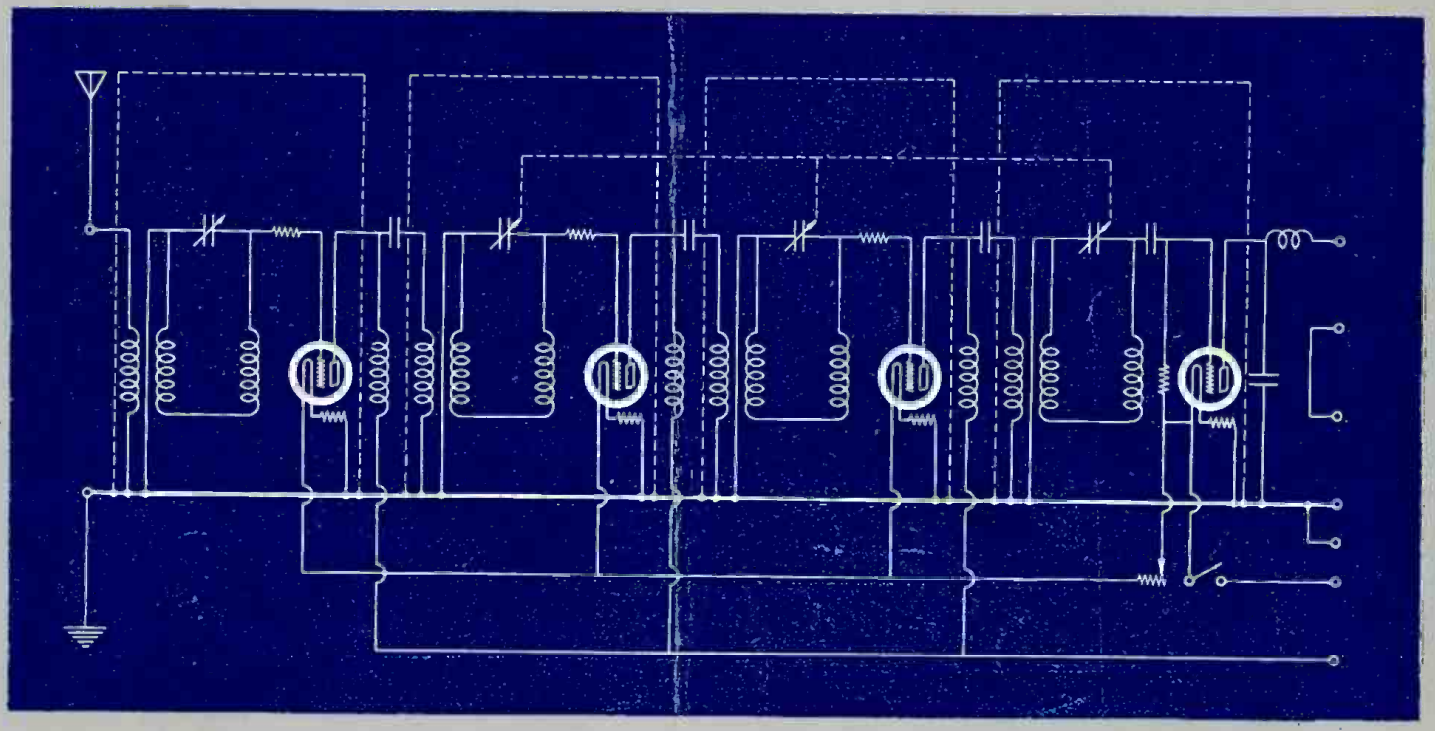
# Popular Radio

25¢

OCTOBER • 1927



*In this Issue —*

**Complete Constructional Details —**
**The New LC-28 Receiver *and***
**The Magnaformer Superheterodyne**

# 30 DAYS FREE TRIAL

## *Battery or*
# All-Electric
## OPERATION

HERE is the great value offer of the day. Test and try this powerful seven-tube RANDOLPH RADIO for thirty days. After it **brings in stations from coast to coast** with amazing clearness—**with easy one-dial tuning**—after it **easily equals any other radio** regardless of cost—after you are more than satisfied then you can buy it **direct at factory prices. Every RANDOLPH must make good before it is sold.**

The RANDOLPH SEVEN-TUBE CONSOLE illustrated here can be had for use with batteries or **connected direct to the electric light socket—absolutely batteryless—no batteries, chargers or acids—just plug in and tune in.** 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities—by leading radio publications and laboratories.

### 7 Tubes—Single Control
**Illuminated Drum**

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a seven-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils. Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate.

### Beautiful Walnut Console
**Built-in Cone Speaker**

The Randolph Seven-tube Ampliphonic Console illustrated above is housed in a genuine burl-walnut cabinet with two-tone hand rubbed finish giving it unsurpassed beauty. The same expert cabinet work has gone into the making of these consoles as in the finest furniture. Has **built-in cone loud speaker that compares with any on the market.** Accurately reproduces complete range of musical notes from the highest to the lowest pitch.

### What Users Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas. I have logged 52 stations from Cuba to Seattle, the set is a world beater.—J. Tampkinson, Detroit, Mich. Your set is a revelation, has all others tied to the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont. On strength of its performance sold two more sets this week.—T. Scanlow, Orlando, Florida.

*The* **Randolph** **7-Tube Console Single Control RETAIL PRICE** *Completely Assembled* **$99**

### The Senior Six

Now you can have a new, modern, single-control, six-tube radio. Do not compare this set with old style 2-dial 6-tube sets selling for about the same price. The Randolph 1923 Senior Six has also been tested and approved by the leading radio engineers.

Comes in a beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated Drum with space for logging. Absolutely dependable and very selective. **Sent for 30 Days' Free Trial. You test it before you buy.**

**6-Tube $55 Retail Price Single Control**

## MAIL COUPON NOW!

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experience in the radio business, we are perfectly confident in sending out a Randolph Radio on trial. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

## Sensationally Big Discounts to Agents

Work either full or part time and make big money. Tremendous advertising campaign helps you sell. Regardless of whether you have ever sold before, be sure to get our proposition. The Randolph sells on first demonstration. Men and women both can make money this easy way. Get your demonstration set for thirty day's **FREE TRIAL.**

## Use This Coupon NOW!

**Randolph Radio Corporation,**
**711 West Lake Street, Dept. 253**
**Chicago, Illinois.**

Send me full particulars about the RANDOLPH Six and Seven-Tube All-Electric and Battery Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name.....

Address.....

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

Mark here ☐ if interested in Agent's proposition.

**RANDOLPH RADIO CORPORATION**
**711 West Lake Street** **Dept. 253** **Chicago, Illinois**

# Restored Enchantment

*This is the Eveready Layerbilt that gives you Battery Power for the longest time and the least money.*

THERE is no doubt of it—radio is better with Battery Power. And never was radio so worthy of the perfection of reception that batteries, and batteries alone, make possible. Today more than ever you need what batteries give—pure DC, Direct Current, electricity that flows smoothly, quietly, noiselessly. When such is the current that operates your receiver, you are unconscious of its mechanism, for you do not hear it humming, buzzing, crackling. The enchantment of the program is complete.

Batteries themselves have improved, as has radio. Today they are so perfect, and so long-lasting, as to be equal to the demands of the modern receiver. Power your set with the Eveready Layerbilt "B" Battery No. 486. This is the battery whose unique, exclusive construction makes it last longer than any other Eveready. Could more be said? In most homes a set of Layerbilts lasts an entire season. This is the battery that brings you Battery Power with all its advantages, conferring benefits and enjoyments that are really tremendous when compared with the small cost and effort involved in replacements at long intervals. For the best in radio, use the Eveready Layerbilt.

## *Radio is better with Battery Power*

**At a turn of the dial a radio program comes to you. It is clear. It is true. It is natural. You thank the powers of nature that have once more brought quiet to the distant reaches of the radio-swept air. You are grateful to the broadcasters whose programs were never so enjoyable, so enchanting. You call down blessings upon the authority that has allotted to each station its proper place. And, if you are radio-wise, you will be thankful that you bought a new set of "B" batteries to make the most out of radio's newest and most glorious season.**

**NATIONAL CARBON CO., INC.** UCC **New York—San Francisco**

*Unit of Union Carbide and Carbon Corporation*

**EVEREADY**
**Radio Batteries**
*—they last longer*

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

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

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

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

*Have you heard the new Victor record by the Eveready Hour Group—orchestra and singers—in Middleton's Down South Overture and Dvořák's Goin' Home?*

# Popular Radio

FOUNDED 1911

VOLUME XII October, 1927 NUMBER 4

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### DEPARTMENTS



VOLUME XII October, 1927 NUMBER 4

Published monthly by Popular Radio, Inc., 119 West 57th St., New York, N. Y.; telephone number, Chickering 1906; Douglas H. Cooke, President and Treasurer; Kendall Banning, Vice-President; Laurence M. Cockaday, Secretary; Emma A. Harm, Asst. Treasurer. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's 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., under the act of March 3, 1879. Additional entry at Jamaica, L. I., N. Y.  *For advertising rates, address* Popular Radio, Inc., 119 West 57th St., New York; or 225 North Michigan Ave., Chicago.
Printed in U. S. A.

KENDALL BANNING, *Editor*

LAURENCE M. COCKADAY, *Technical Editor* E. E. FREE, Ph.D., *Contributing Editor*

# 7 Tube Set
## Single Dial Radio

**30 DAYS FREE TRIAL**

**Metrodyne Radio Sets** *Are Equipped For* **BATTERY or ELECTRIC operation**

# The Metrodyne
**ONLY ONE DIAL TO TUNE**

**RETAIL PRICE**
**$75.00**
**Completely Assembled**
***Big Discounts to Agents and Dealers***

Wonderful offer direct from the factory! The world's greatest radio! A perfect working, single dial control, 7 tube receiver! And just to prove our claims, we will ship it to your home for **30 days' free trial.** Test it under all conditions. Test it for distance, volume and tonal quality—and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

**Three Year Guarantee**

**BIG PROFITS TO AGENTS AND DEALERS**

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon, a letter or a postal for our agent's proposition.

## Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. **Tested and approved by Popular Science Institute of Standards, Popular Radio Laboratory, Radio News Laboratory** and by **America's leading Radio Engineers.** Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet with beautiful, gilt metal trimmings. Very newest 1928 model, embodying all the latest refinements.

Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, **1,000 to 3,000 miles on loud speaker!** The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.

**6 Tube Set $48.50 RETAIL PRICE Completely Assembled**

***30 Days' Free Trial—3 Year Guarantee***

## Metrodyne Super-Six

Another triumph in radio. Here's the new 1928 model Metrodyne 6 tube, two dial, long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station on same dial readings every time — no guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

**We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal 30 days' free trial offer, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis.**

**MAIL THIS COUPON** or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer — **SAVE MONEY—WRITE NOW!**

# METRO ELECTRIC COMPANY
**2161-71 N. California Ave. • Dept. 7 • Chicago, Illinois**

## MAIL COUPON BELOW

***Let us send you proof of Metrodyne quality—our 30 days' free trial offer and 3 year guarantee***

**Mrs. Wm. Leffingwell, Westfield, N. J.,** writes: "The Metrodyne Radio I bought of you is a wow! This is as good as any $225 machine I have ever seen."

**N. M. Greene, Maywood, Ill.,** writes: "My time is up and the Metrodyne works fine. I got Havana, Cuba, Oakland, Calif., Denver, Colo., Toronto, Canada, all on the loud speaker."

**J. W. Woods, Leadville, Colo.,** writes: "Received the 7-tube Metrodyne in fine condition. Had it up and working same day received. Was soon listening to Los Angeles, San Diego, Oakland and other California points; also St. Louis, Kansas City and other east and south stations—all coming in fine. Am more than pleased. Sure enjoying it."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

**METRO ELECTRIC COMPANY**
**2161-71 N. California Ave., Dept. 7**
**Chicago, Illinois**

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer.**

*Name*_____

*Address*_____

*If you are interested in AGENT'S proposition, place an "X" in the square* ☐

# A Page With The Editors

Sir Oliver Lodge's experiments in broadcasting thought transference (described by him in the September issue of Popular Radio), have apparently attracted wide interest.

* *

Following the publication of Sir Oliver's report, other experimenters have sent to the Editors accounts of similar tests made previously. From Mr. E. F. McDonald Jr., of Chicago, comes this report of some experiments in broadcasting telepathy by Dr. Gardner Murphy, of Columbia University, from station WJAZ, New York, on March 2, 1924:

* *

(1): "Over 2500 reports were received and analyzed."

* *

(2): "With the exception of two, all the results were in harmony with the laws of probability; *i.e.*, the successful guesses were about what we would expect from tables of chance coincidence."

* *

(3): "One of these two reported throbbing in the left little finger. This was interesting because one of the senders tied a string around his left little finger, but there is no way of computing the chance probability in this case."

* *

(4): "The report of Miss Florence Wilkes scored three exact successes and two good partial successes. The chance coincidence explanation of her results could not be taken seriously, as the chances were upwards of 100,000,000 against such a score. However, her report was not mailed till March 5th and she had, prior to that date, discussed her experiment with one of the senders. While I have no reason whatever to question her integrity, I cannot take the responsibility of asking scientific men to accept the case as genuine."

* *

Have other readers any additional reports on this interesting line of experimentation to submit?

* *

Prof. Edward L. Bowles, who contributes "How to Select Audio Amplifiers" to this issue, is in charge of the Division of Electrical Communication, Department of Electrical Engineering at the Massachusetts Institute of Technology. He lives in Wellesley Farms, Mass., where he spends much of his time in research on low-frequency amplification.

* *

Mr. Derek Shannon (whose article, "The Effect of Moonlight on Reception," appears on pages 211-213 of this number) ranks as one of the most diligent of the English radio amateurs.

* *

He has been an experimenter for sixteen years. His interest in radio was first caused by a newspaper item; he promptly bought the then available books on the subject, studied the technique and set up a station of his own in Sutton, Coldfield, England. His signals are frequently picked up in Mexico and New Zealand—and it is reported that he can tune in on American stations every evening.

* *

In this issue Popular Radio gives the complete constructional details of the latest and most efficient of all the long line of products of the Popular Radio Laboratory—the LC-28 receiver.

* *

This most advanced of receivers (which is a development of the famous LC-27 that was produced just a year ago) represents over a year of experimentation by the technical staff, headed by Laurence M. Cockaday.

From a photograph made for Popular Radio

THE LC-28 IS EASY TO ASSEMBLE

*All the tools required by the home-builder for putting together the set described on pages 214-217 of this issue are a socket wrench and a screw-driver. And the wiring is simpler and easier to install than in any valve receiver yet developed; less than 5 feet of wiring is used—about one-fourth the amount usually required!*

In quality of tone, in volume, in selectivity, in simplicity of design and arrangement, in ease of construction and operation, Popular Radio believes that this receiver is the best receiver obtainable to-day, regardless of price.

* *

Yet the cost of the apparatus required for assembling this set is about $90.00!

* *

The preliminary announcement of the LC-28, including a consideration of the scientific principles involved in its design, was given in last month's issue of this magazine. In the coming issue —for November—will appear a third article that will tell how to build a low-frequency amplification unit that handles its output properly.

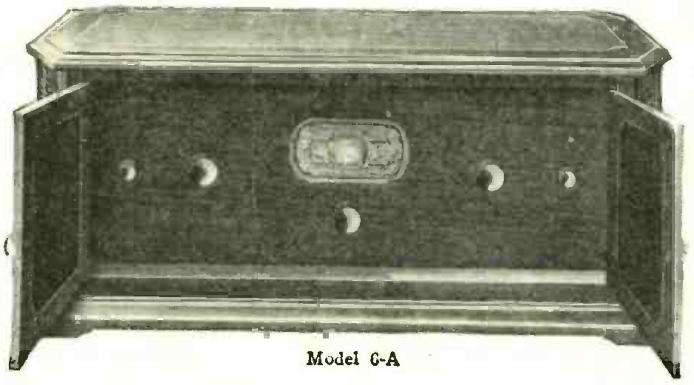
* *

In the coming issue, also, will be published three other articles of special interest and value to the home-builder and experimenter; one will tell how to build the new Hi-Q receiver (see pages 230-232 of this number); the second will give information on the proper operation of the new Magnaformer 9-8 receiver (see pages 226-229 of this number), and the third will announce the new Octa-monic receiver.

—The Editors

Trade Mark

# The Advice of Men Who KNOW Radio "Get a BROWNING-DRAKE!"



Model 6-A

WHEN radio amateurs, . . . men who KNOW radio, are asked by their friends and neighbors to recommend a dependable radio set, they almost invariably reply, "Get a BROWNING-DRAKE!" Why? Because these amateurs have tested every Browning-Drake development themselves and found it to be scientifically sound. They know therefore, that their reputations as engineers and amateur scientists are safe when they recommend Browning-Drake. This unusual recommendation has put Browning-Drakes into over two hundred thousand homes.

Recently the laboratories of the Browning-Drake Corporation presented an entirely new conception of the world-famous Browning-Drake Receiver. Tone, volume, selectivity and distance ability have never before been combined in a single receiver in the same fine way they are brought together in the new Browning-Drakes. These receivers are unconditionally guaranteed and will, we believe, more fully uphold the reputation of the man who KNOWS radio when he advises, "Get a BROWNING-DRAKE!" Ask your dealer to show you the new Browning-Drakes TODAY.

### Specifications:

Browning-Drake, Model 6-A (illustrated above), uses conventional Browning-Drake circuit with slight modifications. Four audio tubes give natural tone and great volume when desired. Small auxiliary condenser is provided to bring signals of distant stations to maximum intensity. Beautiful two-tone Duco walnut cabinet harmonizes with all home furnishings. Length, 27 inches; depth, 15 inches; height, 11 inches. List without tubes and batteries, $105.

## BROWNING-DRAKE CORPORATION
## CAMBRIDGE :: MASS.

*DEALERS: Browning-Drake now offers a complete line of receivers and kit parts. Almost three times as many Browning-Drake parts are sold as those of the nearest competitor. Write or wire for further information TODAY.*

### Model 5-R

Five tubes. Uses three stages of resistance-coupled amplification. Provision for power tube in last audio stage. Cabinet is two-tone Duco mahogany finish. List without tubes and batteries, $95.

### Model 7-A

Seven tubes, single dial, illuminated drum control. Completely shielded. Cabinet can be had in either two-tone Duco mahogany or walnut. Length, 30 inches; depth, 15 inches; height, 11 inches. List without tubes and batteries, $145.

# BROWNING DRAKE

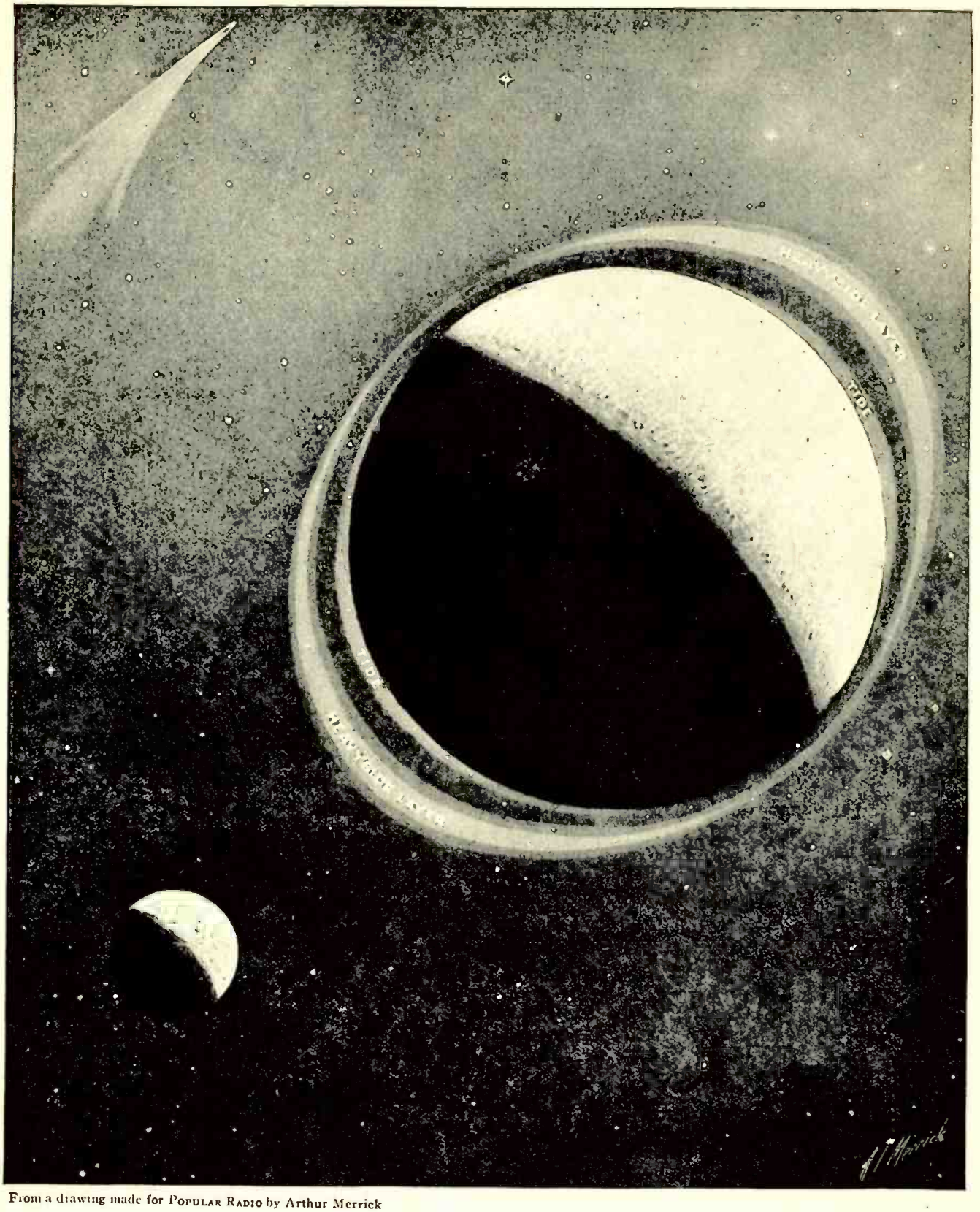
CABINETS PARTS RECEIVERS KITS

# *The* RADIO ALMANAC

## October, 1927

**Full Moon, 10th Day 4h. 15m., evening, E**

| D.M. | D.W. | Notable Events and Anniversaries |
|---|---|---|
| 1 | Sa. | 1924: POPULAR RADIO introduced the popular four-circuit tuner with resistance-coupled amplifier, developed under the direction of LAURENCE M. COCKADAY. |
| 2 | S | 1921: Successful experiments were made in the broadcasting of programs from airplanes in flight. *Slightly colder.* |
| 3 | M. | 1895: SMITH established communication by conduction with the lighthouse on the Fastnet. *Big features in broadcast programs begin this month.* |
| 4 | Tu. | 1858: DR. MICHAEL PUPIN, who has done invaluable research work in the realms of radio and who holds many radio patents, was born. |
| 5 | W. | 1922: Transatlantic test messages were successfully sent for the first time with the 20-kilowatt vacuum valves developed by W. G. HOUSEKEEPER. |
| 6 | Th. | 1866: DR. REGINALD A. FESSENDEN, one of the most prolific of inventors of radio apparatus and the father of the duplex system of radio telephony and of the heterodyne method of reception, was born. |
| 7 | Fr. | 1914: MAJOR EDWIN H. ARMSTRONG (who later discovered the super-regenerative circuit) obtained his patent rights on his famous feed-back or regenerative radio circuit. |
| 8 | Sa. | 1918: Progress in the use of continuous wave transmission was very marked, due to the development of vacuum valves and other improvements. |
| 9 | S | 1920: The removal of war-time restrictions resulted in a great stimulation of interest in amateur radio. *Check over your "A" and "B" batteries.* |
| 10 | M. | 1842: MORSE made wireless experiments by electric conduction through water. *A phonograph pick-up adds another field to your radio reception.* |
| 11 | Tu. | 1913: The steamship *Volturno* took fire in mid-Atlantic, and in response to a radio message ten vessels rushed to the scene and rescued 521 souls. *Cool and clear—good reception.* |
| 12 | W. | 1927: The LC-28 receiver, developed by the Popular Radio Laboratory, was introduced to the radio public during this month. |
| 13 | Th. | 1924: To aid in eliminating interference, the transmitters of several high-powered broadcasting stations were moved to the outlying districts of several cities in the U. S. |
| 14 | Fr. | 1896: MARCONI'S investigations first led him to the conclusion that "Hertzian waves" could be used for telegraphing without the aid of wires. |
| 15 | Sa. | 1901: The first fan aerials were erected for experiments in radio transmission and reception between Poldin, England, and Newfoundland. |
| 16 | S | 1907: Transatlantic radio stations at Clifden and Glace Bay were opened for limited radio public service. *Conditions for DX reception are getting better every day.* |
| 17 | M. | 1919: The Radio Corporation of America was organized under the laws of Delaware "for the purpose of conducting a general wireless business in the fields of communication, dealing and manufacturing." |
| 18 | Tu. | 1926: POPULAR RADIO announced the famous LC-27 (the forerunner of the LC-28) radio receiver, developed in the Popular Radio Laboratory under the direction of LAURENCE M. COCKADAY. |
| 19 | W. | 1862: HEYWORTH patented a method of conveying electric signals without the intervention of any continuous artificial conductor. |
| 20 | Th. | 1892: STEVENSON advocated the use of an inductive system for communication between the mainland and isolated lighthouses. |
| 21 | Fr. | 1831: FARADAY discovered electromagnetic induction between two entirely separate circuits. *Take a portable radio on your autumn auto trip.* |
| 22 | Sa. | 1914: High-powered transoceanic stations were put into operation at Carnarvon, Wales, Belmar, Honolulu and San Francisco. |
| 23 | S | 1873: DR. WILLIAM D. COOLIDGE, physical chemist, holder of the Rumford Medal and the discoverer of the "death ray" that bears his name, was born. |
| 24 | M. | 1924: Radio signals from a radio station in East Pittsburgh, Pa., were successfully repeated from a station in Cape Town, Africa. *Why not try the new AC valves on your receiver?* |
| 25 | Tu. | 1844: PROF. EDOUARD BRANLEY, the eminent French radio expert who invented the coherer that bears his name, was born. |
| 26 | W. | 1915: Successful radio-telephone experiments were carried out between the Eiffel Tower in Paris and the Arlington radio station in Virginia. |
| 27 | Th. | 1923: Successful tests were made at the Etampes Aerodrome in France with radio-controlled airplanes, flying without pilots. |
| 28 | Fr. | 1864: CLERK-MAXWELL read to the Royal Society his paper. "A Dynamical Theory of the Electromagnetic Field," which laid the foundation for modern theories of the wave propagation of electricity. |
| 29 | Sa. | 1923: The Vienna Fire department installed receiving sets on its fire apparatus to keep its forces in communication with headquarters. *Tune in on big football broadcasts to-day.* |
| 30 | S | 1867: DR. LOUIS W. AUSTIN, physicist, since 1923 the chief of the Laboratory for Special Radio Transmission of the Bureau of Standards in Washington, D. C., was born. |
| 31 | M. | 1926: The use of quartz crystals for maintaining constant frequency on radio transmitters made considerable progress during this time. *Cooler.* |



From a drawing made for POPULAR RADIO by Arthur Merrick

## Do Aerial Tides Make Reception Better Under a Full Moon?

*The gravitational force of the moon creates tides in the atmospheric blanket of the earth similar to those which it produces in the ocean, according to a theory which the experiments of Mr. Derek Shannon seem to substantiate. If this tidal effect is real, the bulges thus created in the Heaviside layer that acts as a reflector of radio waves would affect radio transmission, and particularly long-distance transmission, to a noticeable extent.*

Popular Radio

VOLUME XII October, 1927 NUMBER 4

# The Effect of Moonlight on Reception

At one time or another in the past history of mankind the moon has been blamed for nearly everything. The very word "lunacy" means nothing but "moon-struck." Radio has not escaped its theories of lunar influence. Mr. Shannon, a well-known British amateur, provides, however, something more than theories; he has made careful experiments. He finds that the moon *does* influence radio—at least in so far as long-distance reception of short waves is concerned. A full moon means good reception; a dark moon means poor reception. His observations are sure to attract the attention which they so well deserve. With Mr. Shannon's brief theoretical suggestion of a direct effect of the moon in bending the paths of the ether waves we cannot agree. The bendings due to the action of gravity, in accordance with the theory of relativity, are far too small.

