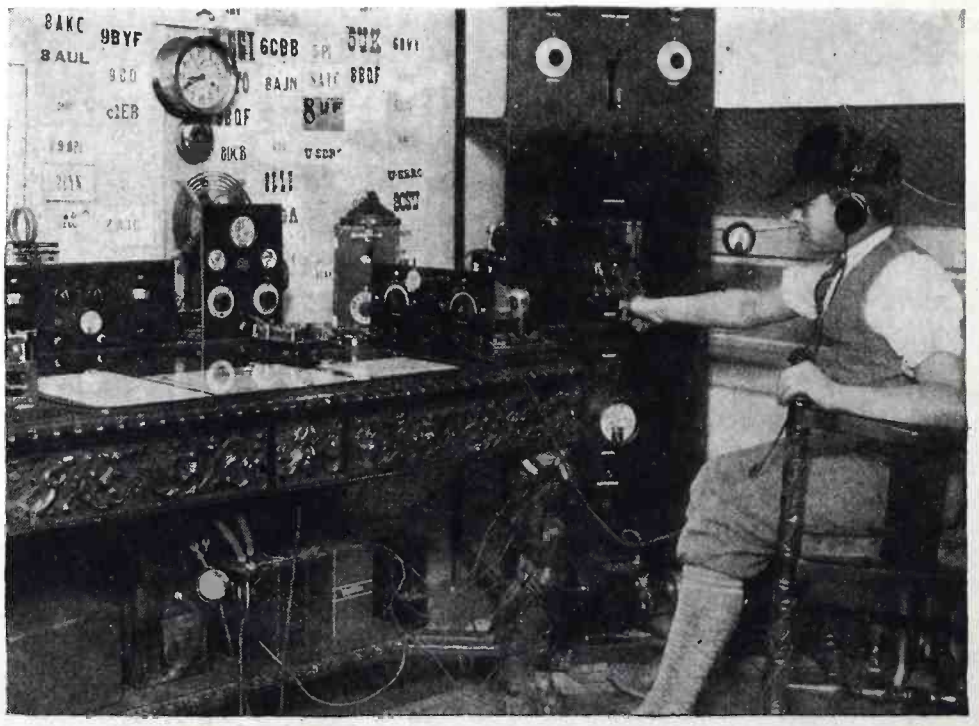
The progress in the installation of radio compasses in ships has kept pace with the growth in number of beacon stations. In addition to a large number of naval vessels, it is estimated that more than a thousand commercial craft are now equipped with radio compasses for getting their bearings by radio. About 600 of these ships are American.

The most phenomenal progress in this field has been shown on the Great Lakes, where two years ago there was not a single radio beacon. Now there are 19, and a large proportion of the important shipping on the Lakes is done with the aid of radio compasses, this method being almost indispensable in fogs and storms.

* *

A New Record in Broadcast Hook-ups

A THOUSAND dollars a minute was the price paid recently by the Dodge Motor Company for an hour's broadcast, which employed three transcontinental circuits totalling twenty thousand miles and a telegraphic communication circuit of ten thousand miles. It is estimated that thirty million people listened in on the program, which was participated in by Will Rogers, Fred



Underwood & Underwood

THE YOUNGEST "HAM"

The youngest licensed radio operator in the country is Robert Marx, shown above with his 40-meter transmitting set. His call letters, 2AZK, have been heard in nearly every part of the world, and he is said to work with 12 foreign stations regularly every night. He is thirteen years old.

and Dorothy Stone, Paul Whiteman and Al Jolson, each in a different corner of the country. The hook-up was both the greatest mechanical achievement in radio telephony and the costliest program ever given.

* *

Tonsils and the Radio Needle

AT a recent medical demonstration before the Philadelphia Laryngological Society in Atlantic City, a needle excited with a high-frequency current of the order of 2,000,000 cycles (150 meters) was used for the bloodless removal of tonsils. At a touch of the needle, the diseased areas of the tonsils turned white within less than three seconds. Dr. Coulter Charlton, who made the demonstration, declared that the operation was absolutely painless and bloodless, the blood vessels being sealed up within the sound tissue. Patients showing tonsils in various stages of the drying-up process that results from the application of the needle were shown to the gathering. Dr. Charlton said that the use of the needle would be especially valuable in cases where the use of a general anaesthetic might involve great risk, or where a hemorrhage might have serious results. Physicians were also inclined to believe that the needle might prove valuable in the treatment of cancer.

* *

Radio Photography Captures a Criminal Abroad

WITH the help of radio photography, the long arm of the law reached across the Atlantic recently to capture a criminal in London who was wanted in Chicago. An exchange of fingerprints between Scotland Yard and Chicago, by means of radio, identified the fugitive, and the British authorities returned him to America to stand trial.