There is a more plausible possibility. Both the moon and the sun raise tides in the sea. They also create tides in the atmosphere, although minute ones. There is reason to believe that they produce tides in the upper atmospheric region so important in radio transmission—in the region of the Heaviside Layer. Probably it is some fluctuation of these aerial tides, varying with the relative positions of the sun and the moon and perhaps creating bulges or hollows in the ionized Heaviside region, which must be held responsible for the interesting variations of reception which Mr. Shannon observes. We share his hope that other observers will repeat and extend his work, as undoubtedly they will.

—THE EDITOR.

By DEREK SHANNON, F.R.S.A.

ONE of the outstanding radio problems still to be solved is that of the mysterious variations of signal strength often observed in long-distance reception, even when the power input to the transmitter and all other conditions at both receiving and transmitting ends remain unaltered.

Some station may be received satisfactorily for a considerable time, perhaps for some weeks. Suddenly, for some unknown reason, the signals from that station will become inaudible, or nearly so, on the same receiver. This condition may last for some days, when, for no apparent reason, the signal will again become normal.

Meanwhile nothing has been altered in either transmitter or receiver. This effect has nothing to do, of course, with the well-known phenomena of increased signal strength at night, believed to be due to the layer of ionized gas in the upper atmosphere, known as the Heaviside Layer.

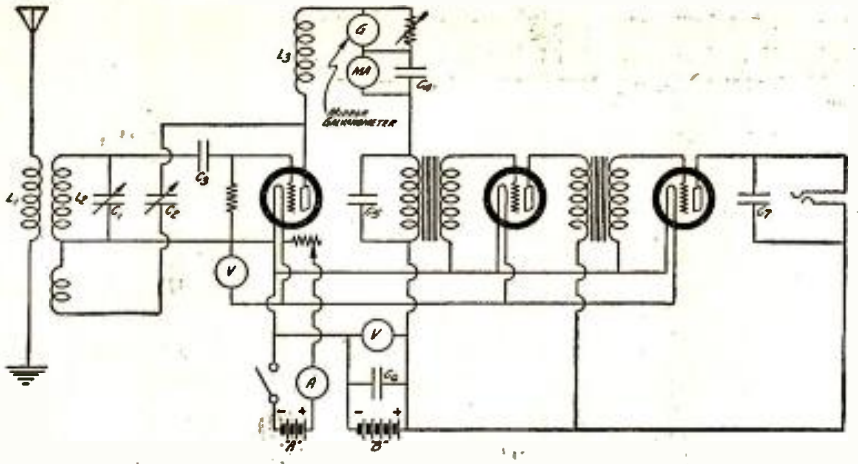
My purpose here is to suggest an entirely new theory to account for these variations in signal strength from time to time, about which so little appears to be known.

I have carried out much experimental work to reach this theory, and I have arrived at some definite results. Other workers in the field may follow up these, I hope, for the benefit of radio science.

When listening to radio transmissions from distant stations I noticed from time to time that on highly moonlit nights the results always appeared much better than at other times. This was true especially for transmissions from the distant stations. This led me to wonder whether the moonlight might have something to do with the effect. I began to make notes of good nights and of bad nights for reception. After a time I found that good reception almost always occurred during the period of full moon, even when the moon itself was obscured by clouds or by bad weather. The moon affects the matter somehow, but I have come to the conclusion that it is not the moonlight which increases the signal strength, but the rotation of the moon round the earth.

I made detailed observations on my reception of the short-wave transmission of KDKA at East Pittsburgh, Pennsylvania, as this station has a fairly constant transmission and is at a distance—3,500 miles—sufficient to make changes in signal strength apparent. My observations were as follows:

As the moon commences to decline from full, the received signal strength of this station also declines. As the moon declines still further the signal strength continues to diminish. At the time when the moon is between the



THE CIRCUIT USED IN MAKING THE TESTS

FIGURE 1: *Here is a schematic diagram of the sensitive regenerative circuit used by Mr. Shannon in England for receiving the signals from station KDKA, in East Pittsburgh, Pennsylvania. Notice that the galvanometer for measuring signal strength is coupled directly to the detector circuit.*

earth and the sun, so that it is dark, the signal strength is at its lowest point. As the moon then begins to increase towards its first quarter, the signals of KDKA show an increase in strength. At first this is very slight; afterward it rapidly increases, and about three days before the moon is full the maximum of signal strength is reached. This maximum remains until about three days past the full, when the signals begin to fade again, and the cycle is repeated throughout the next lunar month.

There were many factors to be considered in the choice of a constant and stable receiver for these tests, especially so because of the short wavelength of 63 meters on which KDKA transmits. After much consideration and many tests I decided to use a simple one-tube circuit with two stages of low-frequency amplification. The chief trouble anticipated was in the use of regeneration, which had to be employed in order to receive KDKA regularly. Being more or less variable, this was the greatest problem.

This difficulty was overcome by using the Reinartz circuit and fitting the regeneration control with a fine vernier adjustment for accurate setting. Once this was set at a critical point, it was never touched again during the test period. Thus handled, the receiver remained quite constant in action. The set was fitted, also, with a filament voltmeter and ammeter and with a plate voltmeter and milliammeter, to insure having exactly the same conditions in the receiver each time that it was used.

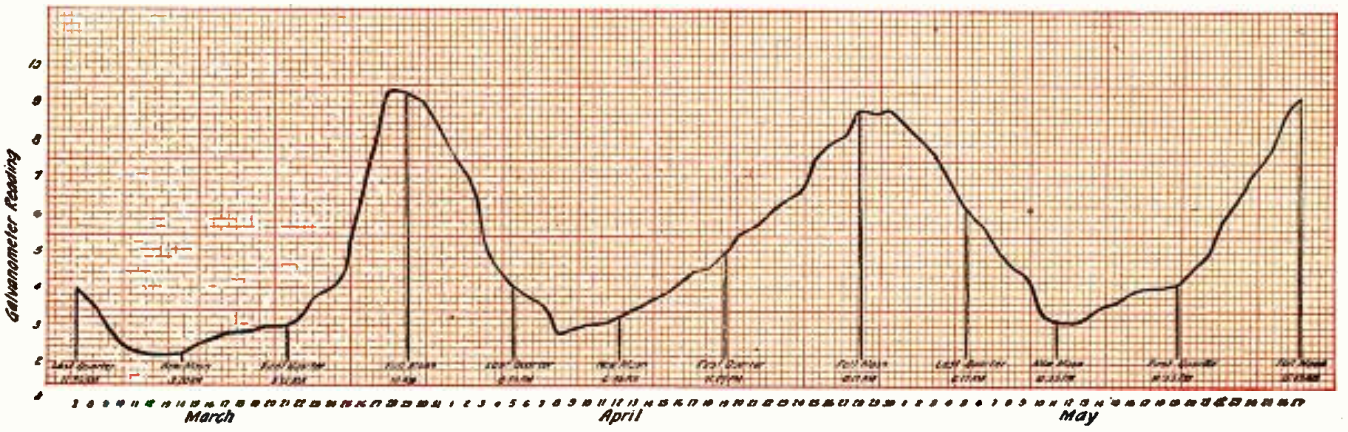
The aerial was of the single-wire, "L" type, fifty feet long, with a twenty-foot down lead. It was forty feet high at both ends, was stretched as tightly as possible between the masts and was kept strained by means of a weight on one halliard. No capacity change could take place by means of the aerial swinging or moving in some other way. It was coupled aperiodically to the receiver.

The ground was only ten feet long, of single fourteen-gauge copper, taken straight to a main water pipe below the set. Every part of the apparatus was fixed rigidly to the test bench. No loose leads were allowed to hang about. The whole of the wiring was done with four feet of square, tinned copper wire. V-24 tubes were used both for the detector and for the low-frequency stages. The low-frequency amplifier was used, of course, for listening to the transmission on telephones. For the actual measurements of the signal strength a sensitive mirror galvanometer was employed.

The deflection of this instrument was not very great, but was magnified by focusing its light spot on a special screen. I so arranged matters that a full-scale deflection of the light spot travelled over a scale of ten inches. The screen was of ground glass, with a scale marked thereon in ten divisions, each division being again split into ten.

In operation, the galvonometer was inserted in series with the plate of the detector tube and was shunted by a variable resistance, to enable adjustments to be made. The light spot was then adjusted to zero on the ground-glass scale, with no signals coming in, but with the receiver switched on and turned to 63 meters. The scale was so arranged that when the carrier wave of the station came in it showed as an increased reading, commencing at zero and finishing at ten. The circuit arrangements are shown in Figure 1.

When all was prepared, preliminary trials were made every night for a week, to determine whether the apparatus would remain stable without adjustments. This was found to be the case, provided all values of voltage and amperage on filaments and plates were




HOW RECEPTION VARIED WITH THE PHASE OF THE MOON

FIGURE 2: *This chart, covering three months, shows how the signal strength, as measured by a sensitive galvanometer, increased and decreased with the waxing and waning of the moon.*

From a photograph made for POPULAR RADIO

LISTENING IN FOR SIGNALS FROM ACROSS THE WORLD

*Here is Mr. Derek Shannon, author of this article, with the apparatus that he used in determining the effect of the moon's phases on radio reception. Notice the complete shielding of the receiving set; this and other measures were adopted to prevent any outside influence from affecting the received signal strength.*

kept adjusted to exactly the same values used when the apparatus was first set.

A start of the actual readings was made on January 10, 1925 at 11.30 P. M., this being the night of full moon. Observations were taken until 12 o'clock. Slight variations took place during the half-hour, but a reading was taken every five minutes and an average was struck; this average was entered on the curve. This test was then repeated every night until February 8, that being the night of the next full moon. A second test was made commencing on February 23, 1925, the night of a new moon; this test continued every night until March 24, 1925, the night of the next new moon. Since KDKA did not transmit on the short wavelength on Sundays, no readings were made on those days.

The curves for each test show a rise in the signal strength as the full moon approaches. This falls off again as the moon declines. The curves do not show straight lines up and down, but we must take into consideration the fact that slight alterations may take place in the transmitter, which would account for this. This does not alter the clear conclusion that the signal strength rises as the moon waxes and falls as it waves, as the chart in Figure 2 shows.

At present I am attempting to devise a receiver with a number of stages of high-frequency amplification and a carborundum rectifier, in which no regeneration will be used. This will be used on a higher wavelength, and I would suggest to anyone who wishes to carry out experiments along this line that some receiver of this type be perfected. The elimination of regeneration would remove the greatest variable factor—something which is most desirable. It is necessary to lay great stress on the additional necessity of making everything as rigid as possible. The whole apparatus must be untouched during the period of the test. I must add, also, that the galvanometer readings indicate the strength of the carrier wave, not the amount of modulation. This is very important, as the modulation of a telephone transmitter, especially at a broadcasting station, is being altered continually and would provide no indication of the strength of reception.

Many nights, when listening to KDKA during these tests, the speech transmission was nearly inaudiable, but the carrier wave was extremely strong. Anyone making these tests should take no notice of the loudness of the speech or music received, but should deal only with the strength of the carrier wave, as shown on the galvanometer.

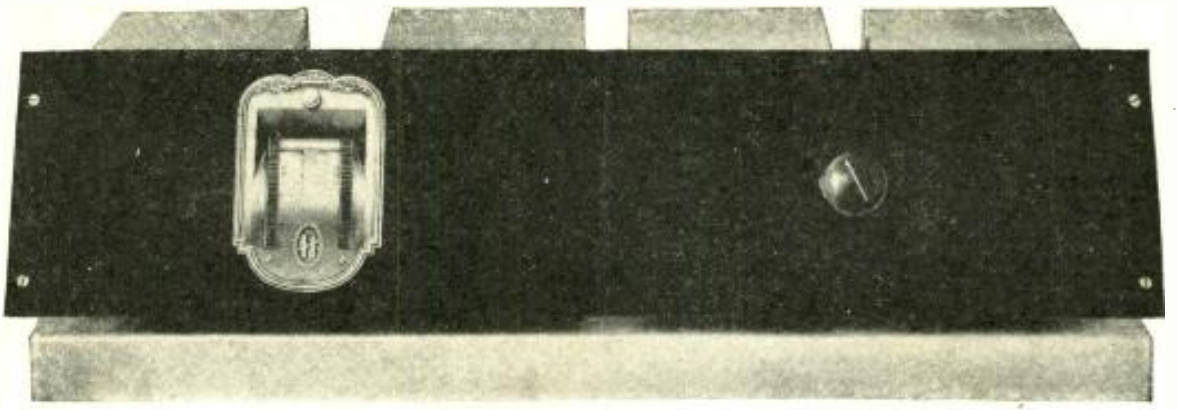
This mirror galvanometer must be of a sensitive type, and the variable resistance placed in a shunt around it must be of sufficiently low resistance to pass the plate current. When adjusting this resistance to obtain the zero reading, great care must be taken that the galvanometer is not burnt out. It is advisable to set this resistance at its lowest value, so that the galvanometer is practically short-circuited, when first switching on the set. The station is then tuned in and all meter readings are carefully noted. Then wait until the station has closed down and adjust the galvanometer to zero by means of the shunt resistance. When the next transmission takes place, the galvanometer will read the strength of the carrier wave. When taking the readings of the galvanometer, it is advisable to stand as far away from the apparatus as possible, in case the set is affected by body capacity.

I have spent so many months making these observations and have checked so carefully the results of the nightly tests that there seems to me no possible doubt that the effect is real and is produced by the moon. About the cause, it is not possible to be so certain. Perhaps the variations of signal strength are caused by the gravitational effect of the moon and the sun, acting on the ether waves and deflecting them from their course in the same manner that light rays are deflected by gravitation. In Einstein's theory of relativity, every kind of matter distorts the ether around itself. Could we not assume that two bodies as near together as the earth and moon, and as constantly changing their positions in relation to each other, might cause a considerable and complicated ether distortion? But this is purely a hypothesis.

There exists one small factor which should not be overlooked. It is that on very bright moonlight nights the atmosphere is usually much more free from moisture than at other times. This may have some bearing on the alteration of signal, although I think not, for it is noticeable that the signal strength usually remains good whenever the moon is full, even on damp nights.

At the present I am engaged on a new series of observations, using more delicate instruments for measuring and recording the variations of signal strength and taking much greater precautions to exclude any possible factor which might give false results. I hope to place on record later on the results of these further tests.

¶Both for the man who has never built a set before and for the experienced set builder the LC-28 offers a unique opportunity of easy construction with unexcelled results.



THE TWO-FISTED CONTROL PANEL OF THE LC-28

FIGURE 1: *This view gives some idea of the absolute simplicity of the LC-28. At the left is the double drum dial for tuning, and at the right is the combination battery switch and volume control.*

## HOW TO BUILD THE NEW

# LC-28 RECEIVER

POPULAR RADIO *believes that outstanding qualities of the LC-28—sensitivity suitable for distance reception without an antenna, tone quality adaptable to any taste, and selectivity sufficient to eliminate interference without causing distortion—make it a receiver unrivaled in the field of radio construction.*

By LAURENCE M. COCKADAY

COST OF PARTS—*Not over $91.00*

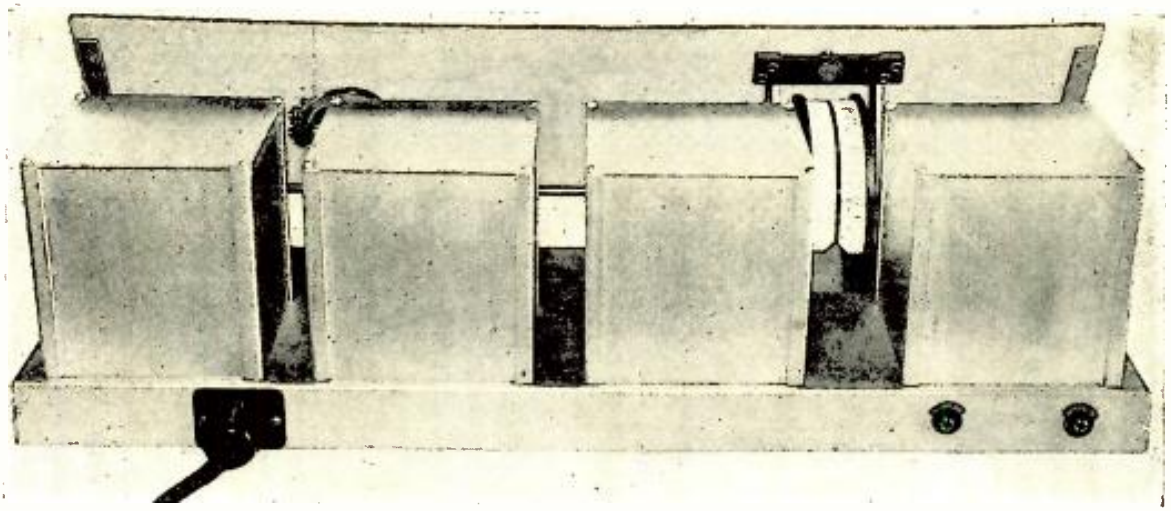
HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES NECESSARY FOR BUILDING THIS RECEIVER—

A, B, C and D—Precision radio-frequency transformers (4 transformers), type 4-B;
E1, E2 and E3—Samson high-frequency chokes, type No. 125;
F—Samson high-frequency choke, type No. 85;
G—Lynch suppressor, 500 ohms;
H—Lynch suppressor, 600 ohms;
I—Lynch suppressor, 700 ohms;
J1, J2, J3 and J4—Hammarlund mid-line variable condensers, .000275 mfd.;
K1, K2 and K3—Aerovox moulded condensers, .02 mfd.;
L—Aerovox moulded condenser, .00025 mfd.;
M—Aerovox moulded condenser, .00075 mfd.;
N—Durham metallized resistor, 6 megohms;
O1, O2, O3 and O4—Carter fixed resistors, type H-4, 4 ohms;
P1, P2, P3 and P4—Benjamin vibrationless sockets;
Q—Yaxley cable connector plug with cable, type 660;
R1, R2, R3 and R4—Special small size aluminum box shields for LC-28, made by the Aluminum Company of America;
S—Yaxley combination switch and rheostat, type No. 906-K, 6 ohms;
T1 and T2—Carter "Imp" plugs and tip jacks, marked "Antenna" and "Ground," respectively, with insulating washers for the antenna;
U—Hammarlund double-drum dial;
V—Brass extension shaft, 16½ inches long and ¼ inch in diameter;
W—Aluminum panel, 6 inches by 26 inches, drilled and decorated, made by Wholesale Radio Service Company;
X1 and X2—Tait brackets;
Y—Aluminum chassis for the LC-28, made by the Aluminum Company of America;
Z—Lynch single-resistance mounting;
Wire, screws, nuts, etc.

THE unique design, both from a mechanical and an electrical standpoint, of POPULAR RADIO'S latest contribution to radio science, the LC-28 receiver, should make it ideal for radio broadcast reception. It embodies, as told in the September number, many new and advanced electrical principles, as well as a mechanical design that is exceptionally well suited to the constructional ability of the home set-builder. Upon final completion, the LC-28 receiver should be comparable, both in construction and in operation, to the finest set now obtainable.

It is the claim of POPULAR RADIO'S technical staff that anyone can build the set and obtain the expected results without previous knowledge of set building, and without any electrical or mechanical ability, by simply following exactly the constructional information in this article.

Some of the reasons for advancing



SOLID CONSTRUCTION MAKES THE LC-28 A PERMANENT JOB

FIGURE 2: *The four stage shields containing the amplifying apparatus are mounted on a metal chassis. The metal panel to which are attached the drum dials is also mounted on the chassis by means of sloping metal brackets.*

this claim are set forth below:

*First:* The set is built entirely on a metal chassis, completely stamped and drilled and ready for mounting the instruments. It contains a complete set of shields and a metal panel drilled and engraved. In assembling, the only instrument necessary is a screw-driver.

*Second:* The wiring is exceptionally easy to do, as there is only approximately five feet of wire in the complete job.

*Third:* The instruments are mounted with brass machine screws and nuts that are obtainable in any hardware store.

The receiver has an exceptionally high amplification and yet is easy to tune by a double drum control.

The appearance, when placed in the special consoles made for it, is in keeping with the finest receivers furnished. The set may be used with no antenna at all, with a loop, or with any form of indoor or outdoor antenna.

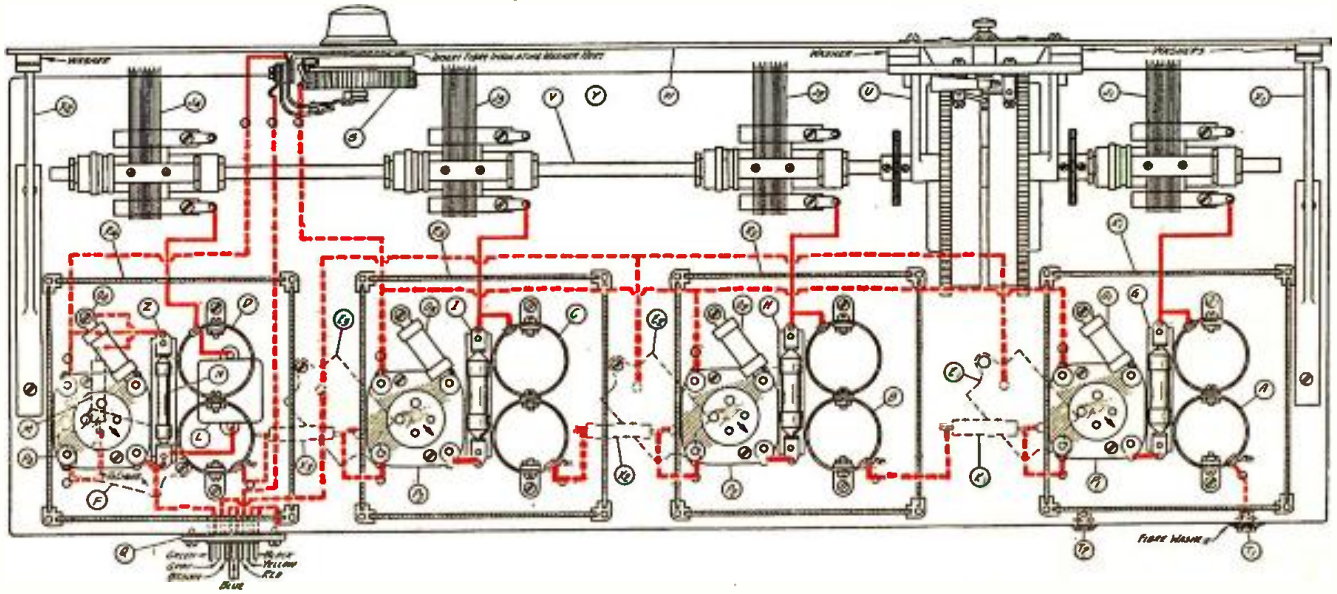
The fundamental circuits employed in the LC-28 high-frequency pack is given in Figure 5.

*How to Assemble the Instruments*

The making of the new receiver is simplified to such an extent that it is hardly necessary to tell in words how to build it. The accompanying illustrations and diagrams tell the story at a glance; but to be doubly sure a complete outline is here given showing the constructional details in the best possible order of procedure.

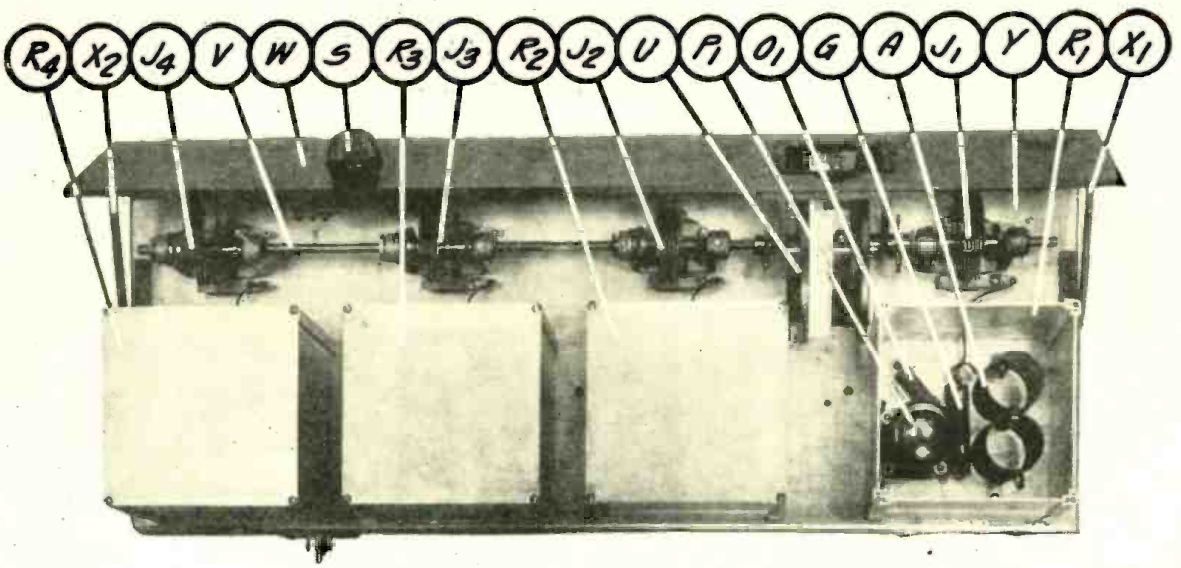
The aluminum chassis, Y, comes from the manufacturer already prepared, drilled, cut, stamped and finished. The same is true of the front panel, W, and the four sets of shields, R1, R2, R3 and R4.

The first job in putting the set together is to mount the various instruments on the chassis, Y. It would be advisable first to mount the four high-frequency choke coils, E1, E2, E3 and



AN ALMOST "WIRELESS" RADIO RECEIVER

FIGURE 3: *The careful planning that has gone into this receiver has eliminated at least 70 per cent of the usual wiring. In this diagram the instruments above the panel, in their correct positions, are outlined in solid* BLACK *lines; those below the panel are shown in dotted* BLACK *lines. The wiring above the panel is shown in solid* RED *lines, and the wiring below the panel in dotted* RED *lines. When the set is completed only one wire is visible in each stage—the wire that connects to the stators of the variable condensors.*




A VIEW OF THE RECEIVER FROM ABOVE

FIGURE 4: *The cover of one of the stage shields has been removed to show the arrangement of the coil, valve, stabilizing resistor and the fixed filament resistor. The four tuning condensers with the drum dials attached may be seen behind the front panel.*

F, underneath the chassis, Y, in the two proper holes drilled for them, as shown in Figures 3 and 6. In mounting all of the instruments, the screw heads of the mounting screws should all be attached from above the chassis, and the nuts should be put on from the under side.

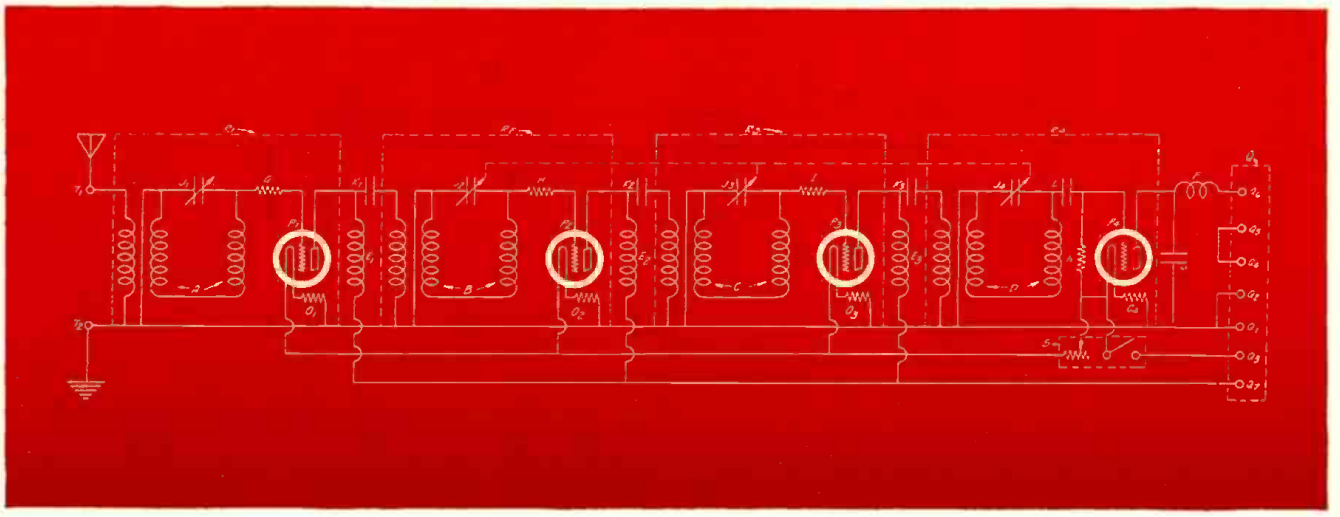
Next, set up the four sockets, P1, P2, P3 and P4, as shown in Figure 3. These should be mounted with two machine bolts and fastened underneath with two corresponding nuts tightened securely.

Next, fasten one end of the four resistances, O1, O2, O3 and O4, to the binding posts marked "—" of the four sockets, P1, P2, P3 and P4. This is done by first unscrewing the knurled nut on the binding post, then placing the ringed terminal of the resistance over the bolt and fastening down tightly with the knurled nut. The other end of the four resistances should be fastened with a bolt and nut to the proper holes in the chassis, Y, as shown in Figure 3.

Next, set up the four high-frequency transformers, A, B, C and D, in their proper places, as shown in Figure 3. This operation requires two nuts and bolts to each instrument.

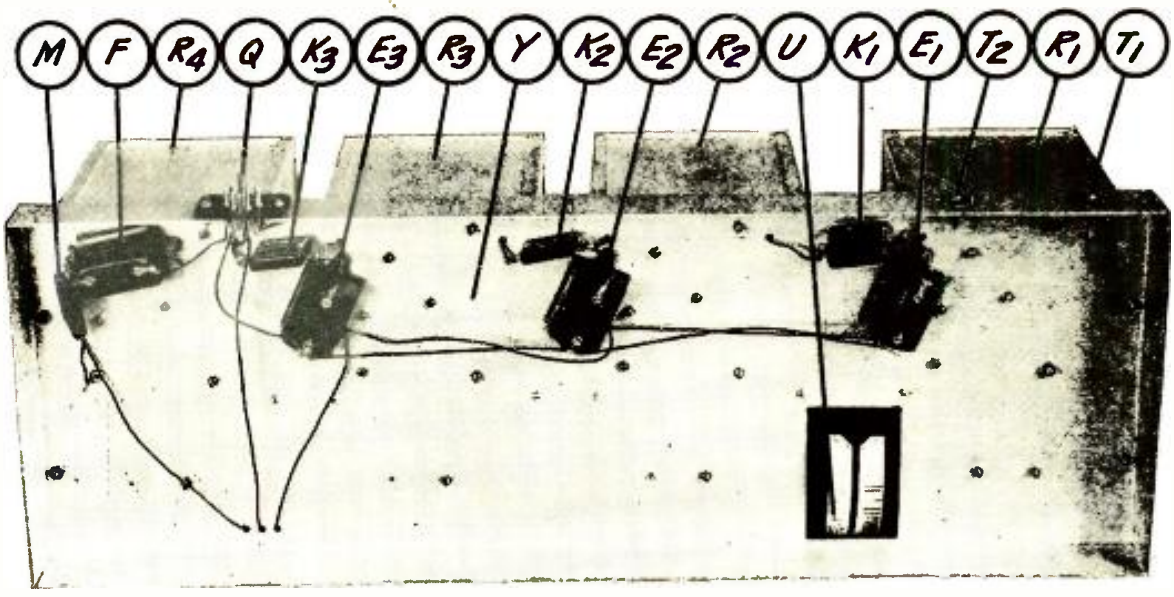
Now set up the three suppressor mountings, G, H and I, and the grid-resistance mountings, Z, in their proper positions on the chassis, Y. This is

*The list of parts given on page 214 includes the exact instruments used in the laboratory model of this receiver. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instrument. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE SCHEMATIC DIAGRAM OF THE LC-28 CIRCUIT

FIGURE 5: *The condenser of the first high-frequency stage, at the left, is tuned by one tuning drum; the condensers of the two following stages and the detector stage, at the right, are tuned together by the other.*




THE UNDER SIDE OF THE LC-28 SUB-PANEL

FIGURE 6: *The chokes and condensers, with their wiring, are shown in their correct positions. A portion of the double drum may be seen protruding from the cut-out.*

shown in Figure 3. One screw and a nut is used in each case.

Next, fasten down temporarily the four variable condensers, J1, J2, J3 and J4, as shown in Figure 3. These are attached to the chassis, Y, by a single bolt and a nut, except in the case of condenser J4. The reason for mounting these condensers with only one bolt and nut to each is that this will allow them to line up properly when the single extension shaft, V, is attached to all three condensers.

Now attach the plug of the Yaxley cable, Q, in the place made for it, as shown in Figure 3. The metal bracket of the plug is not used and the screws are inserted in the screw holes of the bakelite strip that originally held the bracket.

When this is done, the two tip jacks, T1 and T2, marked "Aerial" and "Ground" should be installed, as shown in Figure 3. The one, T1, marked "Aerial" should be insulated from the chassis with insulating washers, and the one, T2, marked "Ground" should be installed without insulating bushings and should be attached firmly to the metal of the chassis, Y.

This completes the constructional work on the receiver up to the point where the wiring should be done. The remaining constructional work should be left over until the wiring is practically completed.

### *How to Wire the Set*

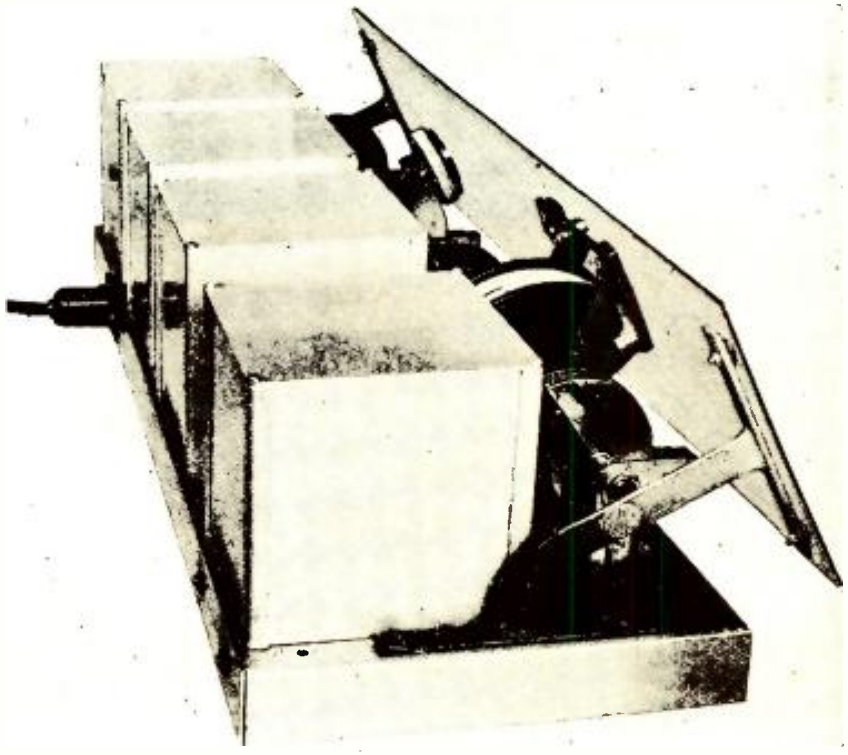
The design of this set is such that the wiring is accomplished, in as many cases as possible, by the mere act of fastening down the instruments onto the metal chassis. This is the case with one connection (the grounded connection) of each of the variable condensers, J1, J2, J3 and J4; with two connections of each of the high-frequency transformers, A, B, C and D, and with one connection of each of the resistances, O1, O2, O3 and O4. It is also the case with all the connections to the ground and the "A" minus (—) and the "B" minus (—) terminals of the power supply.

This feature eliminates probably 15 or 20 feet of wiring that would ordinarily have to be done, and leaves the set completely hooked up with approximately five feet of wiring. *This makes for simplicity!*

All connections should be made with a tinned copper flexible wire, insulated with a hard coating, such as "Celatsite."

Refer to the picture-wiring diagram

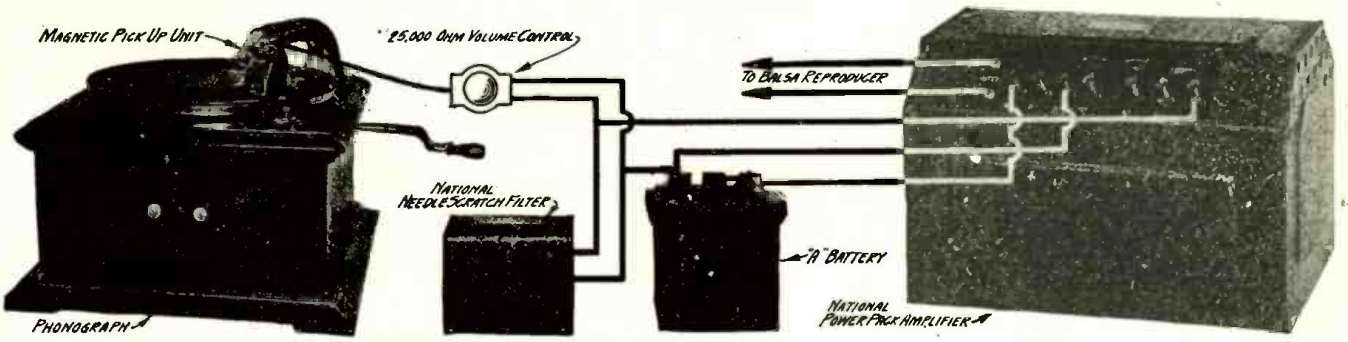
(*Continued on page 286*)



AN END VIEW OF THE RECEIVER

FIGURE 7: *This view shows the receiver fully wired and assembled, and ready to be installed in its cabinet.*

*¶ The third of the series of articles on the new electrical units that enable you to reproduce phonograph programs with the tone quality and volume of the best radio reception.*




A MATCHED COMBINATION THAT PUTS NEW REALITY INTO PHONOGRAPH REPRODUCTION

FIGURE 1: *This easily assembled hook-up employs a power-pack amplifier (shown at the right) that operates from the AC lighting lines. This power-pack amplifier may also be used with any high-frequency amplifier for the reception of broadcast programs—thus making possible two forms of program reproduction with the same low-frequency amplifier and loudspeaker.*

## HOW TO ADD TO YOUR OLD PHONOGRAPH

# *The* New Amplification Units

This installment in the series of articles on the phonograph pick-up units gives new and valuable information on the correct methods of choosing and matching units to obtain the best results in phonograph reproduction. It also gives details for assembling a matched hook-up that employs one of the new combination power-pack amplifiers; this amplifier is a complete instrument operating from the AC lighting lines, that may be used either with a phonograph pick-up or a high-frequency amplifier.

By JAMES MILLEN

NOT so very long ago there existed in the minds of many people some doubt as to whether or not the then new novelty, radio, could ever reach the "perfection" of the phonograph as regards tone quality, service and reliability. Now, on the other hand, there again seems to be some doubt in the mind of the public on the same question, but from the opposite angle: "Can to-day's phonograph compete with radio in tone quality, service and reliability?"

Benefitting by the advances made in the acoustical art as a result of the developments of radio, the electric phonograph of to-day is similar to the low-frequency amplifier, reproducer and power-pack combination used in high-grade broadcast receivers. The output of the electric phonograph, when one gets right down to the matter, is but a standard broadcast program which, instead of being sent over the air, is recorded in a permanent manner and delivered to the consumer on a platter.

With these improvements, and one other—the elimination of the record scratch—the modern phonograph becomes a highly desirable companion to the modern radio receiver.*

However, the phonograph can never take the place of the radio. First, the radio brings news and entertainment into the home as it is actually occurring—banquets, speeches, sporting events and many others; and, second, radio supplies its own program; its repertoire is not limited by the number of records in the album.

But as a companion to modern radio, there is a distinct service to be performed by the electrically operated phonograph.

It is the purpose of these articles to show how standard equipment available on the radio market may be grouped together to improve and beautify the results of the old-style phonograph by radio methods. Furthermore, another article to appear in a future issue of POPULAR RADIO will give the constructional details for a single-control, two-valve set which is so designed as to employ the same power-pack, low-frequency amplifier and reproducer as the electrical phonograph will use. The complete combination may be housed in a specially built cabinet, a radio cabinet or an old-style phonograph console cabinet.

But first let us consider the various components of the phonograph—the pick-up, the needle scratch filter, the volume control, the amplifier and the reproducer.

### *Pick-ups and Volume Control*

There are at least four different types of pick-ups. The electromagnetic and the crystal types function by generating voltages, while the condenser and the

* For previous articles on the Electrical Phonograph see the July-August and September, 1927, issues of POPULAR RADIO.

carbon forms operate by variations of impedance.

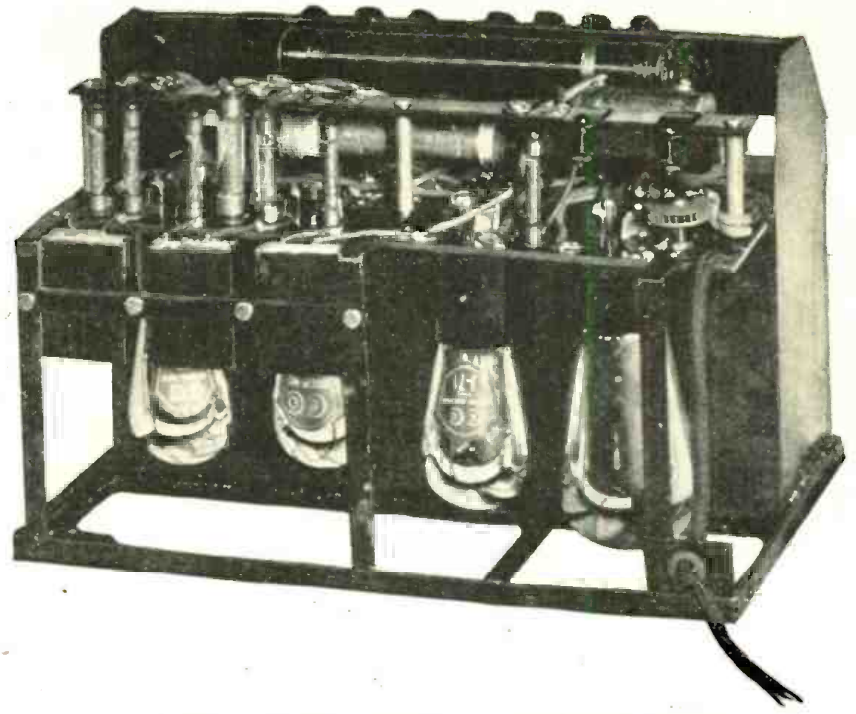
Of these four, the most popular type at present is the electromagnetic form. To this class belong the pick-ups used in the "Electrola," the "Panatrope" and the "Vitaphone." This latter is in reality a special electric phonograph designed for synchronization with a motion picture projector.

One of the large corporations interested in the development of radio is experimenting with a pick-up of the crystal type, but as yet this unique device is still in the experimental stage.

Pick-ups of the carbon type have been in existence for a number of years, but only recently has one capable of high-quality reproduction been perfected. This type of pick-up, which depends for its operation upon the change of its electrical resistance with vibrations of the needle, is in a somewhat different class from the others, as it is designed to operate a reproducer without the use of an amplifier.

Pick-ups can be made of the same parts that are used in the construction of the ordinary radio-type headphones and reproducers. As a rule, however, for best results a unit designed "from the ground up" as a high-grade pick-up should be used. Several units of this type are now being manufactured.

In mounting the pick-up, fasten its base in such a position that the needle, when swung to the center of the record, will rest in the exact center of the turntable shaft. The pick-up selected must be capable of high-quality reproduction or the best results cannot be expected. The Pacent, the Warford and the Bosch "Recreator" have been found extremely satisfactory. Most pick-ups have a volume control located on the base of the stand. If not, a 25,000-ohm resistance, such as a Royalty or the Centralab Radiohm, may either be mounted in the turntable compartment or on the panel of the receiver.



A VIEW OF THE POWER-PACK AMPLIFIER FROM THE REAR

FIGURE 2: *This picture gives an idea of the layout of the complete power-pack amplifier with its metal case removed. The vacuum valves are inserted from the bottom and are protected from dust and mishandling while in use.*

### *The Needle Scratch Filter*

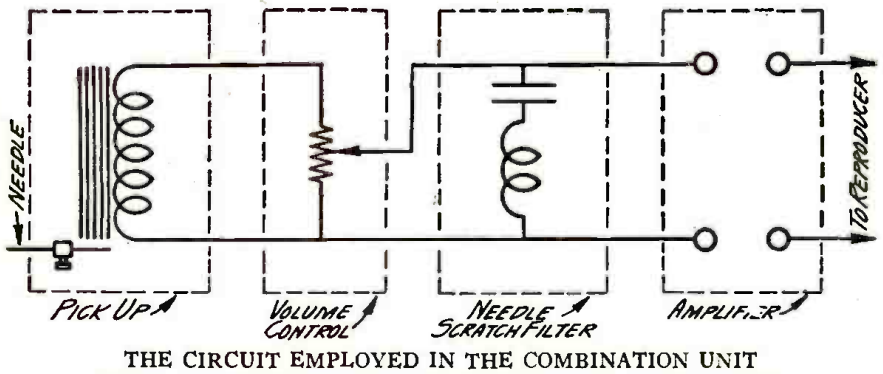
The scratch filter is for the purpose of electrically removing from the output of the reproducer the "hiss" due to the contact of the needle on the record.

While an electrical filter circuit of the type indicated in Figure 3 will remove all objectionable scratch noises from the music issuing from the loudspeaker, it will not prevent one hearing the unamplified scratch noise directly from the record. For this reason the lid of the turntable compartment should be kept closed while records are playing.

While the connection of a .006 mfd. fixed condenser across the output of the pick-up or input to the amplifier will also remove this noise, such an arrangement will also remove many of the higher frequencies and thus partially destroy the quality of reproduction. For this reason an electrical filter circuit, tuned to stop the passage of only those currents in the neighborhood of the scratch frequencies, should be used.

The difficulty in completely eliminating scratch noises lies in the fact that the scratch frequency is not any one frequency, but quite a wide frequency band. If, however, the filter circuit is tuned to approximately 4,500 cycles, the greater part of the scratch noise is removed without the sacrifice of tone quality. The residual hiss, when a scratch filter is employed, is practically unnoticeable and cannot be detected except for the first few seconds or so before the music starts.

Such a device may either be purchased as a complete unit (one is made by the National Company) or may be constructed at home from a choke coil and condenser so selected as to be most effective at about 4,500 cycles. This frequency peak should be somewhat "broadened" by the use of a very small quantity of iron in the construction of the inductance. A scratch filter can be assembled by employing a 1,500-turn honeycomb coil with a .008 mfd. fixed condenser. The circuit for the scratch filter is shown in Figure 3.




THE CIRCUIT EMPLOYED IN THE COMBINATION UNIT

FIGURE 3: *This diagram shows the simplicity of the electrical circuit used in the pick-up and amplifier combination. The reproducer connects directly with the amplifier and may be used in any part of the house by employing an extension cord.*

AN ARTISTIC REPRODUCER

FIGURE 4: *This is one of the decorated Balsa-wood reproducers that may be built in the form of a screen and that gives reproduction of excellent tone quality.*

*The Amplifier*

The amplifier is probably the most important part of the electrical phonograph system. It should have a straight-line frequency characteristic extending well down into the lower frequencies and have sufficient overall gain and undistorted power output for supplying all the volume required for home use.

Such a device is the National combination power-pack amplifier, shown in Figure 2, which is not only a complete high-quality low-frequency amplifier designed especially for phonograph and radio use, but also has the advantage that it requires no "B" or "C" batteries.

The compact little unit consists of two stages of resistance-coupled voltage amplification and one stage of power amplification with special impedance input and output circuits.

The input impedance in the power stage is for eliminating that difficulty encountered with many resistance-coupled amplifiers—the tendency to "motorboat." The output impedance is for the protection of the reproducer from possible damage due to the heavy plate current drawn by the power valve.

The power-pack circuit is essentially the same as that employed in the Nation "B" power-pack, including the new adjustable, fixed-output potentiometer. In addition, however, a special winding is provided on the power transformer for heating the filament of the UX-171 type power valve. The amplifier is completely adjusted before leaving the factory, so that it is only necessary for the user to insert the valves and connect it to his pick-up and reproducer, as shown in Figures 1 and 5.

*The Reproducer*

Good reproducers are of four general types: the large cones, such as the Western Electric; the small baffle cones, such as those devised by Messrs. Rice and Kellogg and used in the "Electrola" and "Panatrope"; the new Balsa-wood flat type, and the orthophonic variety of exponential horns, such as the Newcomb Hawley, the Temple and the Racon.

The Lata Balsa-wood reproducer may be mounted on an easel placed in any convenient part of the room, or hung on the wall in picture fashion. These reproducers, aside from their high electrical excellence, have the additional advantage of distinctive appearance and low cost. It is not at all a difficult problem to construct a very fine speaker in an evening for only $18, the cost of the complete kit. Figure 4 gives an idea of the artistic possibilities of this type of reproducer.

If a cabinet type of orthophonic horn is used, the amplifier and other apparatus may be located right in the cabinet. The turntable, in such a case, may be placed in a small cabinet on top of the speaker. In fact, one of the old table-model phonographs, to which a magnetic pick-up has been added, will be just the thing.

Where a console type of phonograph cabinet is available, the most desirable arrangement is to remove the old horn, and in its place behind the silk grille locate a baffle-type speaker, such as the new Radiola 100-A, or the latest electric-dynamatic movable coil type of Magnavox cone.

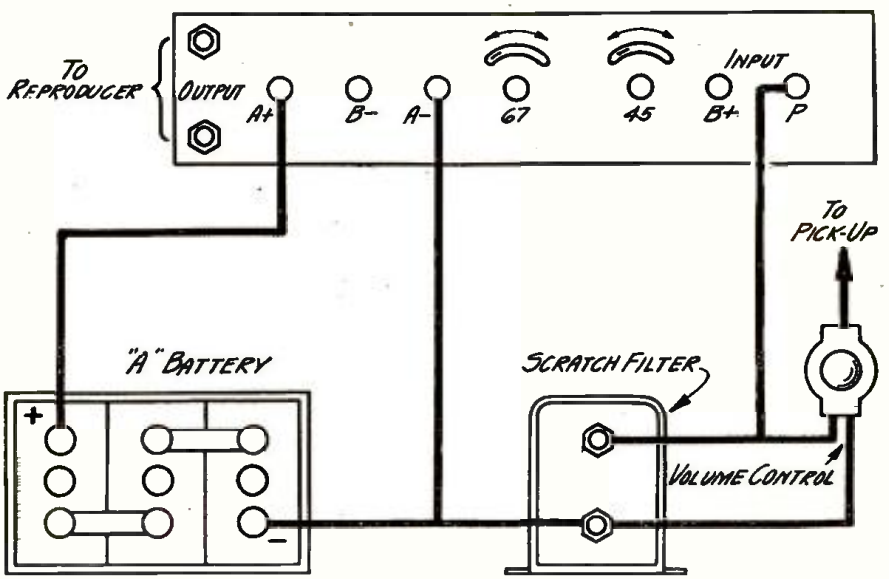
The baffle board for mounting such speakers should be of about one-half inch thick white pine or other soft wood. A round hole should be cut in the center of the board and so beveled that the outside diameter is slightly larger than the inside diameter. The cone framework is then bolted in place so that the cone is centered behind the hole.

Thin veneer should not be used as a baffle board, as it may prove to be resonant at some frequency within the audible range.

Though the preferred arrangement for an AC-operated phonograph is the use of an induction motor to operate the turntable, such motors of the proper size are rather difficult to obtain. Most phonograph dealers, however, stock excellent motors of the universal type, which, as they are only run when the radio receiver is not in operation and will therefore cause no interference, are entirely satisfactory. Such motors cost from $15 to $30.

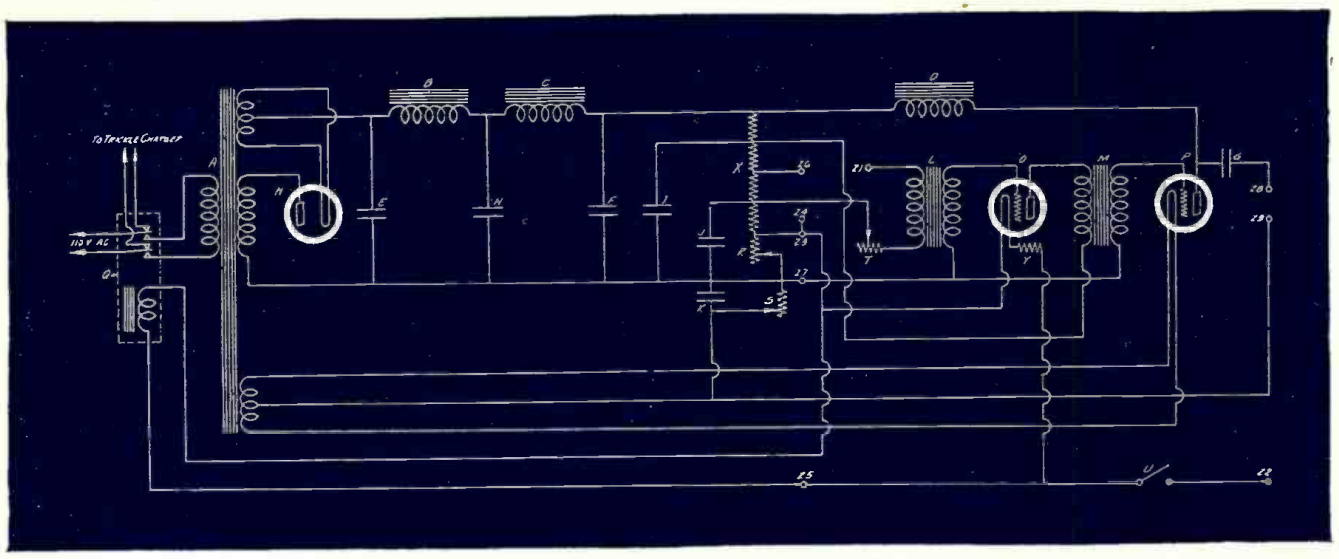
If a spring motor is used in the phonograph the amplifier should be so placed that the rectifier and power valves, which become quite warm in operation, are not directly under the motor, for such placement might cause the graphite in which the spring is packed to melt.

In conclusion, it is well to emphasize the importance of using the new electrically cut records for obtaining the best results with the phonograph.