Transoceanic Calls Heard

THE amateur station of Maurice Goud (EF-8KV), Vernon (Eure), France, reports the reception of the following stations in the United States, using a Schnell circuit with detector and one stage of low frequency:

1BUX, 1BYV, 1UW, 2AQW, 2BAA, 8ADG.

CESAIRE GRANGIER, operator of amateur station FM-8MA, Casablanca, Morocco, reports the reception of the following stations in the United States, using a detector and one stage of low frequency:

1BHM, 1LP, 1RF, 2AGN, 3CUQ, 2GK, 3SJ, 5JF, 5KC, 8BUN, 8KF.

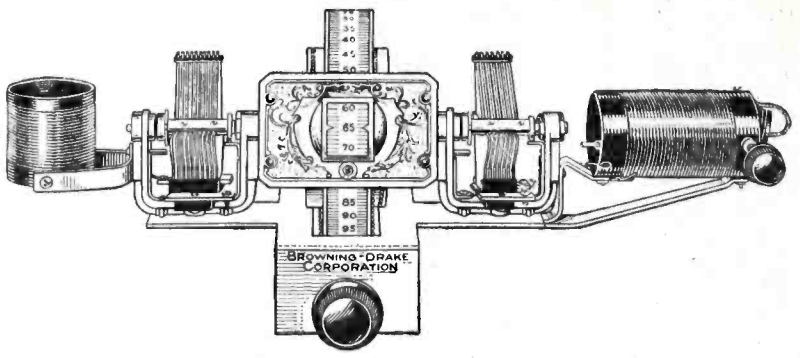
It Works Both Ways

Why some men don't leave home: Radio.

Why some others do: Radio.

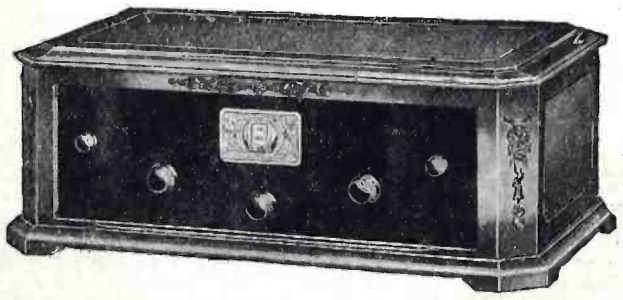
—Miami Tribune.

Now! It Is Easy To Build A Real Good Radio



THE NEW OFFICIAL BROWNING-DRAKE KIT

THIS new Official Browning-Drake Kit is an advance in radio design and engineering. An exclusive product of the Browning-Drake Corporation, it incorporates electrical and mechanical refinements which simplify construction of receiving apparatus and assure efficient operation.



ONE knob controls the single drum illuminated dial, giving a new smoothness of tuning with absolutely no trace of backlash. Coils and condensers are "precision-placed" in the laboratory.

With this new Kit as a basis, it is easy to build either the new Official Browning-Drake five tube Kit-Set, or the new Official Browning-Drake Two Tube Tuner which may be used with any one of the power amplifiers tested and specified by the Browning-Drake Laboratories.

Attractive cabinets are supplied for these new Kit receivers.

Constructional booklets may be obtained either from your dealer or direct, for 25 cents.

BROWNING-DRAKE CORPORATION

CAMBRIDGE **MASS.**

BROWNING-DRAKE RADIO

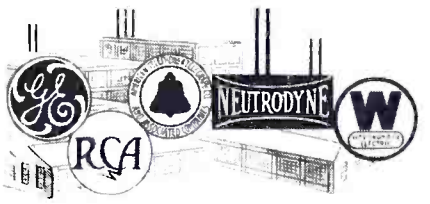
EDWARD LANGER PRINTING CO., INC.,
JAMAICA, NEW YORK CITY.

The Crosley AC Bandbox is the leading radio of today-*because*

of these wonderful tubes

The amazing new RCA alternating current tubes—the UX 226 and UY 227—utilize for their filaments and their heating regular house lighting current. Current is stepped down through transformers. Rectifiers are NOT used.

the radio patents of these industries



The research and development work of these great industries—The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone & Telegraph Co., and The Hazeltine and Latour Corporations—are available to Crosley engineers in the constant advancement of Crosley radio design.

and the amazing capacity of this MERSHON *Electrolytic* CONDENSER

This is one of Crosley's great features. It is an exclusive Crosley device. It is self-healing—will last indefinitely—never needs attention and eliminates the danger of blown out paper condensers, which are causing so much trouble in electrically operated sets.

At last! The radio tube that needs no batteries! Here it is functioning quietly, smoothly, powerfully in this new Crosley 6 tube receiver—the AC Bandbox.

Now, the Crosley AC Bandbox needs no more attention than you pay the electric lamp that lights your home.