HOW THE UNITS ARE TO BE CONNECTED

FIGURE 5: *This diagram gives the exact connections for the power-pack amplifier, the scratch filter and the volume control, as well as the connections to the "A" battery for lighting the filaments of the vacuum valves. A metal link comes with the amplifier that connects the "B" negative terminal to the "A" negative terminal, so that this connection is not shown in this diagram.*



THE SCHEMATIC DIAGRAM OF THE POWER-PACK AMPLIFIER

FIGURE 1: *At the right is the rectifier circuit of the unit, with the connections to the 110-volt AC lighting line and to the automatic relay that controls the trickle charger of the "A" battery. In the center of the diagram is the filter circuit, and at the right is the circuit of the two-stage, transformer-coupled, low-frequency amplifier.*

# How to Get Quality Amplification

NUMBER 5: *How to build a unit that combines a "B" and "C" power-pack with a two-stage, transformer-coupled, low-frequency amplifier. This unit may be used to improve the volume and quality of any old receiver by hooking it up to the output of the detector valve, or it may be combined with any type of high-frequency amplification that the experimental set builder desires, to make a new receiver. The unit is entirely self-contained and may be installed in a console with the high-frequency pack or operated separately.*

By ALBERT G. CRAIG

COST OF PARTS: *Not over $117.00*

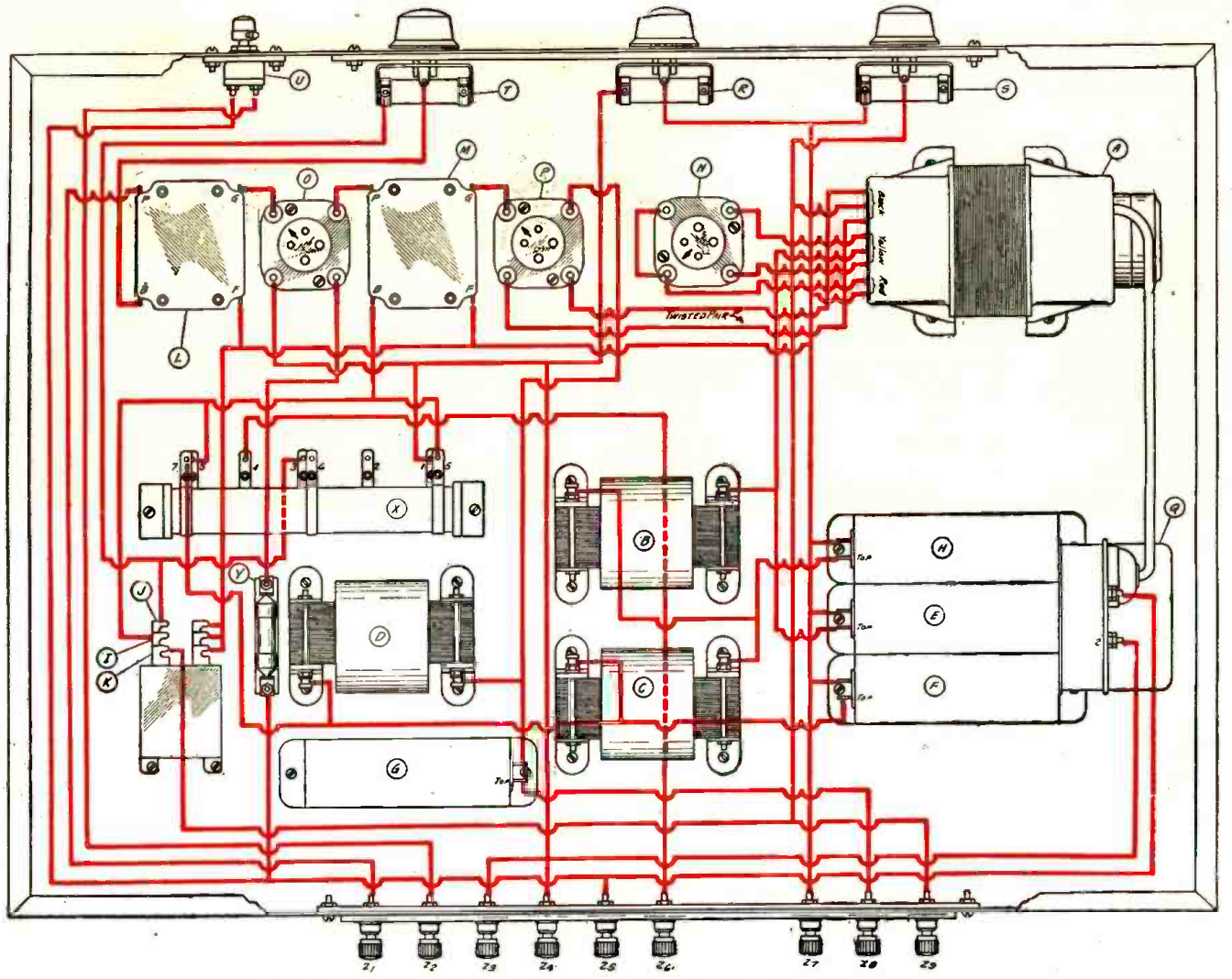
HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES NECESSARY FOR BUILDING THIS UNIT—

A—AmerTran Transformer, PF-52;
B, C and D—AmerChokes, type 854;
E, F and G—Tobe high-voltage condensers for 1,000 volts DC operation, No. 602, 2 mfds.;
H—Tobe high-voltage condenser for 1,000 volts DC operation, No. 604, 4 mfds.;
I, J and K—Tobe filter condensers, type 301, 1 mfd., for 300 volts DC;
L—AmerTran DeLuxe transformer, first stage;
M—AmerTran DeLuxe transformer, second stage;
N, O and P—Benjamin Cle-ra-tone vibrationless sockets;
Q—Yaxley multiple type relay, No. 445;
R and S—Electrad Truvolt variable resistors, 2,000 ohms;
T—Electrad Truvolt variable resistor, 50,000 ohms;
U—Carter "Imp" battery switch;
V—Baseboard, 9 by 19 by ½ inch;
W—Imperial sheet metal box equipped with insulating panels for binding posts, the variable resistors and the battery switch;
X—Combination AmerTran resistor, type 400, for AmerTran power-pack;
Y—No. 1-a amperite;
Z1, Z2, Z3, Z4, Z5, Z6, Z7, Z8 and Z9—Eby binding posts;
25 feet of flexible rubber-covered wire;
Mounting screws, nuts, etc.

THE experienced radio fan and professional set builder, who is looking for quality reproduction, will find in this combination amplifier and "B" power-pack a unit that will give him the best type of program rendition with superb volume and tone quality that is hard to equal.

The complete unit may be built as shown in the illustrations in a ready prepared metal box or can that houses all of the instruments and "live" parts. The metal case, once the unit has been assembled, may be slipped into the console of a radio receiver and connected up in a few minutes. It will furnish "B" and "C" power for the high-frequency end of the receiver with which it is used and needs no further attention when once installed and set into operation.

The amplifier employs two stages of high-quality, transformer-coupled amplification, using a UX-201-a type valve



THE PICTURE-WIRING DIAGRAM OF THE POWER-PACK AMPLIFIER

FIGURE 2: *In this diagram all of the apparatus that is mounted on the baseboard, inside of the metal case, is shown in* BLACK *lines, as well as the parts and equipment that are mounted on the case itself. All of the wiring is shown in heavy* RED *lines running to the correct terminals of all of the instruments.*

in the first stage and a UX-210 type power valve in the second stage. A standard UX-216-b type rectifier valve is used in the power-pack to rectify the high-voltage alternating current.

The smoothing filter is a two-stage choke and condenser type filter. An output filter consisting of a choke and condenser is also attached to the amplifier for protecting the reproducer from current overloads. Leading engineers claim that this is the most efficient type of amplifier for use in modern radio reception, and its use, when correctly laid out, designed and built, is recommended to all radio fans who wish either to improve an old set as to its tone quality and volume, or who wish to incorporate the unit in a new receiver.

The schematic wiring diagram of the new power-pack amplifier is shown in Figure 1.

*How to Construct the Amplifier*

The wooden baseboard should first be cut to a size 9 inches by 19 inches by ½ inch and reinforced with two cleats across the bottom.

The instruments should now be mounted in the positions shown in the picture-wiring diagram, Figure 2, and the top view of the amplifier, Figure 4. Note particularly the location of the terminals of each instrument. First mount the three sockets, N, O and P, and the two low-frequency transformers, L and M, on the baseboard, V. Secure the power transformer, A, the three large condensers, E, F and H, and the three AmerChokes, B, C and D, to the base, V. Complete the base mounting by fastening the amperite, Y, the large condenser, G, the three small condensers, I, J and K, and the resistor, X, to the base, V. It should be noted that the three small condensers, I, J and K, are soldered one on top of the other. The relay, Q, is also

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¶ *The list of parts given on page 221 includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

soldered in position on the side of the three large condensers, E, F and H.

Wire the amplifier exactly as shown in the picture-wiring diagram in Figure 2, leaving flexible leads for connection to all of the binding posts and the other instruments that are to be mounted on the metal box, W.

After placing the amplifier unit in the metal box, mount the binding posts, Z1 to Z9, the three Truvolt resistors, R, S and T, and the battery switch, U, on their respective insulating panels.

Complete the wiring by connecting the remaining flexible leads to the proper instruments.

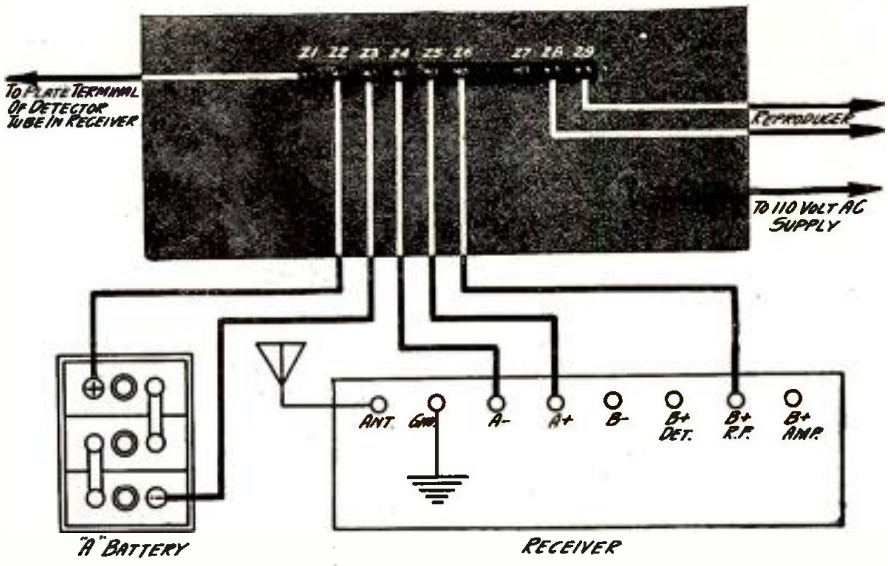
*How to Install the Amplifier*

Figure 3 shows the exact connections to be made between the amplifier unit, the radio receiver and the storage battery. When these connections have been completed, insert a UX-201-a type valve in socket O, a UX-210 type valve in socket P and a UX-216-b type rectifier valve in socket N.

The reproducer which is connected to binding posts Z8 and Z9 should be of the best quality of cone or exponential horn obtainable, in order to insure quality reproduction.

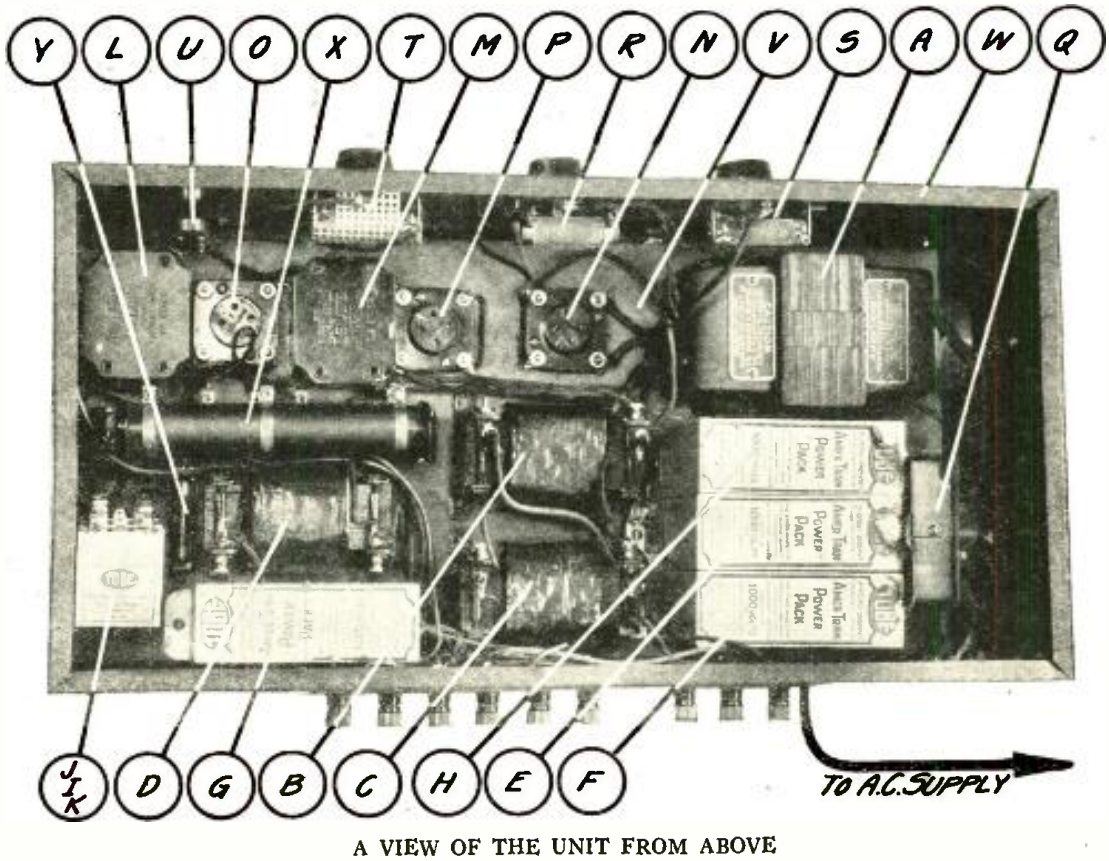
The whole amplifier unit is turned "on" and "off" by means of the small battery switch, U, on the front panel.

The ability of this amplifier to deliver full volume to the reproducer without any overloading should make it very popular with those who want the best in quality reproduction for their homes. In addition, the unit is practically foolproof, as the metal case protects all the instruments, although voltage adjustments may be made with the panel controls. This feature should make it a safe instrument to operate.




HOW TO HOOK UP THE AMPLIFIER

FIGURE 3: *This drawing gives an idea of how this set may be used with any receiver, by cutting out the low-frequency amplifier in the receiver and using the amplifier incorporated in the power-pack amplifier, with excellent results in volume and tone quality.*

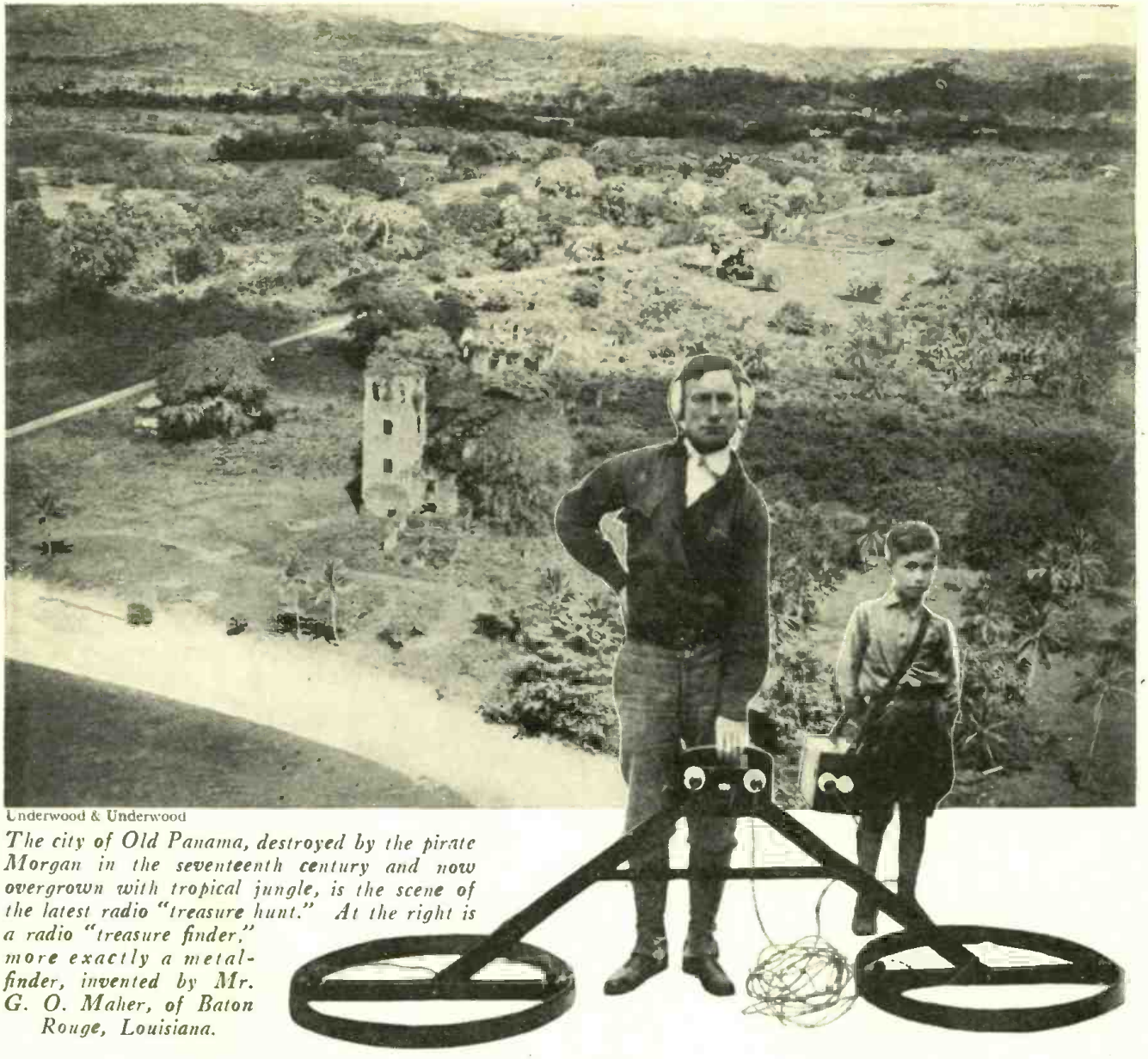



A VIEW OF THE UNIT FROM ABOVE

FIGURE 4: *This view of the power-pack amplifier, with the top of the metal case removed, shows the positions of all of the parts that go to make up this new and powerful unit. All the parts are designated with letters that correspond with the list of parts and the constructional data in the article, so that the prospective builder cannot make any mistake in construction or wiring up.*

# Radio Hunts for Buried Treasure

By CAPTAIN PORTER P. LOWRY, U. S. A.



Underwood & Underwood

*The city of Old Panama, destroyed by the pirate Morgan in the seventeenth century and now overgrown with tropical jungle, is the scene of the latest radio "treasure hunt." At the right is a radio "treasure finder," more exactly a metal-finder, invented by Mr. G. O. Maher, of Baton Rouge, Louisiana.*

NOW radio is being invoked to search for buried treasure.

This treasure, according to belief, is buried in one of the world's most romantic regions—a region that is haunted with memories of pirates, of underground passages, of secret hiding places of immense sums of gold that belonged to the old Inca emperors and to the priests—the city of Old Panama, in Central America.

The city of Old Panama is one of the oldest settlements on the American continent. In 1671 this city was sacked by the English privateersman, Sir Henry Morgan. The amount of treasure found proved much less than the English invaders had expected. There is reason to believe that it was less than the city held; for Panama was an important way station on the great commercial route between Peru and Spain—the route along which there poured back for centuries into the coffers of the Spanish king the gold and gems which were the spoil of the great Inca Empire of South America.

It has long been believed that Sir Henry Morgan's disappointment was not accidental. The citizens of Old Panama had warning of the raid. There have been many stories in the last three hundred years of how the great Spanish families of the time hurriedly buried their ancestral treasures here and there about the city. One of the most circumstantial of these legends tells of how the priests of the cathedral carried into a convenient subterranean passage their store of gold and jewels; not merely the treasure of the church itself, but the collected treasures of many of the wealthy families. This underground storehouse was never found. The priests were captured and put to death, but the secret was kept. Whatever the worthy Fathers may have known went with them to their graves.

No tale such as this could go for long without investigation. There have been innumerable attempts to find the famous underground passage or to discover this or that other cache of precious metals reported to exist somewhere

beneath the foundations of the present city of Panama.

Doubtless some of these caches have been found; it is recorded that from time to time impecunious citizens, not known to be possessed even of visible means of support, have turned up temporarily wealthy.

The latest effort to obtain these buried treasures on a larger scale is the one which involves radio.

Some months ago there came to Panama Lieutenant George Williams of the British Naval Reserves; with him are Commander David Blair and Lieutenant F. W. Keally, both of England, and Mr. Wallace Bain, of the United States.

Another member of the expedition is a piece of radio apparatus, said to be the invention of Mr. Thomas Fahie, of Colchester, England. Using this radio apparatus, Lieutenant Williams is attempting to locate some of the buried hoards of precious metal.

Even the most industrious of treasure-seeking expeditions could not hope to dig and sift the entire subsoil of Panama. There is no lack of maps, reputed ancient, which show places where one should dig. Certainly they cannot all be right, and it is probable that most of them represent the accumulated fancies of three centuries rather than actual facts. It is the function of Lieutenant Williams' radio apparatus to point out the spots where digging may be worth while.

Treasure and secrecy go together. Just what Lieutenant Williams, his aides and his radio apparatus have succeeded in discovering is still a secret. Some objects have been found, including, it is reported, a golden butterfly, jewel-studded and measuring three inches from tip to tip, as well as an image of the Jewish Ark of the Covenant more than six inches long. The government of Panama employs an official charged with the duty of inspecting and controlling searches after buried treasure. The success of the Williams enterprise has been great enough to induce this official to provide military guard for their further operations. It is a known fact that the expedition is having such remarkable success that an extensive concession has been granted by the Panama government to carry on the work on shares.

The exact method of operation employed with Lieutenant Williams' apparatus has also been kept a secret. From such information as is available it is probable that the principle is the well-known one of feeding into the ground an alternating electric current or radio wave. As readers of POPULAR RADIO are well aware, methods of this kind have been perfected in Sweden for tracing the locations of underground mineral lodes. Any underground material which is more highly conducting electrically than is the general average of the subsoil will deflect the currents or radio waves thus introduced. Such disturbances may be detected and will serve, when conditions are favorable, as indications of just where the conducting material lies.

Gold, like other metals, is an electrical conductor. It is quite probable that buried masses of gold could be detected in this way.

Another method which is likely being used by Lieutenant Williams' apparatus depends upon the detuning effect of underground masses of metal upon a delicately tuned oscillating circuit in the air above the treasure-bearing soil. It was this method that was proposed a year or more ago for use in hunting the supposed treasure of Cocos Island, off the southern coast of Panama. Indeed, it is reported that the method actually was used and proved successful, but that the persons who found the Cocos Island treasure concealed that fact and held on to the treasure, for reasons best known to themselves.

Certain it is that one or more radio methods are being used for this purpose, and probably with reasonable success.

Of course there are difficulties to be solved. One of them is the wetness of the subsoil. It is reported that in the course of the present search diggers broke through into an underground passage, now filled with water. It was a common habit of the priests and grandees of Spanish times to dig such passages, both for purposes of secret communication and also for the sake of safety in the days when cities were ill-policed. No doubt many such passages still exist beneath the foundations of present Panama, as they do beneath virtually every city of the world whose history goes back as far.

If all of these passages are now filled with water, that fact will constitute an enormous handicap to all the radio methods or electrical methods of detecting the presence of gold. The water of the soil is never pure, but always contains sufficient amounts of dissolved salts to render it an electric conductor. While it does not conduct as well as gold and silver, its conductivity is probably high enough to constitute a substantial disturbance in the region of the radio detectors.

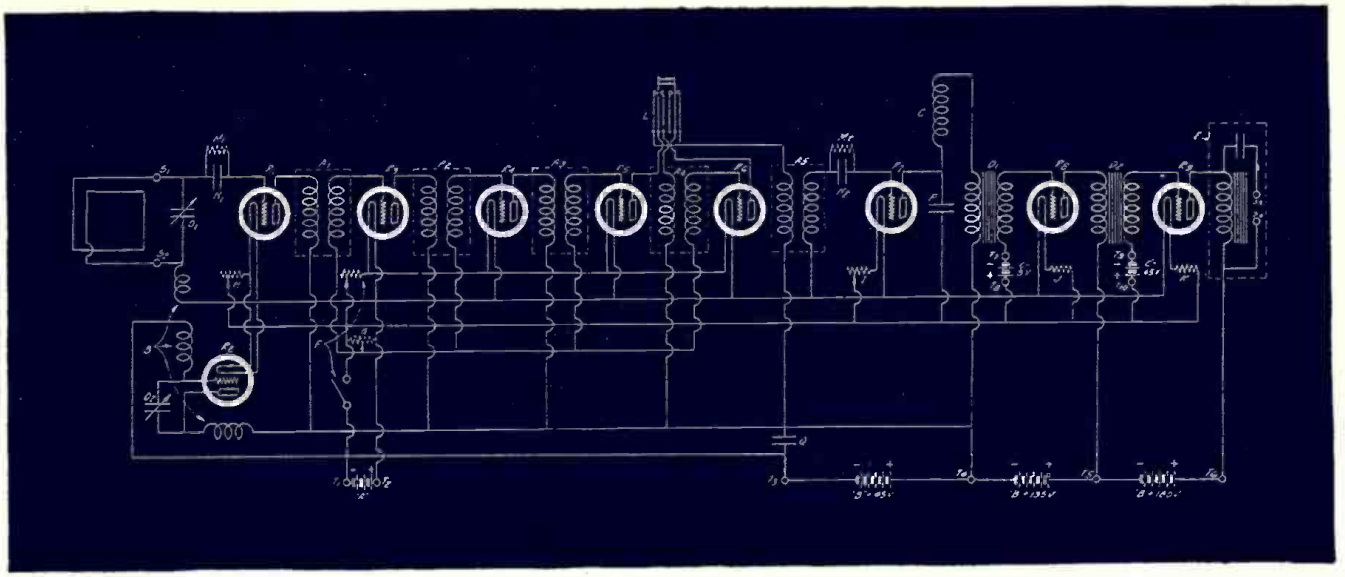
Another difficulty with all radio methods of treasure-finding is the possibility that the precious metals are not in large masses, but are scattered through the soil. Wooden chests in which the ancient Spaniards may have buried their belongings would probably have yielded, years ago, to the tooth of time. The rings and necklaces and other objects which the ancient *señoras* wore, the golden crucifixes or other articles of devotion from the churches, would have escaped from the flimsy wooden walls of their caskets, to lie loosely through the soil. Such loose bits of metal would not be absolutely without influence on

(*Continued on page 258*)

Mr. W. D. Morgan

A DETECTOR FOR USE IN "RADIO GEOLOGY"

*Radio methods are being tested as investigators of underground rock conditions, as well as to find supposed buried treasure. This apparatus, used by Mr. W. D. Morgan, of Los Angeles, California, picks up radio waves sent into the ground by the transmitter illustrated on a later page of this article.*



THE SCHEMATIC DIAGRAM OF THE MAGNAFORMER CIRCUIT

FIGURE 1: *The circuit employed is the standard circuit for superheterodyne construction, but the superior merit of the Magnaformer receiver lies chiefly in the excellence of the parts employed—particularly the intermediate-frequency amplifiers.*

HOW TO BUILD

# *The* Magnaformer 9-8 Receiver

*Here are the constructional details for building the Magnaformer 9-8 Superheterodyne, whose design and theory of operation were described in the September number of* POPULAR RADIO. *This receiver employs eight or nine valves and has great sensitivity when used with a loop antenna.*

By LAURENCE M. COCKADAY

COST OF PARTS: *Not over* $129.00, *without the loop*

HERE IS THE LIST OF INSTRUMENTS AND ACCESSORIES NECESSARY FOR BUILDING THIS RECEIVER—

A1, A2, A3, A4 and A5—Magnaformer intermediate transformers, units R. F. No. 61;
B—Unicoupler, unit C. U. No. 71;
C—Samson high-frequency choke coil, No. 125;
D1 and D2—Ferranti low-frequency transformers, A. F. No. 4;
E—National tone filter;
F—Frost DeLuxe combination rheostat, 6 ohms, and battery switch, equipped with gold arrow knob, No. S-1810;
G—Frost DeLuxe potentiometer, 400 ohms, equipped with gold arrow knob, No. 1824;
H—Frost DeLuxe rheostat, 10 ohms, No. 1810;
I—Frost DeLuxe rheostat, 30 ohms, No. 1830;
J and K—Amperites, No. 112, with holders;
L—Yaxley radio jack switch, No. 60;
M1 and M2—Durham 2-megohm grid-leaks;
N1 and N2—Sangamo fixed condensers, .00025 mfd., type No. 1475, with grid-leak clips;
O1 and O2—Remler variable condensers, .0005 mfd., No. 639;
P—Sangamo fixed condenser, .001 mfd., type No. 1450;
Q—Sangamo by-pass condenser, 1 mfd., type No. 200, short;
R1, R2, R3, R4, R5, R6, R7, R8 and R9—Benjamin sockets, No. 9044;
S1, S2, S3 and S4—Frost tip-jacks, No. 253;
T—Yaxley cable-connector plug, No. 660;
U—Formica front panel, 7 by 26 by 3/16 inch, drilled and engraved;
V—Formica sub-panel, 9 by 25 by 3/16 inch, completely drilled;
W1 and W2—Benjamin sub-panel brackets, 2 inches high, No. 8629;
X1 and X2—Remler Universal drum-type dials with controls, No. 110;
Y1 and Y2—2-inch, right-angle supports for propping up rear of sub-panel;
Wire, screws, lugs, nuts, bolts, solder.
Quali-Tone loop—Duro Metal Products Co.
2 Wood blocks for sub-panel center support, 5/8 by 5/8 by 2 inches.

RADIO fans who are superheterodyne enthusiasts will want to build this new and ultra-modern loop receiver, for with it they will be able to accomplish excellent reception from a loop antenna, both as regards distance and quality of tone.

As told in the advance article in last month's issue of POPULAR RADIO, the receiver is a real engineering feat, and contains many new and original features that make its results possible.

To summarize briefly, the receiver contains four stages of high-gain amplification which may be converted at will to three stages for local work. It has two tuning controls and adequate adjustors for obtaining the proper operation of each valve used in the set. Both of the tuning controls work with drum dials that are illuminated.

The construction is simple, as all the parts are mounted on an insulated baseboard or the front panel itself.

The low-frequency end of the receiver contains two stages of transformer-coupled amplification, with an output filter device that protects the reproducer and maintains the quality of tone.

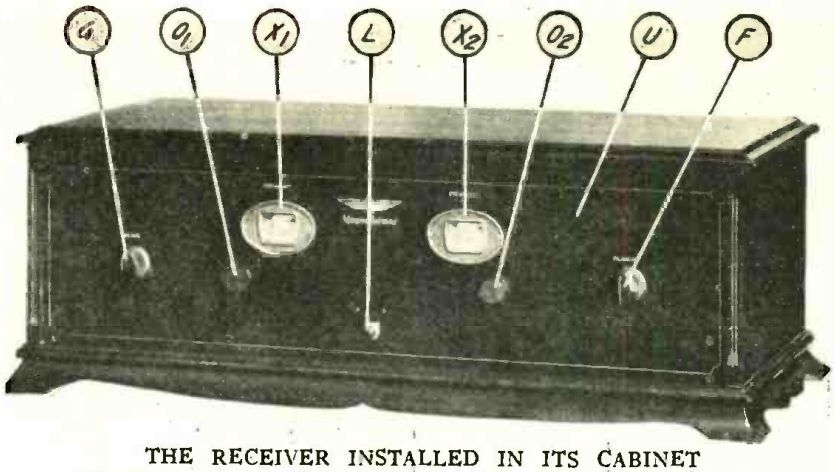
A study of the circuit diagram as shown in Figure 1 will reveal the fact that the oscillator is coupled directly to the grid-circuit of the first detector. The strength of the oscillator output is controlled by a rheostat that enables the greatest sensitivity to be obtained. A switch is included in the valve circuit just preceding the second detector that cuts "in" or "out" one high-frequency stage of amplification of the intermediate amplifier. A high-frequency filter is included in the output circuit of the second detector valve to keep unwanted high-frequency currents from the low-frequency amplifier. The proper "C" batteries are also included in the circuit for the valves in the low-frequency stages.

The illustration shown in Figure 2 gives an idea of the appearance of the completed set when installed in its cabinet.

*How to Assemble the Receiver*

The assembly of the receiver is simplified by the fact that both the front panel and the sub-panel come completely drilled. The front panel is also engraved with the designations for the various tuning controls.

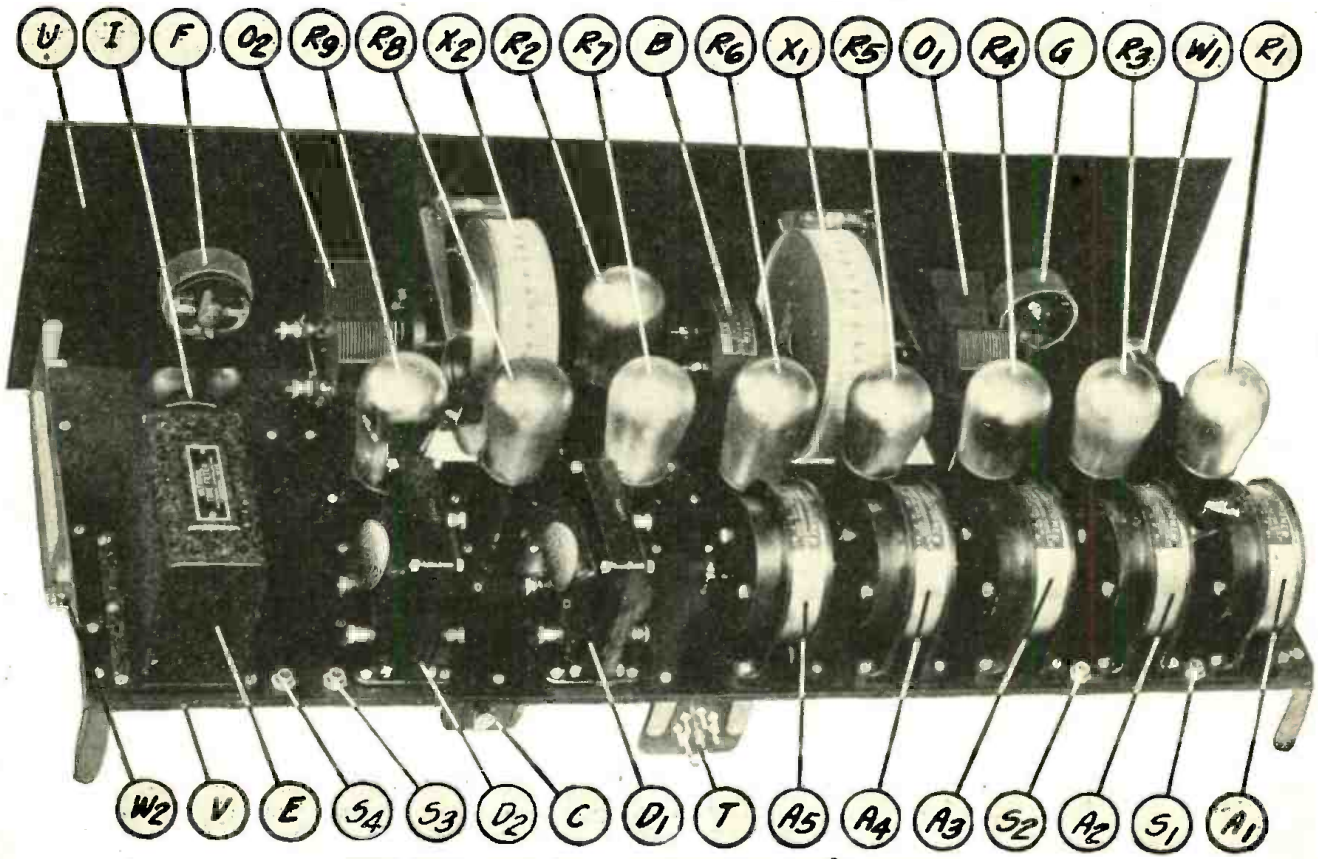
In starting to build the set, the rheostat, F, and the volume control potentiometer, G, should be mounted on the panel in the positions shown in Figure 2. The jack, L, is also mounted, with its framework toward the top of the front panel.




THE RECEIVER INSTALLED IN ITS CABINET

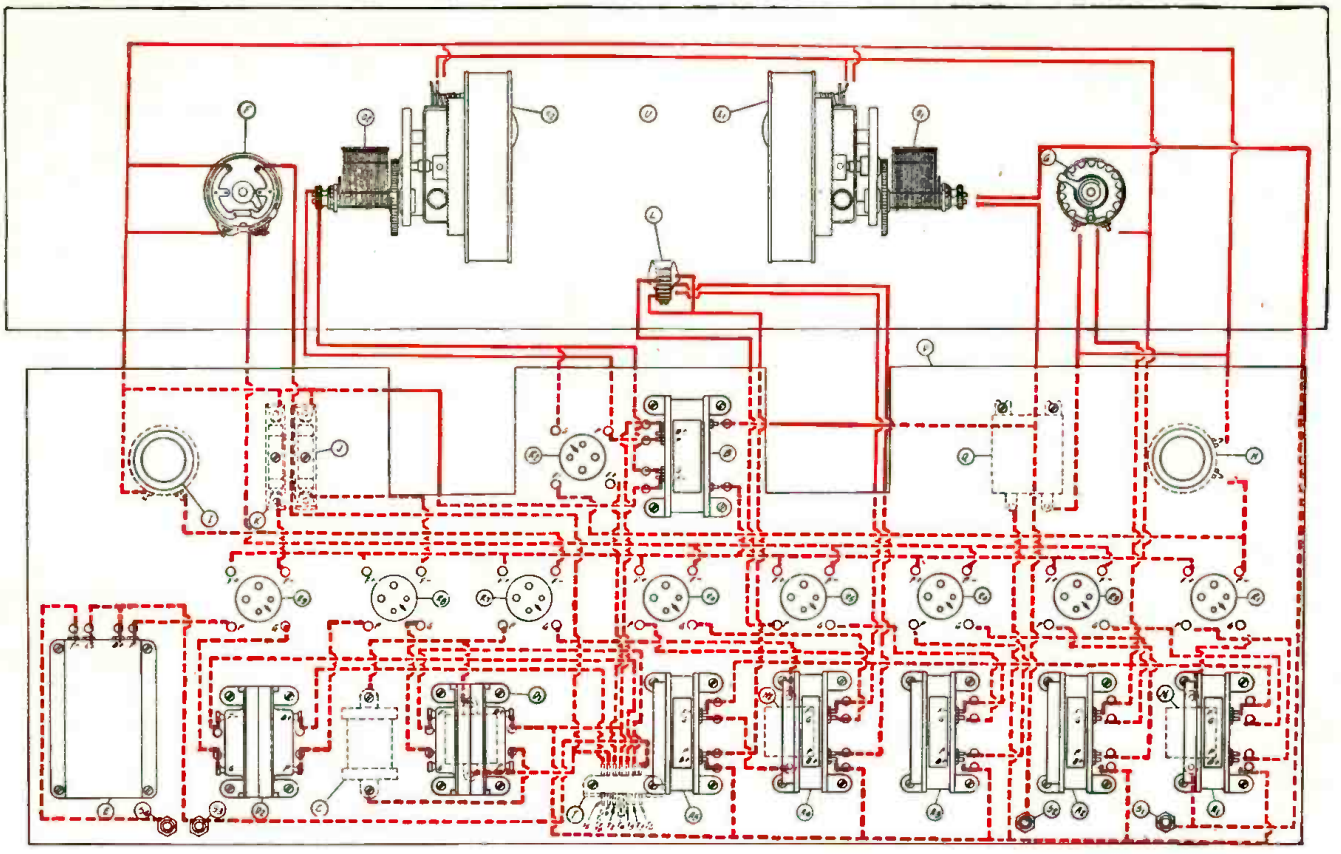
FIGURE 2: *All the tuning is accomplished with the two controls, O1 and O2, while the knobs, F and G, provide complete control over sensitivity and volume. A turn of the switch, L, introduces into the circuit an extra stage of intermediate-frequency amplification for distance work.*

The condensers and drum controls must be assembled before they can be mounted on the panel. The assembly is accomplished by first mounting the variable condensers, O1 and O2, on the flat surfaces of the brass frames which accompany their respective drum controls. This mounting is accomplished by means of three screws which project through from the inside of the brass




THE SUB-PANEL ARRANGEMENT OF THE RECEIVER

FIGURE 3: *The construction of this receiver is greatly simplified by the fact that the sub-panel may be purchased completely drilled; this relieves the builder of much tedious work. The five Magnaformer coils are at the right, the output filter and the low-frequency transformers at the left.*



THE PICTURE-WIRING DIAGRAM OF THE RECEIVER

FIGURE 4: *The instruments above the sub-panel are outlined in solid* BLACK *lines; those beneath the sub-panel are outlined in dotted* BLACK *lines. The wiring above the sub-panel is indicated in solid* RED *lines, while the connections beneath the sub-panel are shown in dotted* RED *lines.*

plates and extend into the tapped legs of the condenser frames. The drums are then slipped over the shafts of the condensers until the worm gears at the rear of the brass plates mesh with the circular flanges on the drum dials. The set screws on the bushings of the drums are then tightened onto the condenser shafts, and the complete units may be mounted on the front panel of the receiver. Only one screw is necessary for each of these mountings, as a single-hole mounting which extends through the panel is provided on each of the control shafts, these serve to hold one end of each of the units firm.

There is no necessity for a detailed description of the mounting of the instruments on the sub-panel. It is only necessary to place the various instruments in the positions indicated in Figures 3 and 4. It will be found that the holes provided in the sub-panel correspond exactly with the mounting holes in the instruments themselves, so that the mounting screws may be inserted without any difficulty.

It is advisable, before mounting any of the instruments, to mount the brackets, Y1 and Y2, on the under side of the sub-panel, and also the small wood blocks which support the middle of the sub-panel. This will keep the baseboard up off the table, and will prevent damage to the instruments mounted on it.

The three small fixed condensers, N1, N2 and P, should be mounted underneath the sub-panel before the other instruments are attached. This is necessary because the heads of the mounting screws for these units are located under instruments which are to be mounted on the top of the sub-panel.

The balance of the sub-panel assembly may then proceed in any convenient order; but it is recommended that the seven transformers be mounted last, as this will make the panel easier to handle and, at the same time, minimize the possibility of damage to the instruments mounted on it. Upon completion of this job, the receiver is ready to be wired.

The front panel and sub-panel should not be fastened together as yet. A good deal of the wiring may be completed before this is necessary, and the work of soldering will be simplified by following this method of procedure.

*How to Wire the Receiver*

The kind of wire used in making the connections is left to the choice of the individual constructor. In the model receiver shown in the illustrations, three types of wire were used, including bare bus wire, Celatsite bus wire, and flexible Celatsite wire. In the case of long leads that have several branch connections made to them, the bare bus wire is convenient, inasmuch as these branch connections can be soldered to any point along the wire without the necessity of removing the insulation. On the other

*The list of parts given on page 226 includes the exact instruments used in the unit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

hand, the flexible wire is somewhat easier to work with and is equally satisfactory from the electrical standpoint.

Starting first with the sub-panel wiring, it is a good plan to wire up the terminals of the valve sockets first. This should be done because these terminals are flush against the lower side of the sub-panel and, therefore, most of these connections should be run close to the panel. The plate connection to the socket, R5, and the connection to the jack, L, can be delayed until after the front panel has been attached to the sub-panel. In all cases where connecting wires extend from instruments beneath the panel to others on top, the wires should be run under the panel and then brought through the panel at a point directly beneath the above panel terminal. This gives an extremely neat appearance to the completed set.

The balance of the connections between the other instruments on the sub-panel should now be made, with the exception of those that extend to the front panel. The front panel may then be attached to the sub-panel and the wiring between the two panels completed.

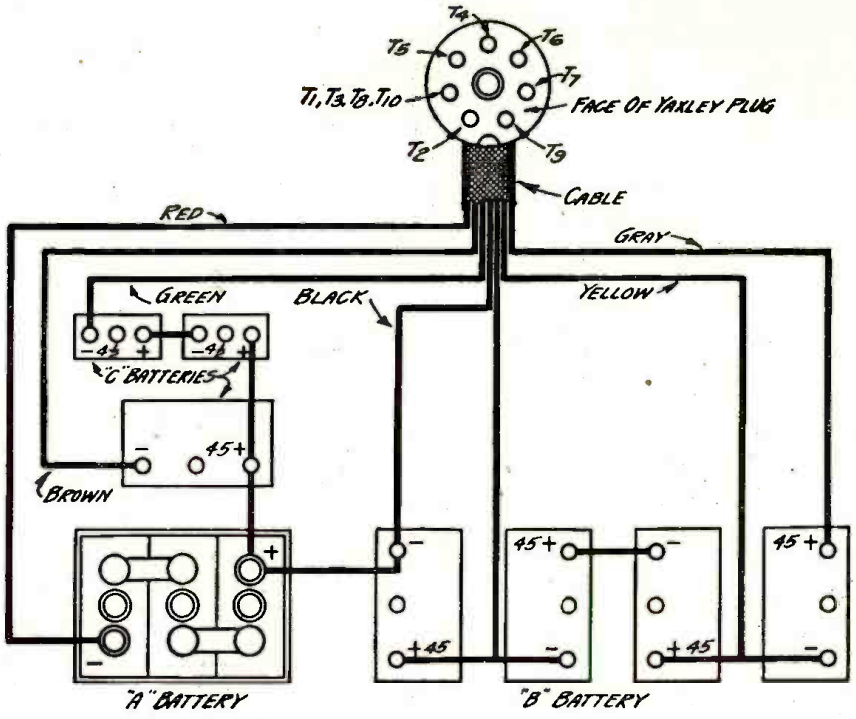
There are no tricks about the wiring, and it is so clearly shown in the picture wiring diagram in Figure 4 that there is no necessity for further instructions.

*How to Install the Receiver*

Figure 5 shows the detailed connections for the free ends of the battery cable, which provides a means for connecting all batteries to the receiver. It is advisable to make these connections before the plug on the cable is connected to the plug-base on the sub-panel of the receiver.

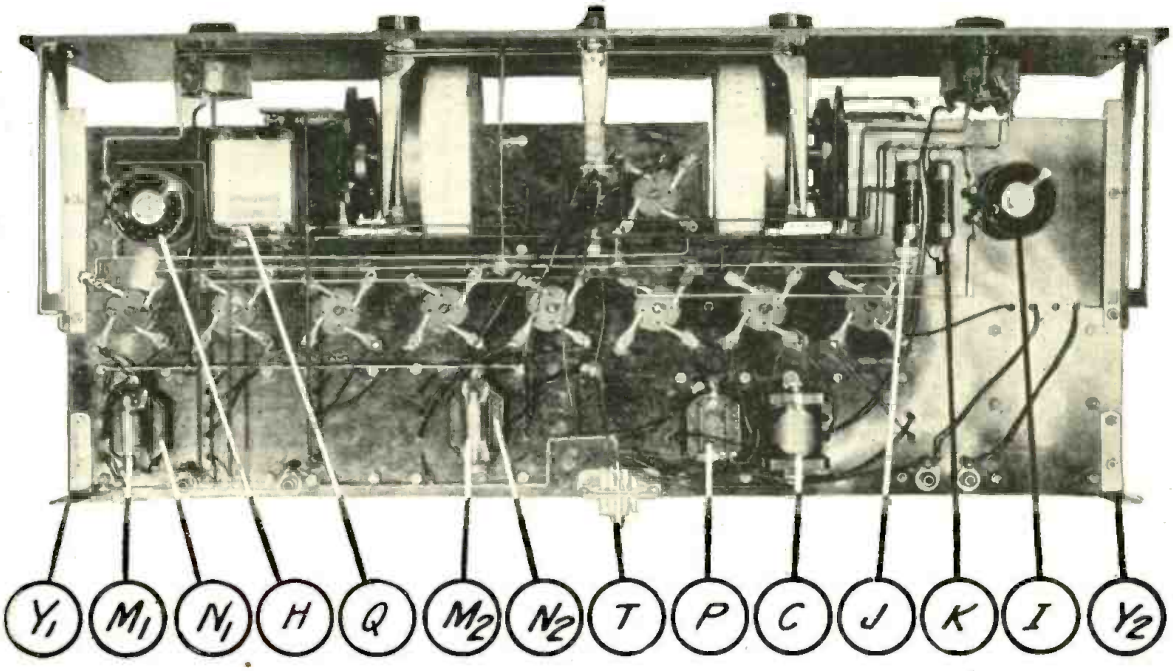
Now, turning to the receiver, the filament-control knob at the right-hand end of the front panel should be turned all the way to the *left*, as should the knobs of the two rheostats mounted on the sub-panel. The small switch at the bottom center of the front panel should be set with its set-screw pointing toward the figure "8." Now insert UX-201-a

(*Continued on page 257*)



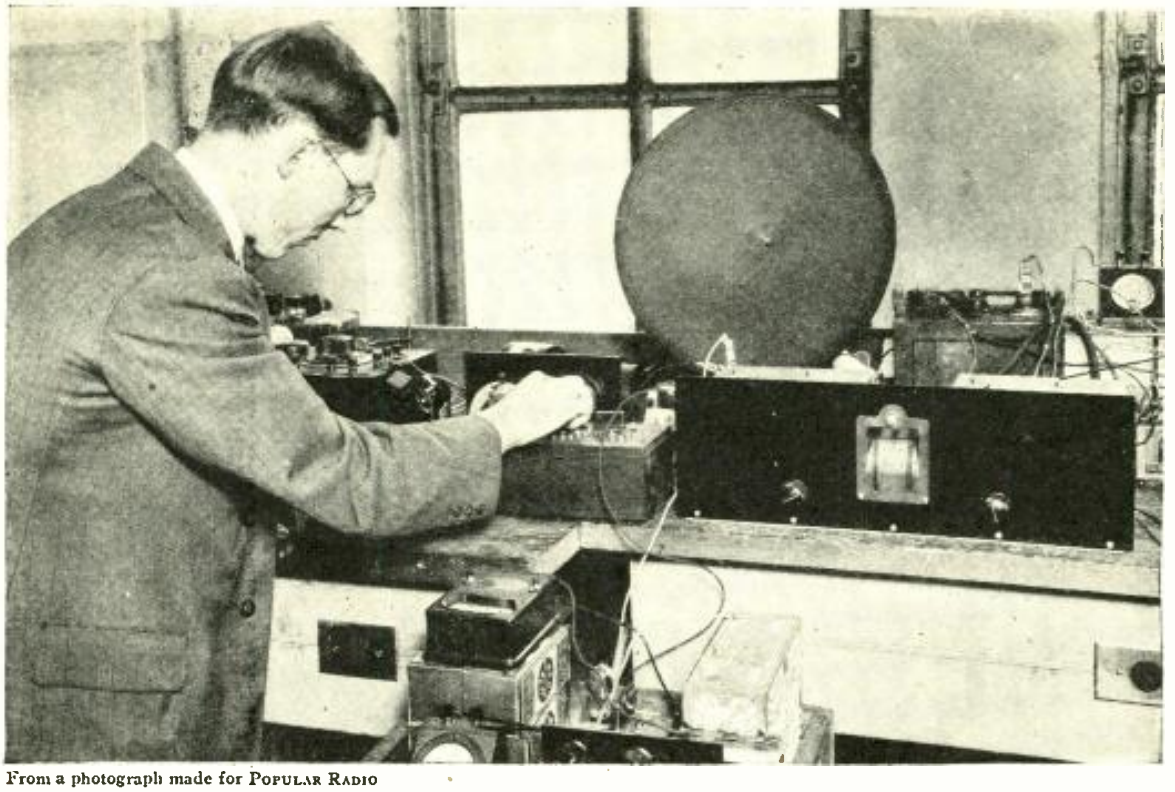

THE BATTERY HOOK-UP FOR THE RECEIVER

FIGURE 5: *When the batteries have been connected to the battery cable as shown in this diagram, and the cable plug has been inserted in the plug socket on the sub-panel of the receiver, the batteries need no further attention except for replacement.*




A VIEW OF THE SUB-PANEL FROM BENEATH

FIGURE 6: *Nearly all the wiring of the receiver is done beneath the sub-panel, thus improving the outer appearance of the receiver. This view shows how several various kinds of wire were employed in the laboratory model—bare bus wire for long leads with several branches, and flexible wire for shorter connections.*



From a photograph made for POPULAR RADIO

MAKING THE FINAL TESTS ON THE HI-Q RECEIVER

*Here is D. K. Oram, the Hammarlund engineer, testing the completed model of the Hi-Q receiver in the Hammarlund laboratory. This is the last of a long series of tests made to determine the exact operating characteristics of this set.*

ADVANCE INFORMATION ABOUT

# *The* HI-Q RECEIVER

Here are told some significant facts about this new receiver, the constructional details of which will be given in the November issue of POPULAR RADIO. The set will consist of three stages of high-frequency amplification, shielded and utilizing a carefully designed and balanced method that gives equal amplification over the entire range.

By RAYMOND F. YATES

IF a careful analysis were made of the trend of home-built receiver design during the past two years, it would show that many of the receivers which have become accepted as the very popular, due to their general excellence of performance, employ circuits of a similar nature. For instance, in the Browning-Drake receivers, the LC-26 receiver, the Hammarlund-Roberts set, the Samson T-C, and many others which space prevents a detailed mentioning, the circuits are generally alike, differing perhaps only in the method of neutralization employed in the high-frequency amplifier. All of these circuits have for the tuner end a single stage of tuned-high-frequency amplification, followed by a regenerative detector.

In the early years of their use it was felt that a single tuned stage of high-frequency amplification, if properly built and perfectly stabilized, would produce results which would be on a par with that of the popular neutrodyne circuit. While this is absolutely true, engineers realized the difficulties which confronted the average set builder in duplicating the work of skilled mechanics in radio laboratories. Then, too, there was the realization that even though a most exact duplication was possible, the chances were that improper or incomplete neutralization of a high-frequency amplifier might nullify all the advantages to be gained by its use.

Many changes have taken place in the past three years, not the least important of which are those of a purely economical nature. The prices of individual parts which go to make up a radio receiver nowadays are much lower than they were several years ago. This feature has had its effect on circuit design because now it is possible to build a multistage receiver and still keep the cost within limits of the average set builder's pocketbook. In the use of a circuit comprising a number of tuned-high-frequency stages it is also possible to duplicate the results attained by the

use of a single "high-gain" stage.

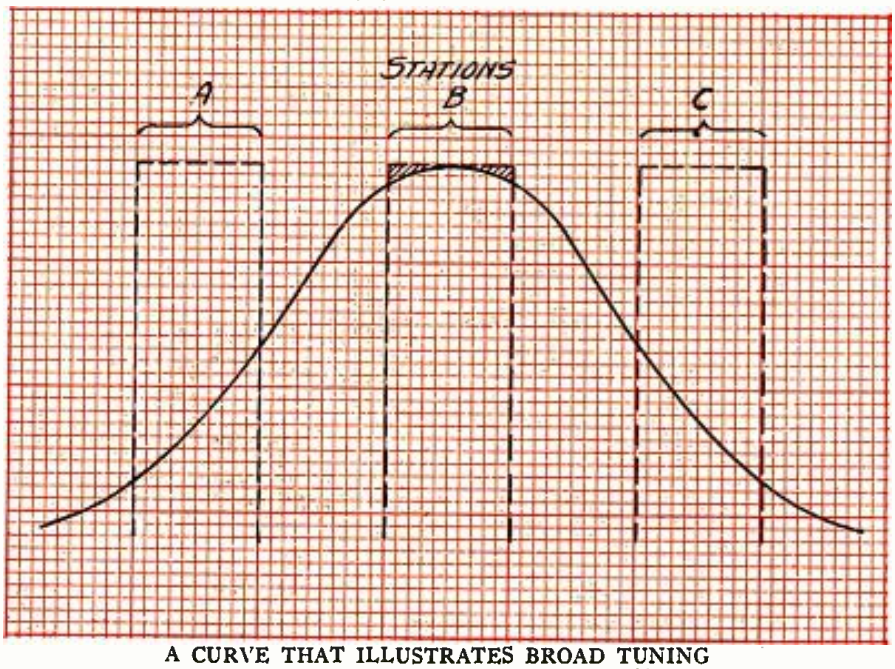
This is particularly true of the new Hammarlund Hi-Q 6-valve receiver which makes its appearance this fall. The engineers responsible for the design of this receiver have had in mind the points outlined here and have succeeded in producing a receiver consisting of three non-regenerative tuned-high-frequency stages, followed by a vacuum valve detector and a low-frequency amplifier employing high quality parts—thus insuring excellent reproduction, both in quality and volume.

*The High-Frequency Amplifier*

It would be helpful here to make a general comparison of the type of circuit employed in the Hi-Q with the "high-gain" single-stage circuit.

The ideal response curve is shown in Figure 2. It shows that an equal amplification is obtained of all the frequencies within the ten-kilocycle band which is occupied by the signal emanating from a broadcasting station.

In a high-gain single stage of tuned-high-frequency amplification the response curve usually obtained when the circuit is tuned to an incoming signal is illustrated in Figure 3. Note that sharp tuning exists, as manifest by the narrowed tapered top of the curve. Yet when it is considered that to obtain good quality of reception there must be no cutting of the side-bands of the received signal, it is hardly possible to associate this type of circuit with excellent tone reproduction. The shaded section of the curve represents the frequencies within the ten-kilocycle band which are either lost or are amplified to such a low degree that they are practically unheard in the reproducer.

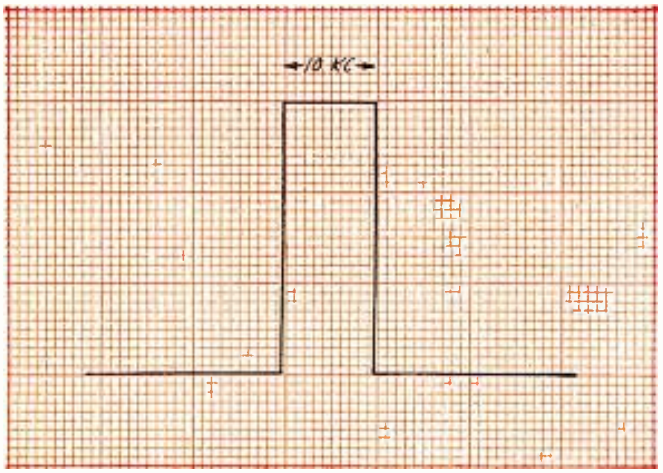



A CURVE THAT ILLUSTRATES BROAD TUNING

FIGURE 1: *This is the type of resonance curve obtained with an ordinary stage of amplification. While it will give good quality of reception on a 10-kilocycle band, a great amount of interference will be encountered, due to its overlapping on outside wavebands, indicated on the curve at A and C.*

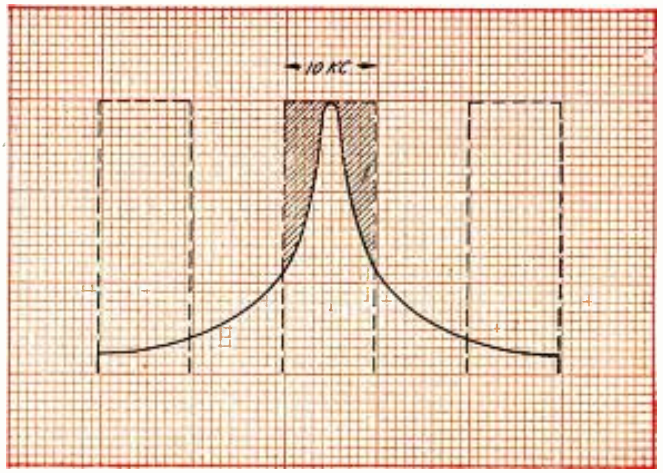
In the hands of experienced operators a higher degree of neutralization might be obtained, which would result in not so great a loss of the frequencies within the band, because the circuit is then less of a regenerative nature than when incomplete neutralization exists. However, perfect neutralization, or anything approaching it, exists only in theory, as far as the average set builder is concerned. It is not to be considered that he is as highly versed in the art as the laboratory technicians who write the constructional information he reads.