Combined with the Crosley facilities for economical manufacture is the patent situation of which Crosley has full advantage. Licensed to manufacture under the patent controlled by the electrical and radio industries, the Crosley Bandbox is a NEW receiver incorporating latest radio developments, the most advanced ideas of radio reception as well as sound reproduction. This outstanding engineering job is best understood when you consider its features are such as are found in radio twice and more its price.

1. Complete shielding of all elements.
2. Absolute balance (genuine Neutrodyne).
3. Volume control.
4. Acuminators for sharpest tuning.
5. Single cable connections.
6. Single station selector.
7. Illuminated dial.
8. Adaptability to ANY type installation.

The set is solidly mounted on a stout steel chassis. As all controls are assembled together in the front, cabinet panels are easily cut to allow their protrusion. The metal escutcheon is screwed on over the shafts and the installation has all the appearance of being built to order.

Two large furniture manufacturers have designed console cabinets in which the Bandbox can be superbly installed (Showers Bros. Co., of Bloomington, Ind., and the Wolf Mfg. Industries of Kokoma, Ind.). Powel Crosley, Jr., has approved them mechanically and acoustically and has seen to it that the famous Crosley Musicones are built in them so that the best type of loud speaker reproduction may be insured.

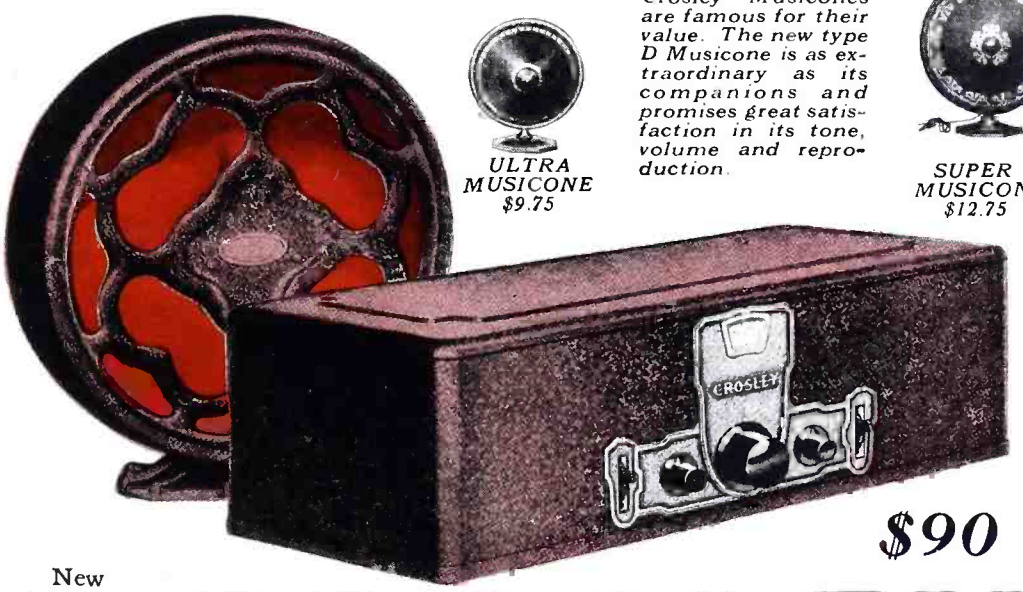
The Bandbox is housed in a brown frosted crystalline finished metal case which is easily removed for console installation.

See the new Crosley AC Bandbox at your dealer's NOW! Hear first hand its delightful performance! Enjoy the best in radio at the least cost! Write Dept. 16 if you can't locate a dealer.

ULTRA MUSICONE $9.75

Crosley Musicones are famous for their value. The new type D Musicone is as extraordinary as its companions and promises great satisfaction in its tone, volume and reproduction.

SUPER MUSICONE $12.75



$90

New Type-D Musicone $15

CROSLEY RADIO

Crosley is licensed only for Radio Amateur, Experimental and Broadcast Reception.

THE CROSLEY RADIO CORPORATION Powel Crosley, Jr., President, Cincinnati, Ohio

Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.

Most of the better sets are Faradon equipped

When buying a set — or kit or replacement parts — it will pay you to keep in mind the fact that Faradon Capacitors are the choice of leading manufacturers.

Look for the familiar blue and white label on the condensers in the hook-up. It is your assurance that you are securing reliable electrostatic condensers.

Your favorite radio store carries Faradon Capacitors and Faradon equipped sets.

WIRELESS SPECIALTY
APPARATUS CO.
Jamaica Plain
Boston, Mass., U. S. A.
Established 1907

Faradon

1456

Electrostatic condensers for all purposes

QUADRICOLOR CO., JAMAICA, N.Y.C.