Now where a broadly tuned circuit is employed, whose response curve is depicted in Figure 1, it is found that the ideal of equal amplification of all the frequencies within the band is more nearly approached than with the high-gain circuit; but on the other hand there does not exist a similar sharpness of tuning, with the result that stations in near-by frequency bands are heard almost as loud as that to which the circuit is tuned.



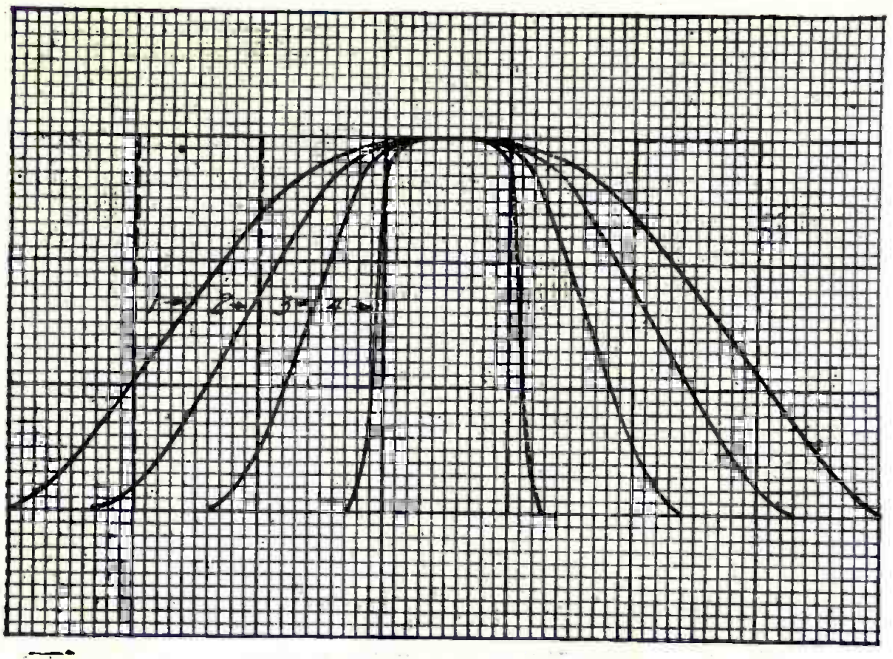

A RESONANCE CURVE SHOWING AN IDEAL STATE OF TUNING

FIGURE 2: *This theoretical resonance curve illustrates a tuning condition that would be ideal under present broadcasting conditions. It would cover the 10 kilocycles necessary for adequate side-band reception without interference from near-by wavelengths.*




A CURVE ILLUSTRATING TUNING THAT IS TOO SHARP

FIGURE 3: *If a receiver had a resonance curve of this type it would be free of interference, but the quality of reception would suffer from the incomplete reception of all those side-bands which are indicated by the shaded portions of the chart.*




HOW THE HI-Q'S CIRCUITS TUNE

FIGURE 4: *These are the respective resonance curves for the four tuning circuits of the new set. Notice that the last stage (No. 4) conforms closely to the perfect tuning stage illustrated in Figure 2, getting all of the side-bands without picking up interference from the two adjacent wavelengths.*

Experimenters have determined through research that when a number of slightly broad-tuned circuits are arranged in cascade formation there is a tendency to retain the flatness of the top portion of the curve, which indicates good quality reproduction, and also a gradual narrowing of the sides of the curve. This point is graphically illustrated in the family of curves shown in Figure 4. It will be observed that where four tuned circuits are cascaded in this manner to form a four-stage amplifier the final curve obtained has the desirable properties of a broadly tuned circuit, together with those that result from the use of a single high-gain stage. In other words, the cascade circuit has resulted in combining quality reproduction with a satisfactory degree of sharpness of tuning—*i. e.*, selectivity—so that there is no noticeable interference from stations in adjacent frequency bands.

This is exactly what has been accomplished in the new Hi-Q receiver.

To further insure the attainment of this goal, it was necessary to incorporate in the circuit a number of protective features which would guard against intercoupling effects between the several tuned circuits. Had not these precautions been taken, it is doubtful whether the results would have proved to be satisfactory.

Intercoupling effects may be produced in a number of ways. First, there may be capacitative coupling between the wires of the several tuned circuits. Secondly, the tuning coils of the several stages may have their electromagnetic fields interlinked so as to cause inductive coupling. Thirdly, resistance coupling might exist, due to a resistance which is common to all the tuned circuits, such as in the "B" batteries.

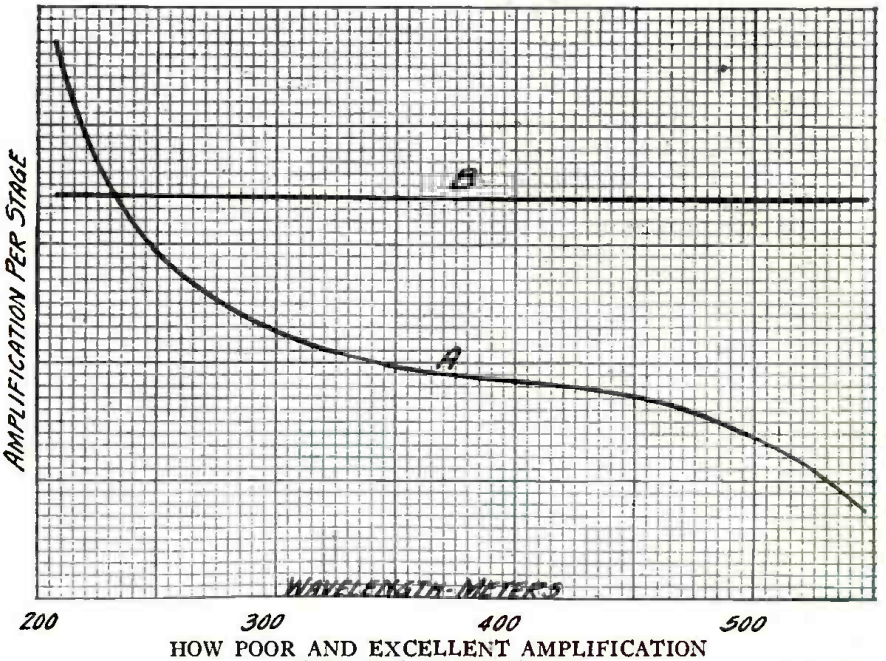
By the use of interstage shields, which effectively separate each of the tuned circuits, and the use of high-frequency choke coils and by-pass condensers, these difficulties have been satisfactorily overcome. With the use of the shields, chokes and condensers, each of the tuned circuits has been completely isolated so that no intercoupling effects are experienced.

The Hi-Q receiver also has incorporated in it another feature which very effectively overcomes one other bugbear of radio. This feature is a mechanical device which so alters the coupling between the primaries and secondaries of the several tuned stages as to obtain an equal degree of amplification over the entire wavelength band covered by the receiver.

Circuits which are not neutralized and where the coupling between primary and secondary is fixed may operate satisfactorily on the upper end of the tuning scale, but when tuned to the lower wavelength these circuits sometimes go into violent oscillation. On the other hand, if the circuits are adjusted so that no oscillation takes place at the lower wavelengths, it usually happens that the amplification falls off quite rapidly as the dial is turned to the upper wavelengths, unless some other precautions are observed.

By means of cams on the shafts of

(*Continued on page 252*)




HOW POOR AND EXCELLENT AMPLIFICATION COMPARE GRAPHICALLY

FIGURE 5: *The curve A shows how the amplification of an ordinary tuned-high-frequency receiver varies with the wavelength. Notice that a great amount of amplification is obtained on the wavelengths between 200 and 250 meters; this amplification is frequently unstable, due to excessive regeneration. At 500 meters this same curve drops to a low value. This explains why some sets "squeal" on the lower wavelengths and do not bring in the upper wavelengths. At B is an ideal curve showing equal amplification at all wavelengths.*

# What's New *in* RADIO

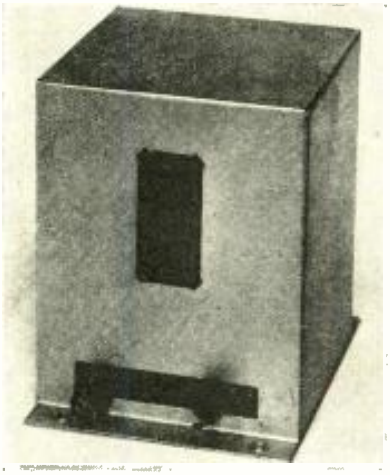
*Conducted by*
THE TECHNICAL STAFF

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

Walter E. Burton

A RECEIVER BUILT INTO A LOUDSPEAKER

*This compact little receiver, employing a four-valve regenerative circuit, was designed by V. C. Babcock, of Akron, Ohio. As it weighs only ten pounds, it is easily portable. It is said to give excellent results in quality and volume.*



## A Filter Condenser that Will Stand High Voltage

*Name of instrument:* Filter condenser, type 1002.

*Description:* A metal "can" is used to completely inclose the condenser construction and is filled with an insulating compound to seal in the condenser and provide complete protection from atmospheric conditions. The size of the "can" of the 4 mfd condenser shown in the illustration is 5 1/16 by 4 by 4 inches, exclusive of the mounting flanges at the bottom. Terminals are in the form of flexible, insulated wires which protrude through an insulating strip provided near the bottom of the "can." These condensers are designed for continuous use with direct current voltages up to 1,000 volts. This makes them particularly useful in high-voltage power-packs which provide output voltages of 300 to 500 volts. Such power-packs require filter condensers that are capable of withstanding voltages considerably in excess of the rated output, because the voltages in the part of the filter next to the rectifier are subjected to heavy strains.

*Usage:* In the filter network of high voltage power-packs. Obtainable in capacities ranging from .1 mfd. up to 6.0 mfd.

*Outstanding features:* High voltage rating. Capacity within 10 per cent of rated value. Neat appearance. Small size for a given capacity.

*Maker:* Aerovox Wireless Corp.

## Well Constructed Low-Frequency Transformers

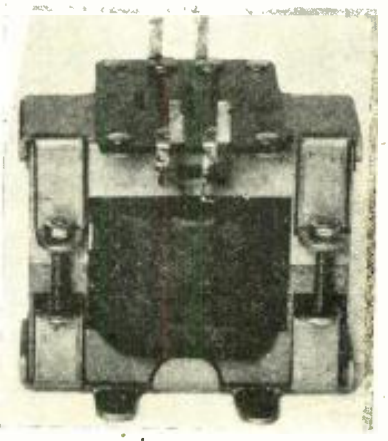
*Name of instrument:* Kellogg low-frequency transformer, type No. 508. Kellogg insulating (output) transformer, type No. 509.

*Description:* Exceptionally heavy cores and windings are employed in these transformers, in line with the current tendency toward bigger and better transformers, with the resulting better quality of musical reproduction. None of the size and weight is in a metal case and sealing compound, for these transformers are of the open type. The laminated core is solidly clamped on all outer sides by heavy metal stampings, which are attached by means of bolts that exert a considerable pressure on the laminations. Extensions on these metal stampings provide the mounting feet, which are drilled to accommodate the four mounting screws. There are also extensions to which is attached the composition terminal panel. Terminals take the form of soldering lugs. The entire windings are thoroughly impregnated with wax to make them solid and moistureproof.

*Usage:* Type No. 508 is for use as the coupling transformer in a low-frequency amplifier. Type No. 509, which is identical in appearance with type No. 508, is made for use in the plate circuit of the last low-frequency amplifying valve, to insulate the reproducer from the high-voltage direct current present in this circuit.

*Outstanding features:* Solid construction. Large cores. Coupling transformer ratio 3 to 1.

*Maker:* Kellogg Switchboard & Supply Co.




## This Condenser Block Simplifies "ABC" Power-Pack Construction

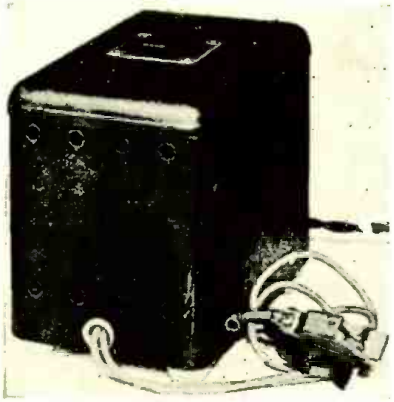
*Name of instrument:* Series 350-BA condenser block group for Raytheon "ABC" light socket power unit.

*Description:* This group of condensers is divided into three sections and is assembled in three "cans," as illustrated. These are known as type Nos. 350-BA1, 350-BA2 and 350-BA3. It provides all of the numerous capacities required in the construction of an "ABC" power-pack. If all of these condensers were assembled in a single "can" it would be cumbersome in size and would involve the use of long leads running to all parts of the power unit. By dividing the capacities into sections according to their locations in the circuit the construction of the power-pack can be much simplified and a more evenly balanced layout can be obtained. The various condensers are carefully designed to withstand voltages considerably in excess of those to which they will normally be subjected and these voltage ratings are scaled according to the function and use of the particular capacities. For instance, the condensers used in the transformer secondary circuit and immediately following the rectifier are rated at 600 volts, while the last filter condenser, where the voltage is lower, is rated at 400 volts. The output condensers are rated at 160 volts, as the output voltages across which these condensers are connected are 90 volts or less. The heavy metal "cans" serve not only to protect the condensers mechanically, but they also serve as electrostatic shields. Terminals are made with flexible, insulated wires which may be connected directly to the proper points in the circuit of the power-pack.

*Usage:* To provide all the capacities necessary in the construction of a Raytheon "ABC" power-pack or other "ABC" power-pack of similar characteristics.

*Outstanding features:* Well constructed. Carefully designed to withstand the voltages to which they are subjected in this circuit. Sealed in "cans" and thus protected from atmospheric changes, electrostatic coupling or physical damage.

*Maker:* Dubilier Condenser Corp.



## A Battery Charger That Requires No Attention

*Name of instrument:* Elkon 3-ampere battery charger.

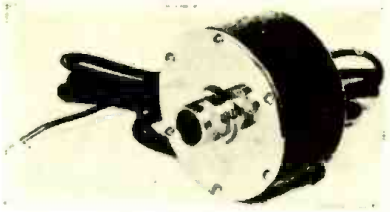
*Description:* This charger consists of a step-down transformer and a rectifier unit, both inclosed in a perforated metal case. It is provided with an extension cord to be plugged into any convenient 105-120 volt, 50-60 cycle light socket and with two insulated wires that terminate in spring clips, for attachment to the battery to be charged. The rectifier unit used is a new "dry" type that requires no attention whatsoever. The rectifier operates entirely without noise.

It is usually advisable to have some sort of audible or visible indicator in connection with battery charging, and for this reason a small pilot lamp has been included in the charger case. This remains lighted as long as the charger is in operation. The charging rate, if the battery being charged is low, is approximately 3 amperes per hour. As the battery becomes charged this rate tapers off to less than 2 amperes.

*Usage:* For charging storage batteries from alternating current lines.

*Outstanding features:* Noiseless. Requires no attention. Practically indefinite life. Tapering charging rate.

*Maker:* Elkon Works, Inc.



## A New Unit for Rejuvenating Old Loudspeakers

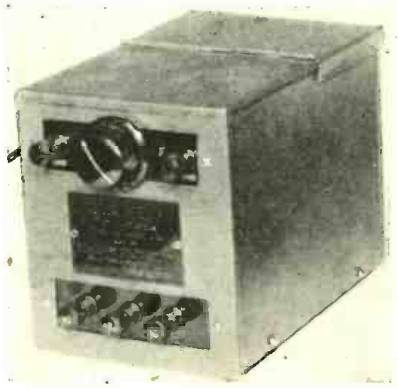
*Name of instrument:* Operetta reproducer unit.

*Description:* This reproducer unit is of high quality construction and intended for use with horn type reproducers. It is of standard inclosed construction. The body is finished in ebony and the top in highly polished nickel. The unit is permanently adjusted at the factory and requires no attention after it has once been attached to a horn. It is equipped with metal-tipped extension cord.

*Usage:* As the reproducer unit in a horn type reproducer.

*Outstanding features:* Good quality of reproduction. Well constructed.

*Maker:* Victor Radio Corp.



## A "B" Power-Pack for DC Wired Homes

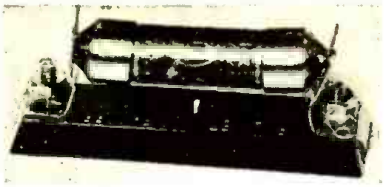
*Name of instrument:* DC power-pack for "B" voltage supply.

*Description:* This "B" power-pack is designed for those whose homes are equipped with direct-current lighting supply, but who wish to eliminate "B" batteries. The unit is rectangular in shape and measures 4¾ inches wide by 7¼ inches long by 5½ inches in height. It includes the necessary resistances and filter to provide pure, non-fluctuating direct current for the operation of a radio receiver. There are two output voltages. The high voltage is approximately 105 volts, while the detector voltage may be varied anywhere between 10 and 67 volts by means of the knob on the front of the unit. A device is included in the unit to prevent any possibility of short-circuiting the lighting lines through the ground connection of the receiver. The entire unit is inclosed in a metal case.

*Usage:* To provide "B" voltage from the 110 volt DC house-lighting lines.

*Outstanding features:* Contains an isolating device to prevent short circuiting of light lines. Variable detector voltage. Neat appearance. Requires less space than a heavy-duty "B" battery.

*Maker:* Chamberlin Electrical Co., Inc.



## A Filament Control that Increases Valve Life

*Name of instrument:* "Polytrol" automatic filament control and mounting.

*Description:* The resistance of each Polytrol unit is sufficient to reduce the battery voltage to that required by the valve or valves which the Polytrol is to control. This electrical element is inclosed in a glass tube and metal ferrules are mounted on the ends for making contact with the mounting clips.

These units are made in several values to match the current requirements of different valve filaments.

*Usage:* To reduce the filament supply battery voltage to that required by the valve or valves used. The type of Polytrol used will depend on the type and the number of valves it is to control.

*Outstanding features:* Controls the current to be supplied to the filament of each valve in a receiver, without any attention or manipulation on the part of the operator.

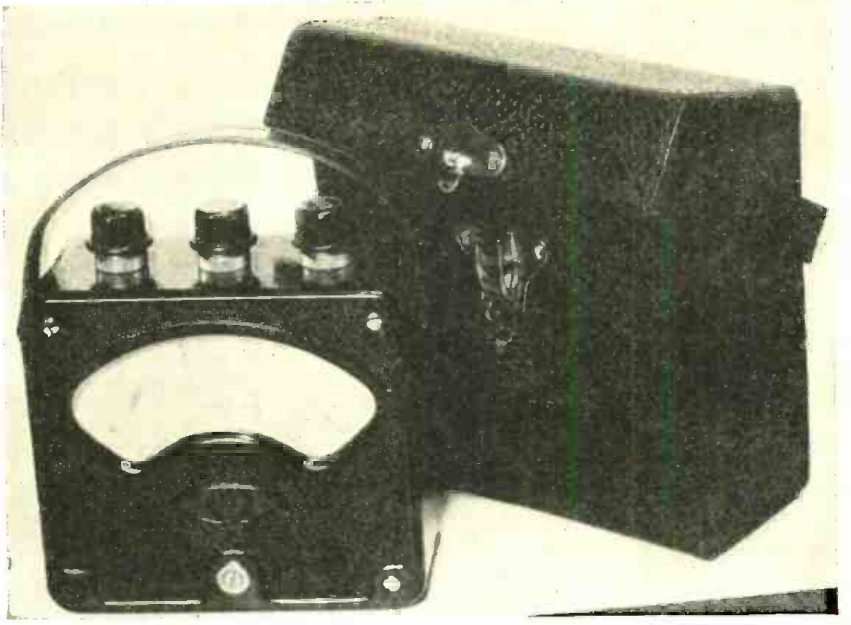
*Maker:* Polymet Mfg. Corp.

## A Complete Condenser Unit for "B" Power-Packs

*Name of instrument:* Filter condenser block, Type No. F-1000.

*Description:* This block consists of several fixed condensers mounted in a single "can" with a total capacity of 14 mfd. This total capacity is divided up into five groups of 1, 1, 2, 2 and 8 mfd. respectively. One side of each of these groups is connected to a separate terminal on the outside of the block to permit making individual connections to each unit. The other sides of all groups are connected together and brought out to a common terminal. The values of the capacities at each terminal are clearly marked on the block.

*Usage:* To be incorporated in a "B" power-pack to supply all the various capacities required. Especially intended for use with the Raytheon BH rectifier circuit or other circuits with similar voltage ratings.



## An Accurate Voltmeter for "B" Power-Packs

*Name of instrument:* Westinghouse high-resistance voltmeter.

*Description:* This meter provides an excellent means for measuring the output voltages of "B" power-packs, as its resistance is 1000 ohms per volt. It is a recognized fact that the ordinary voltmeter is of little use for this purpose because its comparatively low resistance alters the value of the output circuit to which it is connected. This meter has two ranges, 0-250 volts and 0-50 volts. For measuring "detector" and "C" voltages the two left-hand binding posts on the top of the meter are used for the connections. These provide full scale deflection at 50 volts. These readings are made from the lower scale on the face of the meter. For the 250-volt range the two outside binding posts are used, and the reading is taken from the upper scale. To permit extremely accurate readings the face of the meter is equipped with a mirror to enable the operator to bring his eye directly in front of the indicator needle. The case of the meter is equipped with a strap handle. A leather carrying case, as shown in the illustration, may also be obtained at an additional cost.

*Usage:* For measuring direct-current voltages within the range of 0-250 volts. Particularly useful in high-resistance circuits such as the output circuits of "B" power-packs.

*Outstanding features:* High resistance. Convenient size. Two range, easily readable scale. Zero adjustment. A precision instrument.

*Maker:* Westinghouse Electric & Mfg. Co.

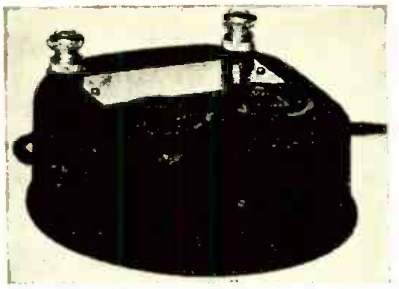
*Outstanding features:* Compact. Neat. Terminals conveniently located. Easily mounted.

*Maker:* Polymet Mfg. Corp.

## A Combination Switch for "A" and "B" Supply

*Name of instrument:* Continental Uni-Switch.

*Description:* The working parts of this relay switch are enclosed in a neat metal case. Flush with the top of the case are two standard plug receptacles, into which the plugs from the "B" power-pack and the trickle charger may be inserted. There are also two binding posts on the case for connection to the "A" battery and to the receiver. An extension cord and plug are provided for connecting the switch to the AC house-lighting lines. When the battery switch on the panel of the receiver is turned "on" the current from the "A" battery flows through the magnet winding of the relay switch. This trips the relay and causes contacts to be made which connect the "B" power-pack to the house-lighting lines. When the panel switch is turned "off" the relay arm is released. This breaks the line connection to the

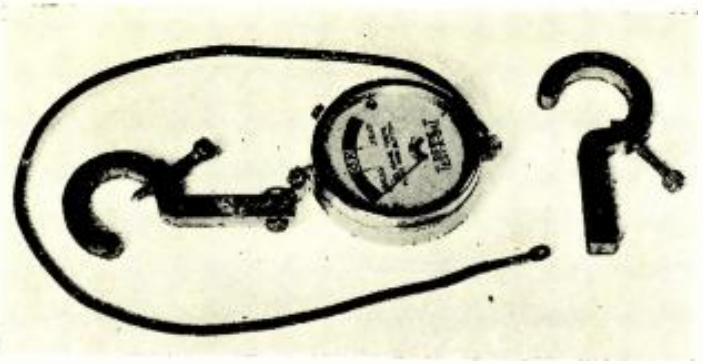


"B" power-pack and in turn connects the line to the trickle charger. Thus when the receiver is turned "on" the power-pack is also "on," and when the receiver is turned "off" the trickle charger is turned "on" to replenish the current consumed from the battery. The "B" power-pack is at the same time turned "off." The relay unit is neatly finished and is attractive in appearance.

*Usage:* To provide automatic control of the "B" power-pack and trickle charger used in conjunction with a radio receiver.

*Outstanding features:* Automatic in operation. Compact in size. Neat appearance.

*Maker:* Gardiner & Hepburn, Inc.



## This Meter Gives an Instantaneous Check on the "A" Battery

*Name of instrument:* "Test-A-Bat" "A" battery testing meter.

*Description:* This is a small "watch-case" meter, with its dial marked into three sections instead of being calibrated. These three sections are marked "start charge," "O. K." and "stop charge." The meter is equipped with two metal brackets, by means of which it may be permanently attached to the terminals of a storage battery. There is a button on the side of the meter which may be pressed to obtain the meter readings. The meter is therefore always in position, ready for use, and the condition of the battery is determined instantly by a momentary pressure on the button.

*Usage:* To test the state of charge of a storage "A" battery.

*Outstanding features:* Handy to use. Always ready for use. The scale is easily readable, even in a poor light, as when the battery is inside of a console, etc.

*Maker:* Beede Instrument Co.


## A Single Unit That Provides All Filter Capacities for a "B" Power-Pack

*Name of instrument:* Filter condenser block, type BH-420.

*Description:* The metal container which incloses this condenser group measures 5 1/16 by 5 by 2 inches. In it are five condensers of the capacities recommended for use with filters for "B" power-packs which use the Raytheon BH rectifier valve and which provide an output of approximately 200 volts. The first two condensers in this block have a capacity of 2.0 mfd. each and are designed for an operating voltage of 400. The third condenser has a capacity of 8.0 mfd. and, inasmuch as it is subjected to lower voltages than the first two, is rated at 300 volts. The last two condensers serve as by-pass condensers across the low-voltage output terminals of the power-pack; their voltage rating of 200 is adequate for safety. These two have a capacity of 1.0 mfd. each. There are a common terminal and five individual terminals provided on this block. These are flexible wires, heavily insulated, and are intended to be connected directly to the other parts of the power-pack filter.

*Usage:* To provide all condenser capacities required in a medium voltage "B" power-pack.

*Outstanding features:* Convenient size and shape. Simplifies power-pack construction by combining five condensers in a single unit. Voltage and capacity ratings adequate for this service.

*Maker:* Aerovox Wireless Corp.

## A Battery Charger Without Bulbs or Liquids

*Name of instrument:* Two-ampere rectifier cartridge, type BA.

*Description:* This rectifier consists of a metallic cartridge about the size of a man's index finger. One end of the cartridge is closed with an insulating disc from which a smaller metal cylinder protrudes about ½ inch. The rectification device is based on the principle of rectification obtained through the association of two metals with a non-conducting agent suitably disposed around or between them. It is an entirely "dry" device, inasmuch as it consists of metals and a solid non-conductor. The rectifier unit is entirely inclosed within the metal cartridge. Its efficiency as a rectifier is claimed to be approximately 50 per cent higher than that of rectifiers of the bulb type. When supplied from a step-down transformer of suitable voltage output, this rectifier will provide a rectified current of 2 amperes for battery-charging purposes. Several inexpensive battery chargers which incorporate this rectifier have been recently placed on the market. The 2-ampere chargers consist of a transformer and a single one of these cartridges. Five-ampere chargers consist of a transformer and two of these rectifiers so arranged as to provide full-wave rectification. Mountings consist of two fuse clips into which the rectifier cartridge is inserted like a fuse.

*Usage:* As the rectifier in a battery charger or for other purposes where a rectifier capable of supplying up to 2 amperes at low voltages is required.

*Outstanding features:* No liquids or filaments. Requires no attention. Guaranteed minimum life of 750 hours. Either one or two cartridges may be used to provide half-wave or full-wave rectification, respectively.

*Maker:* Raytheon Manufacturing Co.

## A "B" Power-Pack That Works With Any Receiver

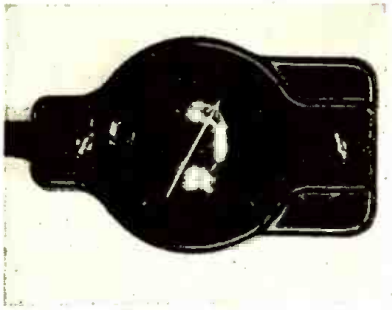
*Name of instrument:* Little Giant "B-C" power-pack.

*Description:* This power-pack makes use of a Raytheon BH type rectifier valve and is capable of supplying 180 volts at a normal current drain of 40 milliamperes. It is inclosed in a metal case that is finished in a pleasing brown shade. All output voltages are variable to permit the power-pack to be adapted exactly to the requirements of any receiver and to permit the use of either a UX-112 or UX-171 type power valve in the last low-frequency stage of the receiver. Three "B" voltages are supplied and two "C" voltages. The front end of the unit carries the five control knobs, as shown in the illustration. The rectifier valve is inserted in its position through a hole provided in the top of the case. The unit is equipped with an extension cord and plug for insertion in a lamp socket and a switch for use in turning the power "off" and "on." It is for use where the alternating current light supply is 60 cycle, 110 volts.

*Usage:* To supply the "B" and "C" voltages to any receiver from the alternating-current lighting lines.

*Outstanding features:* All output voltages are variable. Neat appearance. Supplies adequate current for the use of a UX-171 power valve in the last low-frequency stage of a receiver.

*Maker:* Webster Co.



## A Volume Control Unit for Any Receiver

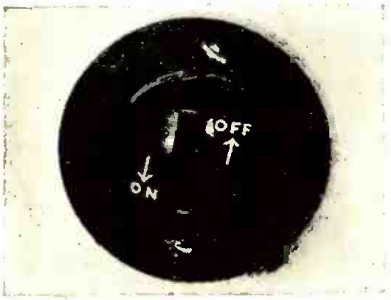
*Name of instrument:* Centralab Moduplug (modulator plug).

*Description:* This modulating device is obtainable in two styles. One is similar to an ordinary phone plug, except that it contains a resistance unit and a knob to vary this resistance. The other is the one pictured above. This is furnished with a 30-inch extension cord which is equipped with phone tips for connection to the output binding posts of a receiver. The tips of the reproducer cord are slipped into the spring grips provided in the other end of this plug. When so connected, the volume of reproduction can be varied at will by simply turning the knob on the plug. Either of these units is particularly useful in the case of old receivers which have no adequate provision for controlling volume. Also, in cases where the reproducer may be in a different room from the receiver, the volume can be controlled at the reproducer by inserting one of these plugs in the extension cord.

*Usage:* For controlling the output volume of a receiver; this control to be operated at the reproducer instead of at the receiver.

*Outstanding features:* Provides exact control of volume without reducing sensitivity, as is usually the case where volume is controlled in the high-frequency amplifier. Provides variation of output from maximum to zero. Installation involves no alteration in the receiver and no tools.

*Maker:* Central Radio Laboratories.




## A Simple Battery Switch

*Name of instrument:* Toggle switch, No. 622.

*Description:* The housing of the switch is of moulded bakelite and measures 1¼ inches in diameter. Its top is engraved with arrows and the words "off" and "on." The toggle lever is also of bakelite and projects through a slot in the bakelite form. The switch is designed for panel mounting and for this purpose requires two small holes in the panel to accommodate the two long screws which extend from the back of the switch. These screws serve not only as the mounting screws, but also as the connection terminals, so that the connection wires need not be brought through the panel. The contact members are of spring brass.

*Usage:* As a filament switch in a radio receiver or for other light-duty switching purposes where a single-pole, single-throw switch is required.

*Outstanding features:* Neat appearance. Good insulation. Positive operation.

*Maker:* Herbert H. Frost, Inc.

## A Large Loop with Good Pick-Up Qualities

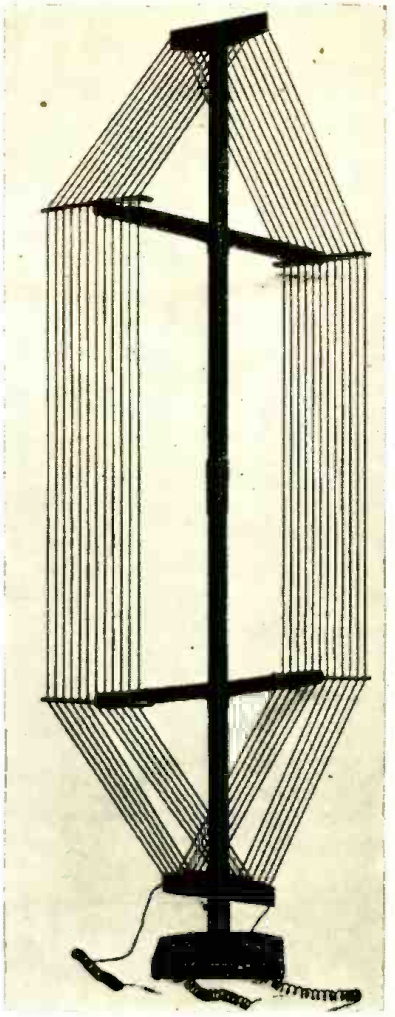
*Name of instrument:* Loop antenna.

*Description:* This folding loop measures approximately 46 inches in height by 19 inches across. It is tightly wound with silk-covered loop wire on slotted composition spreaders that are mounted at the extremities of the mahogany framework. Metal parts are of satin-finished brass. The loop frame fits into a socket in the base, in which the loop may be readily revolved. The terminals are in the form of three wires that terminate in metal tips for direct connection to the receiver input binding posts. Two of these terminals are taken from the ends of the loop winding, while the third is a center tap.

*Usage:* As the antenna for use with especially sensitive multivalve receivers, particularly with superheterodyne receivers.

*Outstanding features:* Large size and good pick-up. Excellent workmanship, materials and finish. Center tapped. Folds into space approximately 6 inches by 6 inches by 2 feet.

*Maker:* Mathiesen-Sandberg Co.



## A Filter that Insures Long Life for the Reproducer, and Better Reproduction

*Name of instrument:* Erla output filter.

*Description:* This filter unit consists of a choke coil and a by-pass condenser, so arranged that the direct current in the plate circuit of the power valve of a receiver does not pass through the delicate winding of the reproducer magnets. The alternating current, which is to be transformed into music and speech by the action of the reproducer, is permitted to pass freely to the reproducer. Thus the strain which would be imposed on the reproducer windings by the direct current is eliminated, with the result that the quality of reproduction is improved and there is no chance of demagnetizing the reproducer mechanism. This filter is completely inclosed in a metal case and is provided with two input and two output binding posts. It may be incorporated in a receiver during construction, or may be used externally with receivers already in operation. In the former case the filter is connected directly into the plate circuit of the power valve and the output terminals of the filter are connected to the output terminals of the receiver. When used externally, the output terminals of the receiver are connected to the input terminals of the filter and the reproducer is connected direct to the output terminals of the filter.

*Usage:* In the output of the power valve that is used in the last low-frequency stage of a receiver, to provide a by-pass around the reproducer windings for the heavy direct current that is present in the plate circuit of such a valve.

*Outstanding features:* Well constructed. Neat appearance. Easily installed. Improves quality of reproduction. Protects reproducer.

*Maker:* Electrical Research Laboratories.


## Trouble Shooting Made Easy With This Device

*Name of instrument:* Radio set tester, Model 519.

*Description:* A single meter is incorporated in this test set, but it serves a fourfold purpose. It has three voltage ranges—0 to 8, 0 to 80 and 0 to 200 volts—and a current range of 0 to 20 milliamperes. On the panel, inside of the case, are mounted, in addition to the meter, an 8-position rotary switch, a valve socket, a small push-button switch and three binding posts. The three binding posts are for use when the instrument is to be used as a straight voltmeter for measuring the voltage of batteries, "B" power-packs, etc. The other devices are used for receiver and valve testing.

As a receiver tester, or "trouble shooter," this instrument presents many advantages. An extension cord with a plug similar to the base of a vacuum valve is provided with the tester. To test a receiver this plug is inserted in one of the sockets of the receiver and the valve which was removed from this socket is plugged into the receptacle in the tester. The other valves in the receiver are left in position and the receiver is turned "on" just as when in normal operation. Then, by turning the testing switch to its various positions it is possible to obtain exact readings of the filament voltage, plate voltage, plate current and grid-bias voltage applied to the valve under test. All of the valves in a receiver can be tested in this manner.

To test valves, the plug of the tester is inserted in a socket in the receiver—preferably one which will provide a plate voltage of 90 and a grid-bias of 4.5 volts. The various voltage and plate current readings are then taken as described above. In addition, the small push-button switch is brought into play. This changes the value of the grid-bias voltage and consequently the value of the plate current if the valve is in good condition. The instruction booklet which accompanies the tester gives complete information on testing valves.

The meter in the tester has a resistance of 1,000 ohms per volt, which makes it suitable for use in taking voltage readings on "B" power-packs, as well as on batteries. This is a particularly advantageous feature, not only because it permits the use of this tester with receivers that employ "B" power-packs, but it enables the operator to adjust his "B" power-pack to the required voltages.

The tester is also equipped with two cords with insulated handles. When using the tester as a voltmeter for testing batteries these cords are connected from the binding posts of the tester to the batteries that are under test.

*Usage:* For "trouble shooting" in receivers, for testing valves, and for use as a standard, high-resistance voltmeter.

*Outstanding features:* When used as a set tester, it shows exactly how each valve is functioning in the set. It provides a reliable test on valves. It contains a high-resistance voltmeter, which makes the device suitable for testing power-pack voltages. The unit is inclosed in a neat carrying case which also has a compartment for the accessories and extension cord. It is also equipped with adapters to permit its use with valves of the UX or the UV-201-a type.

*Maker:* Weston Electrical Instrument Corporation.

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## A Neat Combination "A" Power-Pack

*Name of instrument:* Universal "A" supply.

*Description:* A storage battery, charger and automatic relay switch are combined to provide a self-contained "A" supply unit of convenient size and neat appearance. These devices are inclosed in a crystalline metal container. The storage battery is of sufficient capacity to meet the requirements of any receiver. The charger is of the bulb type and uses a 2-ampere Tungar bulb. There are two charging rates and a toggle switch on the front of the case permits a choice of the two rates. When this switch is thrown to the "high" side the rate is 1½ amperes per hour. On the "low" side the charge is reduced to ½ ampere per hour. Normally the switch is left on the "low" side. This provides sufficient current to maintain a good trickle charge and keep the battery fully charged except in cases where the battery is subjected to unusually heavy drain, in which event the "high" charge should be resorted to occasionally. A receptacle is provided on the front of this unit so that the "B" power-pack, if one is used, may be plugged in, to be operated by the automatic relay switcb contained in this unit. Thus, when the receiver is turned "on" by means of its battery switch, the charger is disconnected from the AC line and the "B" power-pack is connected to the AC supply. When the receiver is turned "off" the action of the relay switch is just the reverse.

*Usage:* To furnish a constant source of filament current for the operation of any receiver.

*Outstanding features:* Storage battery, charger and automatic control switch all inclosed in a single case. Two charging rates. Supplies constant source of filament current for operation of any receiver.

*Maker:* Acme Electric & Mfg. Co.


## A Tube for General Use

*Name of valve:* D-Ola.

*Description:* This valve is of the standard UX-201-a type with a UX-type base. It is interchangeable with any standard valve in a circuit. The base is of isolantite.

*Valve rating:*

Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—16.5 to 157.5.
Negative grid bias—0 to 9 volts.

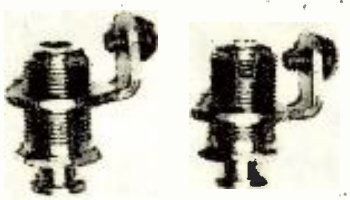
*Valve characteristics* (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:

Plate resistance—10,750 ohms.
Amplification factor—6.6.
Mutual conductance—613 micromhos.
Plate current—3.5 milliamperes.

*Usage:* As a detector, a high-frequency amplifier or as a low-frequency amplifier.

*Outstanding features:* Interchangeable with any UX-201-a type of valve in a circuit. Isolantite base.

*Maker:* DeForest Radio Co.



## These Phone-Tip Jacks Provide Positive Contact

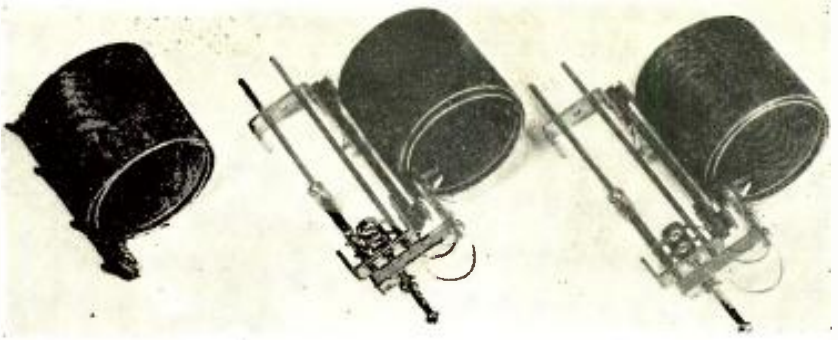
*Name of instrument:* Cord tip jacks, No. 253.

*Description:* The main portions of these jacks consist of a metal cylinder which is threaded on the outside and which contains a hollow plunger, a coil spring and a gripping device. A threaded bushing-bracket is also provided. To mount the jacks on a panel, a single hole approximately ⅜ inch in diameter is required. The threaded cylinder is slipped through this hole and the bushing screwed up against the panel from the back, thus holding the jack securely in position. The plunger projects from the front of the large cylinder. To make a connection with a phone tip, the tip is inserted in the hole in the plunger. Pressing in slightly on the phone tip causes the gripping device to admit the tip, and when the pressure is released the coil spring inside closes the grip on the tip. To release the tip, the plunger is pressed in. This releases the grip and permits the tip to be withdrawn.

*Usage:* At the connection terminals where connection is to be made by means of a wire equipped with phone tips.

*Outstanding features:* Positive connection. Tips will not pull out accidentally.

*Maker:* Herbert H. Frost, Inc.



## Precision Made Coils For the Loftin-White Circuit

*Name of instrument:* Loftin-White coil set, type LW-3.

*Description:* The set consists of three coils—an antenna coupling coil and two interstage coupling coils. The antenna coupling coil comprises primary and secondary windings that are fixed in their coupling relation and are mounted on a thin bakelite strip which also carries the solder-lug terminals. The windings themselves consist of silk-covered copper wire which is wound on a form and then impregnated with a film of cellulose material. The form is then removed and leaves a coil of high efficiency, due to the extremely small amount of dielectric material in the immediate vicinity of the windings.

The two high-frequency transformer units are wound in this same manner but are equipped with a mechanical device which permits variation of the coupling between the primaries and the secondaries. This variation is controlled by hand and may be made with extreme accuracy. In the Loftin-White receiver the coupling adjustments need be made only once. These transformers are made with a high degree of accuracy to permit them to be simultaneously tuned by means of a tandem condenser. This means that for all practical purposes their inductance values are exactly equal.

The connection terminals of all three coil units are in the form of soldering lugs and are mounted on the bakelite strips which also serve the purpose of mountings and supports for the windings.

*Usage:* These three units furnish the complete coil equipment for the Loftin-White circuit that includes two stages of tuned, high-frequency amplification and a tuned detector input circuit.

*Outstanding features:* Electrically and mechanically efficient. Accurately made. Neat appearance. Moisture-proof windings. Adapted to the Loftin-White circuit and approved by Messrs. Loftin and White for this use.

*Maker:* Hammarlund Mfg. Co., Inc.

## A Device that Helps to Wire a House for Radio

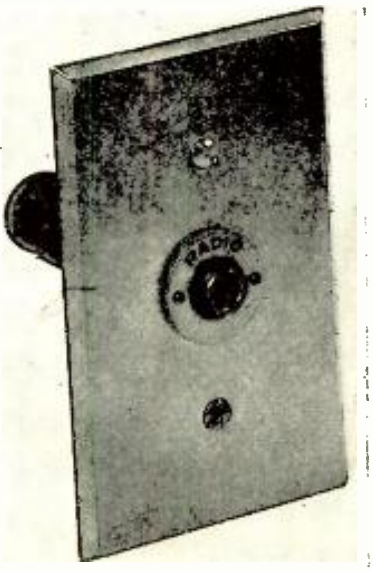
*Name of instrument:* Radio convenience outlet.

*Description:* This outlet resembles the ordinary flush-type electric wall switch except that instead of push-buttons, it has on its face only a single round hole encircled by the "radio" name-plate. Behind the satin-finished brass plate is a standard jack which is entirely inclosed to protect it from contact with the wall. All of the wiring to this outlet is carried through the walls in the same manner as the electric light wiring.

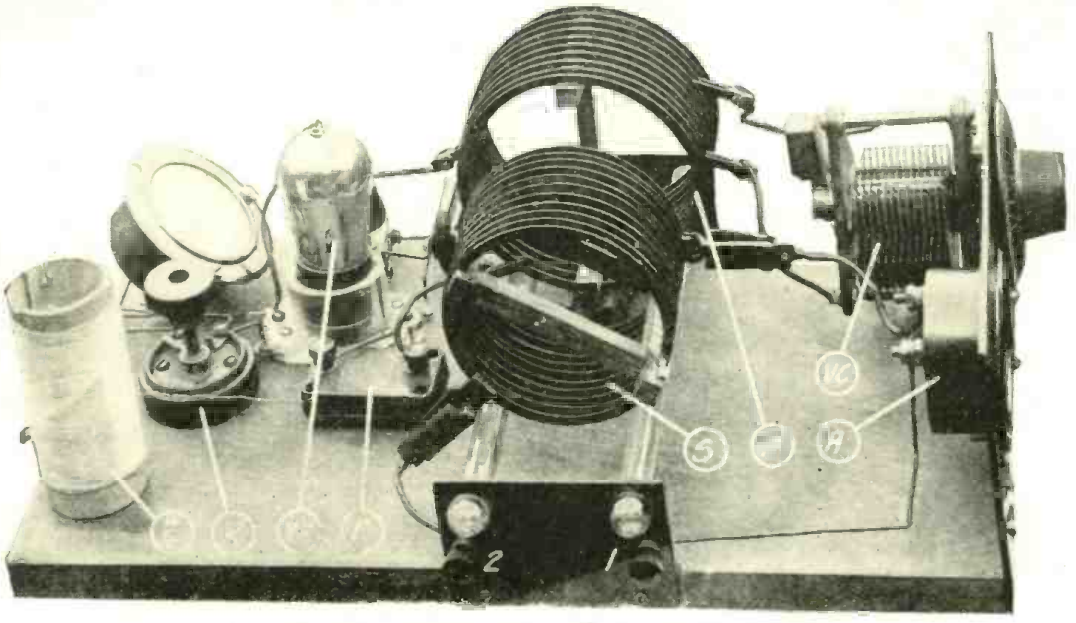
*Usage:* Where it is desired to have one radio receiver, but to provide facilities for plugging in reproducers at various points around the house or building. While the receiver is in operation the programs it is picking up may be reproduced in any room to which the receiver is connected by simply inserting a loudspeaker or head-phone plug in the wall jack above described.

*Outstanding features:* Neat in appearance. A great convenience in large homes, hospitals, hotels, etc.

*Maker:* Yaxley Mfg. Co.



¶ Here is an opportunity for the broadcast fan who wants to enter the field of short-wave radio to build a good short-wave transmitter—at a very small cost.




A VIEW OF THE TRANSMITTER FROM THE SIDE

FIGURE 1: *The view of the transmitter shows the remarkable simplicity of the hook-up for short-wave transmission. The high-frequency choke at the left and the two large coils may be constructed by the builder; the rest of the parts are easily obtainable from dealers or manufacturers.*

HOW TO BUILD

# A Transmitter for Less Than $30

Anyone who has previously built and operated a receiving set can easily construct this remarkable short-wave CW transmitter, with which the author of this article has been able to work several thousand miles—using an ordinary receiving set vacuum valve and batteries.

By JAMES MONTAGNES

COST OF PARTS: *Less than $30*

HERE IS A LIST OF PARTS AND ACCESSORIES USED IN THE COSTRUCTION OF THIS SET—

S—Secondary inductance, consisting of 10 turns of edgewise copper strip on a form 3 inches in diameter;
P—Primary inductance, consisting of 9 turns of edgewise copper strip on a form 4 inches in diameter;
KL—Sending key coupling to inductance, consisting of one turn of edgewise copper strip on a form 4 inches in diameter;
VC—General Radio variable condenser, .0005 mfd.;
HFC—High-frequency choke, consisting of 60 turns of No. 22 DCC wire on a form 1½ inches in diameter;
VT—UV-201-a type valve and socket;
A—General radio high-frequency ammeter, 0-1 amp.;
V—General Radio DC voltmeter, 0-10 volts;
K—Switch;
C—Micadon fixed condenser, .001 mfd.;
GC—Sangamo fixed condenser, .001 mfd.;
GL—Bradleyleak, 1,000 to 10,000 ohms;
R—Rheostat, 20 ohms;
Wooden baseboard, 12 by 16 inches;
Bakelite panel, 5 by 12 inches;
4 Fahenstock clips;
2 binding posts;
Wire, screws, etc.

HERE is a short-wave transmitter that costs less than $30, that uses a receiving vacuum valve as an oscillator, and yet has a transmitting range of several thousand miles. The set, in addition to these features, is compact enough to be used as a portable transmitter for the vacation camp. In fact, the set was built primarily as a portable for this very use, but the results were so far in advance of expectations that it is here offered to the experimenter as a good transmitter for general use.

The transmitter was originally installed on an island suburb near Toronto, and was attached to a double-feed antenna tuned to forty meters. For plate supply some old "B" batteries, discarded by broadcast listeners, were obtained, with a total voltage of about 200. A UV-201 valve was used with dry cells for the filament supply. The Hartley circuit was employed, as shown in Figure 2.

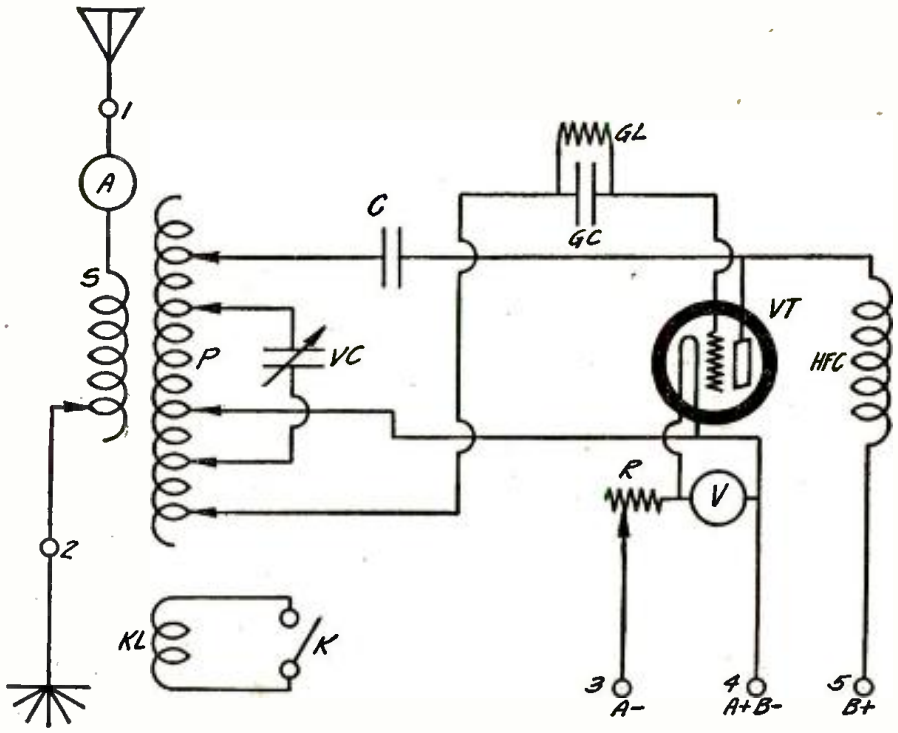
Tests in daylight were conducted with Cape Cod, Mass., on one-half watt. Many Eastern and Southern sta-

tions were worked on two watts or less and HIK in Dominica, West Indies, and Quito, Ecuador, were reached with less than ten watts of power.

The transmitter, as may be seen from Figures 1 and 3, is mounted on a wooden baseboard 12 by 16 inches in size. The panel is 5 inches high. All the instruments are mounted on the baseboard and the panel with plenty of room to shift coils and adjust clips.

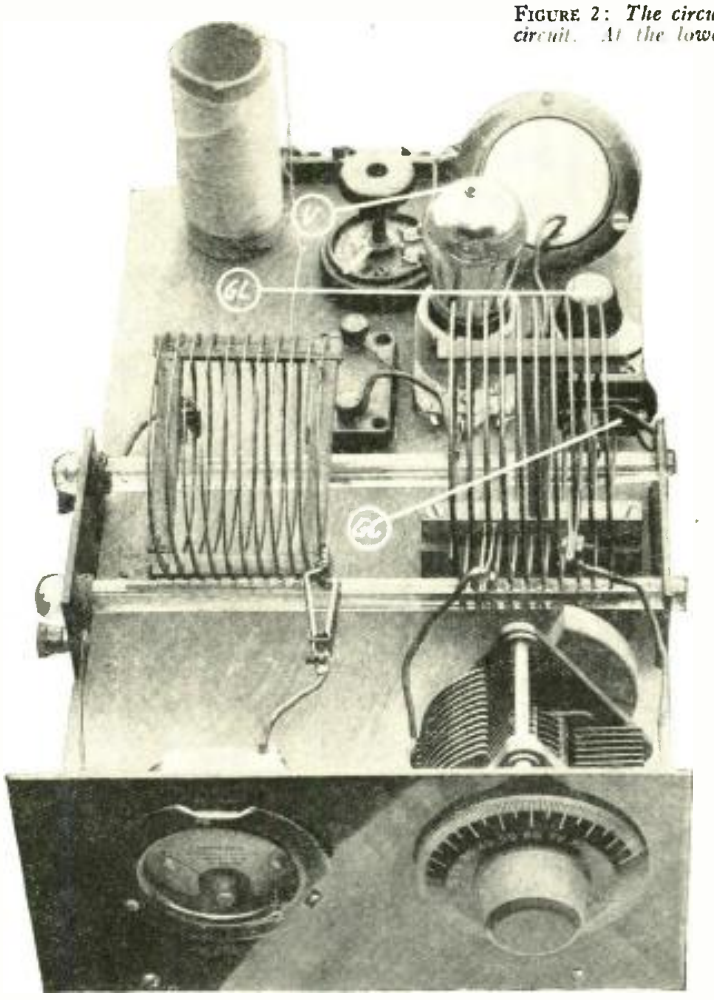
On the panel are mounted a .0005 mfd. condenser and a 0-1 high-frequency ammeter. The condenser tunes the primary inductance by means of two clips, which can be shifted to their best positions for wavelength adjustment. The antenna ammeter is connected to the antenna and secondary inductance.

The inductances are 4 and 3 inches in diameter respectively. The ones shown in the photograph are wound with edgewise-wound copper strip and supported by means of two grooved pieces of wood held in place by a crosspiece. Other coils that may be used with this set are wound with 3-16-inch brass tubing, and will hold their shape and spacing without inside supports.




THE CIRCUIT EMPLOYED IN THE TRANSMITTER

FIGURE 2: *The circuit shown above is a modification of the Hartley circuit. At the lower left of the diagram is shown the absorption circuit used for keying.*




A VIEW OF THE SET FROM THE FRONT PANEL

FIGURE 3: *The only operating controls of this transmitter are the tuning condenser on the front panel, the variable grid-leak shown at GL, and a filament rheostat.*

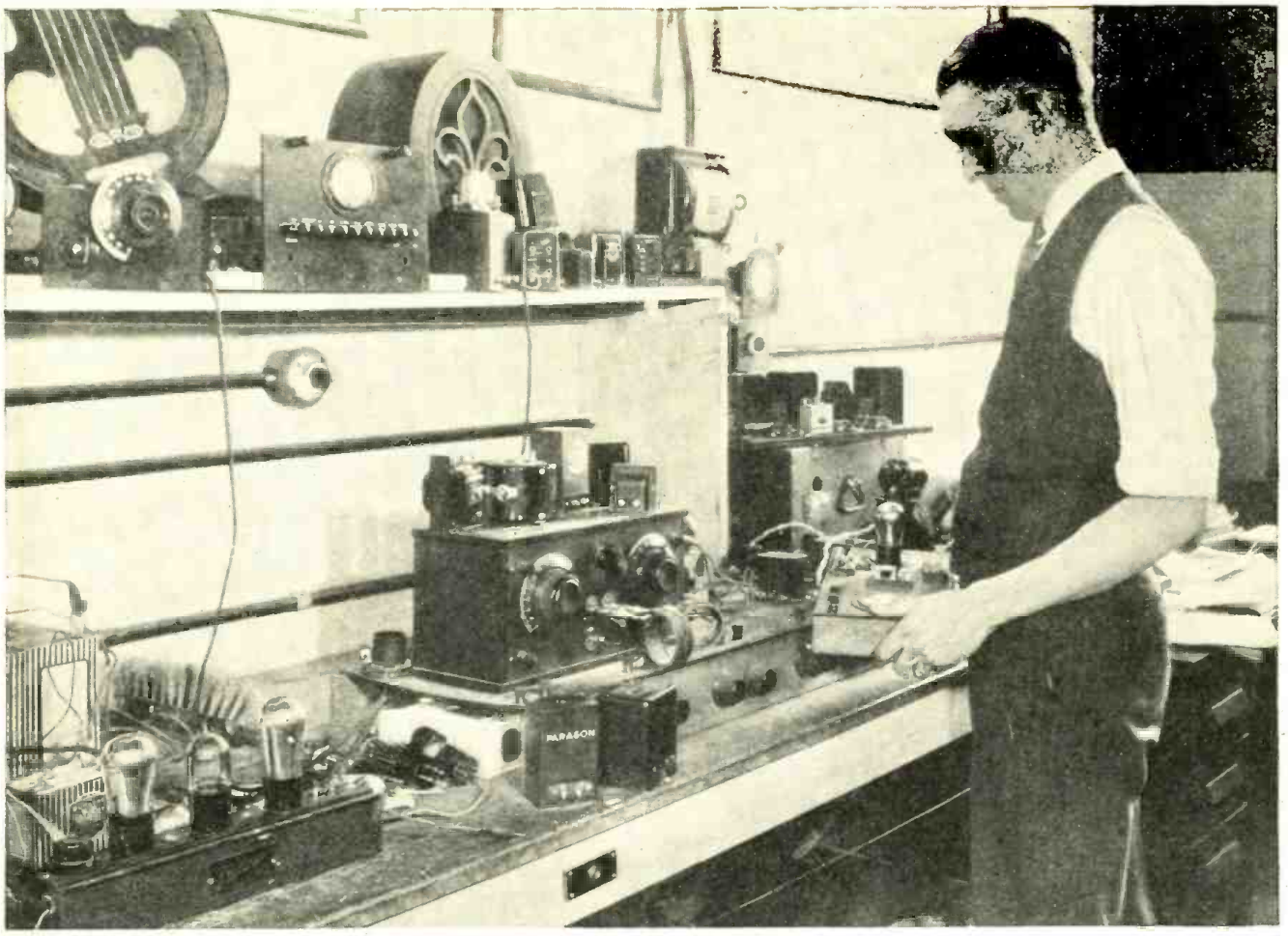
The primary coil consists of 9 turns of wire and can be used on the 40 to 80 meter band, being replaced by a 12-turn coil, 2½ inches in diameter for 20-meter work. The secondary coil, which is 3 inches in diameter and has 10 turns, is available for all three wavelengths.

The inductances are mounted on glass towel bars, which can be procured at the ten-cent store. The method of mounting is evident in the illustrations. Two binding posts can be seen on the bakelite strip in Figure 1; No. 1 is for the antenna and No. 2 for the counterpoise. The coils merely rest on the glass rods, which are spaced about 2¾ inches apart.

Immediately behind the inductances are the grid condenser and the variable grid-leak, the valve and valve socket, the plate-stopping condenser, the high-frequency choke, the rheostat and the filament voltmeter. At the back of the baseboard is a connection strip with four Fahenstock clips mounted on it.

The valve socket used is of glass, and an ordinary receiving rheostat is used for the filament supply of the vacuum valve. The plate condenser is a Micadon of .001 mfds. capacity and the grid condenser is a Sangamo of the same capacity, with a variable Bradley-

(*Continued on page 256*)



From a photograph made for POPULAR RADIO

TESTING LOW-FREQUENCY AMPLIFIERS IN THE POPULAR RADIO EXPERIMENTAL LABORATORY

*This work is one of the most important items in the development of radio reception.*

## HOW TO SELECT

# Audio Amplifiers

ARTICLE 2 of a series on the principles that underlie the amplification of low frequencies. This installment tells the proper method of comparing amplifiers, with particular reference to the transformer-coupled type.

By PROFESSOR E. L. BOWLES

IT is difficult to make a fair comparison of low-frequency amplifiers in a superficial manner. When scientific principles are involved there is often a tendency to overlook the value of experience.

For example, no device is ever developed without some actual trial before it is considered satisfactory. In fact, as time goes on, the device is usually improved as the result of experience.

In judging or comparing audio amplifiers, however, too hasty a conclusion is sometimes reached. One amplifier may give more volume than another, but the quality may be poorer. Two amplifiers may sound equally well under certain conditions, yet one may be far superior to another.

This superiority would be obvious if the comparison had been properly made. Suppose the two amplifiers had been judged by having one "on" one night and another "on" another night. It would be almost impossible to say directly that one was better than the other. Other unfair situations might be cited; for example, the two sets might reproduce programs from the same broadcast station at different times on the same evening or from different stations on the same evening at the same time.

Setting aside the possibility and probability that the transmissions of one broadcast station were better than those of the other, or that one required more amplication than the other at the receiver, one set might have reproduced a piano solo and the other a violin solo. The violin solo would be easier than the piano for the poorer amplifier to re-

produce. One set might have reproduced a soprano voice, the other, a *basso-profundo* voice. The latter would lack quality in the amplifier having the lowest amplification at the lower frequencies.

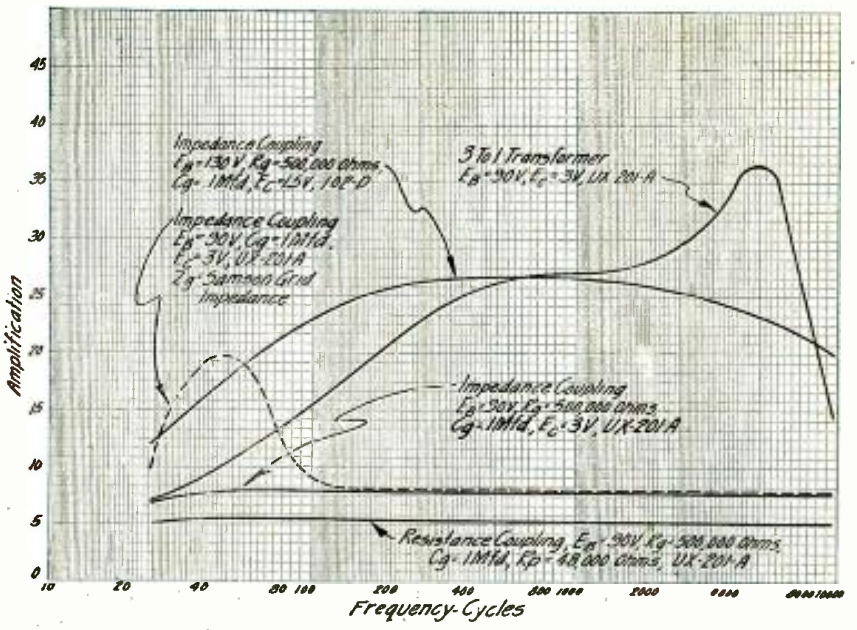
If both amplifiers had equal amplification at the higher frequencies the soprano voice would sound the same on both. Even if one of the amplifiers cut off the high notes more than the other, the chances are that this amplifier would make the bass voice sound worse than the soprano, since the low notes might sound mushy because of insufficient articulation caused by a lack of the higher audible frequencies.

Yet another trouble in making a hasty comparison would arise if one amplifier were required to reproduce passages of soft, or *pianissimo* music, and the other, passages of loud, or *fortissimo* music. With the poorer amplifier reproducing the soft music it might seem as good in performance as the better amplifier; yet had the poorer amplifier been required to reproduce the louder sounds it might have given very poor quality due to "overloading."

One good way to compare two low-frequency amplifiers is to connect them alternately to the same detector tube and its tuner. Often it is convenient to plug from the detector jack of a set to a change-over switch so that either amplifier may be switched on at will. Even in such an arrangement the "change-overs" should be made often and at points where the character or intensity of the music does not change during the operation.

These possible difficulties suggest that *the choice of an amplifier must be made with care.* One amplifier may amplify a certain range of frequencies unduly and not amplify others. In particular, a poor transformer usually amplifies excessively the frequencies in the neighborhood of 1,000 cycles per second. Thus the notes in the neighborhood of two octaves above middle "C" would be amplified an excessive amount, relatively. The same transformer probably would not amplify the notes below middle "C" at all well. Again, the transformer might not amplify properly the high notes, such as those above three octaves above middle "C."

To the person uninterested in music, the difference between a good and a bad amplifier may not be bothersome as long as he can understand the spoken word. If one were to judge a low-frequency amplifier without "trying it out" on the most varied types of sounds, the performance would be discouraging and disappointing in just the same way that it would be were one to judge an automobile he expected to buy simply by the fact that the engine ran.

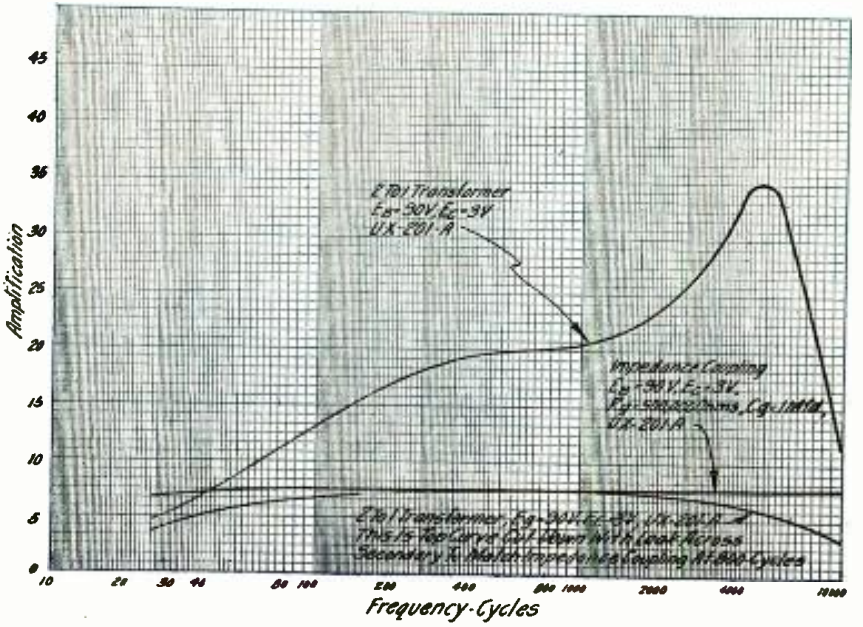



AMPLIFICATION CURVES FOR VARIOUS AMPLIFIER UNITS

FIGURE 1: *In this chart the amplification is plotted against frequency for a 3-1 transformer, for impedance coupling of various types and for resistance coupling. The curves are for a single stage using standard UX-201-a type valves.*

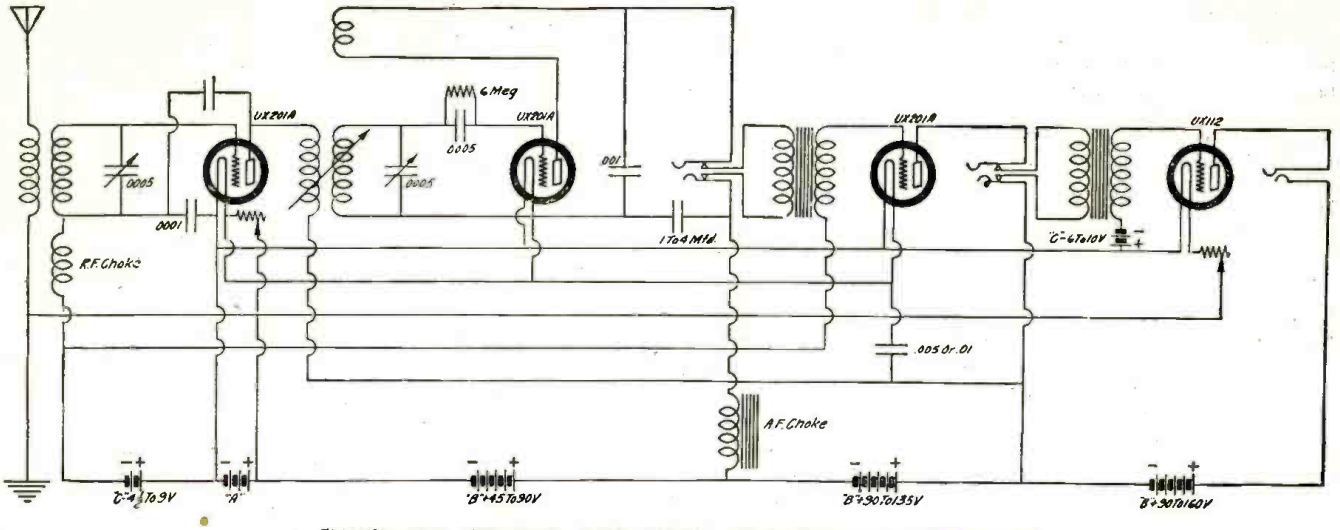
The greater the range of reproduction, the more difficult it is to design the amplifier. It is comparatively easy to design an amplifier to reproduce the average human voice so that the articulation will be fairly good. It is another thing to design an amplifier to produce the low notes of an organ, the double-bass viol, or the piano, and at the same time the high notes of the violin, with the proper amplification over all the notes in between.

The greater the volume of sound which it is desired to produce, the greater the difficulty in designing the amplifier, and the greater the care which must be taken to build such an amplifier. Also, the greater the volume, the more obvious will be the distortions which exist in the amplifier.




HOW A SHUNT RESISTANCE FLATTENS THE AMPLIFICATION CURVE

FIGURE 2: *The peaked line shows the curve for a 2-1 transformer. The lower curve line shows the results obtained with the same transformer, using a resistance shunted to the secondary, as compared with the curve obtained with a stage of impedance-coupled amplification.*




A STANDARD CIRCUIT EMPLOYING TRANSFORMER COUPLING

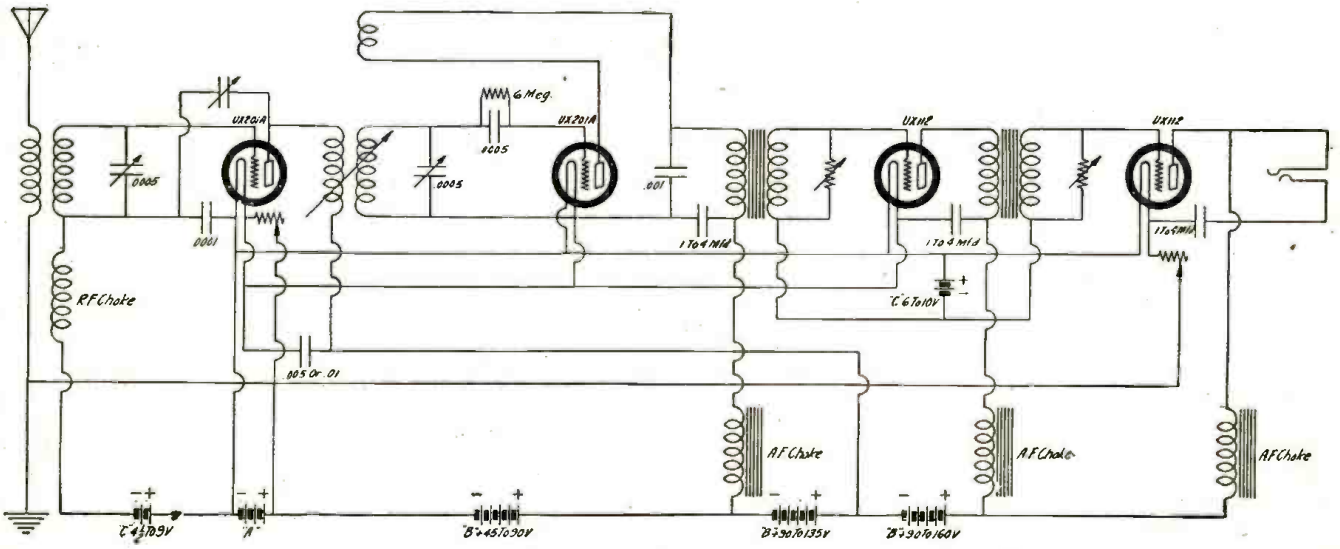
FIGURE 3: *The various methods for obtaining good quality amplification are carried out in this circuit, which employs one stage of high-frequency amplification, a regenerative detector and two stages of transformer-coupled, low-frequency amplification.*

To judge an amplifier one must not only be certain that the quality of the particular station broadcasting is recognized as excellent, but that the receiving set as a whole is properly adjusted, and that the reproducer is of a good type. It would seem ridiculous to test a good amplifier in conjunction with a reproducer if the latter were incapable of reproducing the lower notes and the higher notes which the amplifier may have been carefully designed to amplify. After all, no matter how nearly perfect an amplifier is, it cannot do itself justice if it must "feed" a poor reproducer.

An amplifier must be judged for quality at small and large volume, for permanence, and for economy. Naturally, permanence is essential; that is, the quality of the parts must be such that they will not wear out or disintegrate with time. For those interested in music, the quality must be good, and for any user the amplifier must be economical.

The measure of economy is a difficult one to fix, for some will consider it most economical to have the very best in every way. Others may be governed by "A" and "B" battery consumption, and still others by the cost of vacuum valves. In general it may be said that the smaller the tubes, the poorer the quality of reproduction. A transformer-coupled amplifier will always give better reproduction with UX-201-a type tubes than with UX-199 type tubes, and it will give even better results when UX-112 power valves are used in all amplifier stages for the same volume. To be sure there are cases where compactness, power consumption, weight, or all three, make the use of the smallest valves necessary.

The ear is a poor judge of the character, quality or intensity of a sound. Some ears are naturally more sensitive than others to low or high-frequency sounds; again, one who is musically inclined can discern a distortion or misrepresentation better than one who is not. One musically trained could in a moment discover a deficiency of lower notes or higher notes. A loud sound may be doubled in intensity (the energy doubled) and the ear may hardly detect the change. Thus it is impractical for one person to judge the quality of an




AND SOME WAYS OF BETTERING THE AMPLIFICATION

FIGURE 4: *In this circuit the addition of "C" batteries to the two low-frequency valves, which are of the UX-112 type, the use of two variable shunt resistances across the secondaries and the use of two extra low-frequency choke coils, will produce improved results in the quality of amplification obtained.*

amplifier with any degree of finality. Any aural judgment requires a study over a long period of time, for human beings see the same things and hear the same things differently from day to day.

In order to design amplifiers logically, tests on them must be made by some instrument which does not misbehave, and which is not influenced by one's temperament, as is the ear. For this reason, what are known as amplification curves are often made. They may be studied to determine how a given amplifier behaves. In this way it is possible by electrical rather than acoustic tests to determine the effects of changing certain elements of an amplifier. Effects may be measured in this way which could not be detected by the ear. Even though these effects may not be detected by the ear, when considered singly, the addition of several of them may *in total* make a decided improvement in the quality of an amplifier.

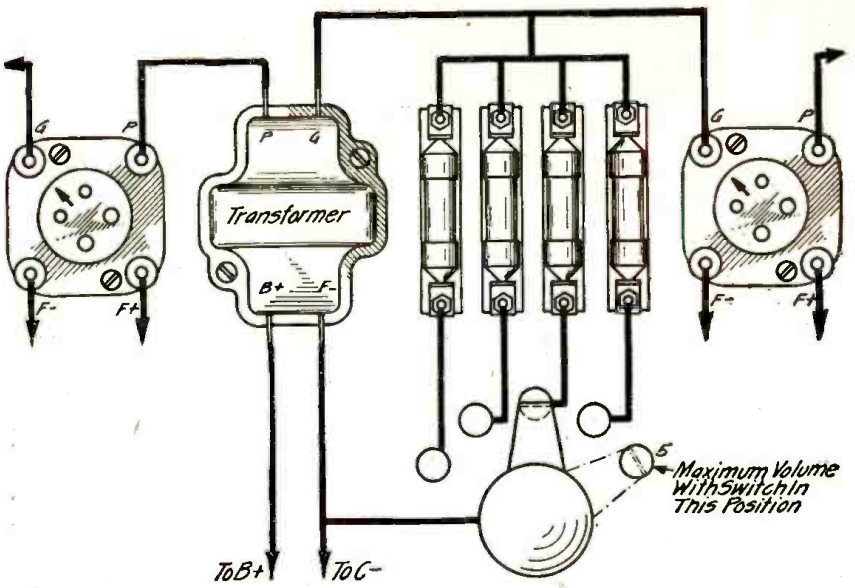
Usually voltage amplification curves are made to show how an amplifier amplifies different frequencies. Electrically, these curves represent the ratio of the signal voltage of a single frequency on the grid of a given valve in an amplifier to the voltage on the grid of the preceding valve. Figure 1 represents the effective voltage amplification as a function of frequency in several amplifier combinations, per tube and coupling unit. The frequency is carried to 10,000 cycles per second to such a scale that the changes in horizontal length along the curve represent the approximate tone changes the ear perceives. The vertical distance to the curve at any point represents to scale the voltage amplification per valve and coupling unit (that is, per stage) at that frequency.

There is not much use for a good amplifier in the receiving set if the low-frequency amplifier at the broadcast station is poor. Usually the speaking voice does not reproduce well at the lower frequencies. In order to compensate for this, it is essential that the low-frequency amplifier should amplify the lower frequencies well. In spite of this requirement, many low-frequency amplifiers are deficient in the amplification of low notes. There is a logical reason for this deficiency, *the additional cost of overcoming it*. In order to amplify the low frequencies, the development of an amplifier will require *more material*, either iron or copper or both, and *more care* in the winding of the coils entering into its construction.

Figure 2 illustrates how the curves of amplification compare for the Samson 2-1 transformer and the impedance amplifier. For a comparison of resistance and impedance coupling, see Figure 1. The same valves were used for all the curves. The 2-1 transformer coupling gives about twice as much voltage amplification per stage at 100 cps. as the impedance coupling, so that two stages of such transformer coupling with this particular transformer will give the same volume at this frequency as four stages of choke-coupled amplification using the same tubes. The quality *theoretically* would be better for the two stages of impedance coupled amplification.

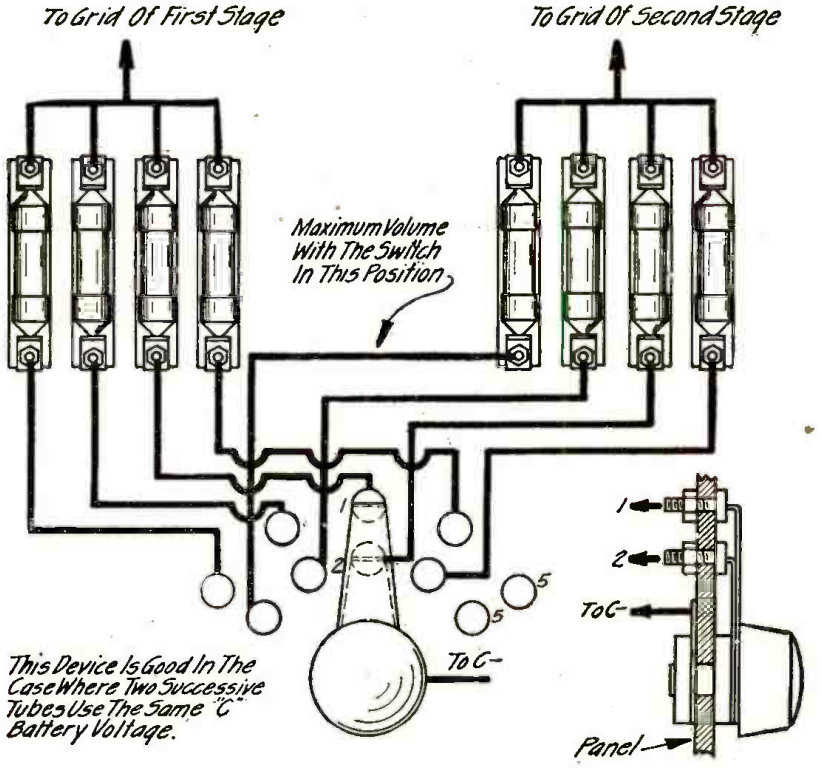
It will be noticed that although over the greater portion the transformer curve is higher in proportion, it slopes off at the lower and higher frequency ends more rapidly than does the flatter but lower impedance coupling curve.

The curves of amplification represent



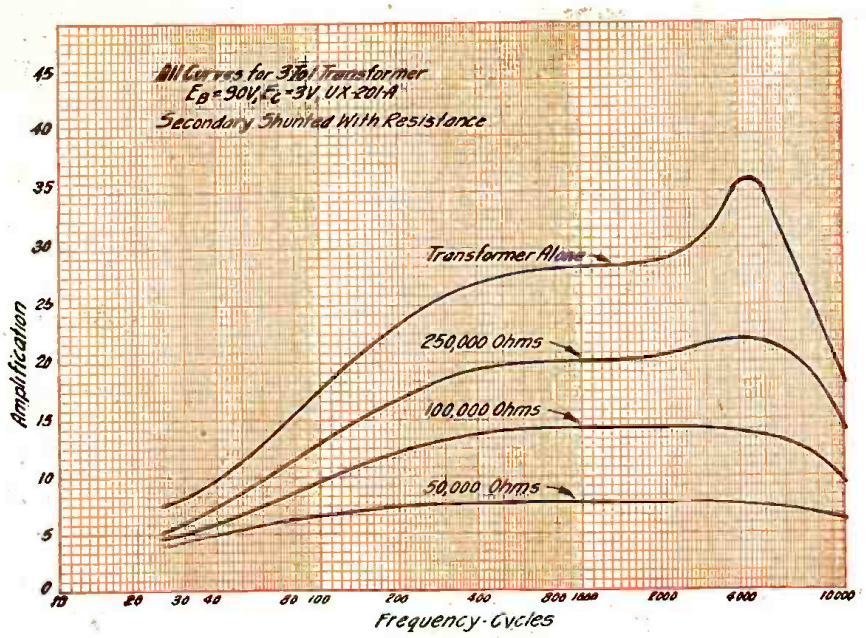

HOW RESISTORS MAY BE USED

FIGURE 5: *This drawing shows the electrical connections for a bank of four fixed resistors of different values which may be used in a transformer-coupled amplifier as a volume and quality control.*




CONTROLLING TWO STAGES WITH A SINGLE SWITCH

FIGURE 6: *This drawing shows the connections for two sets of resistors to be used in two following stages. This allows a single switch to control both low-frequency valves at once.*




HOW SHUNT RESISTANCE AFFECTS A TRANSFORMER CURVE

FIGURE 7: *Here are a series of curves with the same transformer used alone and shunted by various sized resistors. Notice that when shunted with 50,000 ohms, the curve is practically flat, although the volume is reduced.*

the behaviour of the amplifier more accurately than the ear can determine. By judging from the curves, there is no danger of making a mistake, so far as frequency response is concerned. A snap judgment by ear will almost always result in ultimate disappointment.

It has already been pointed out that the quality of reproduction, insofar as it is affected by the receiving apparatus, depends upon the selectivity of the receiver, its proper tuning, upon the detector, the low-frequency amplifier, the reproducer, and upon its surroundings. Later the reproducer will be discussed.

### *The Facts About Transformer-Coupled Amplification*

In order that the best results may be obtained with a transformer, the associated circuit and circuit apparatus must adapt themselves to the instrument. Figures 3 and 4 give several combinations of transformers and tubes.

The diagrams do not give any idea of the method of construction of the amplifier, but they suggest the order of the electrical arrangement. The leads should be short and direct. In the observation of this suggestion it is unnecessary to go so far as to make the wiring smack of the cubist's art. The apparatus should be arranged in an orderly manner. Often this may be done on the top of a baseboard.

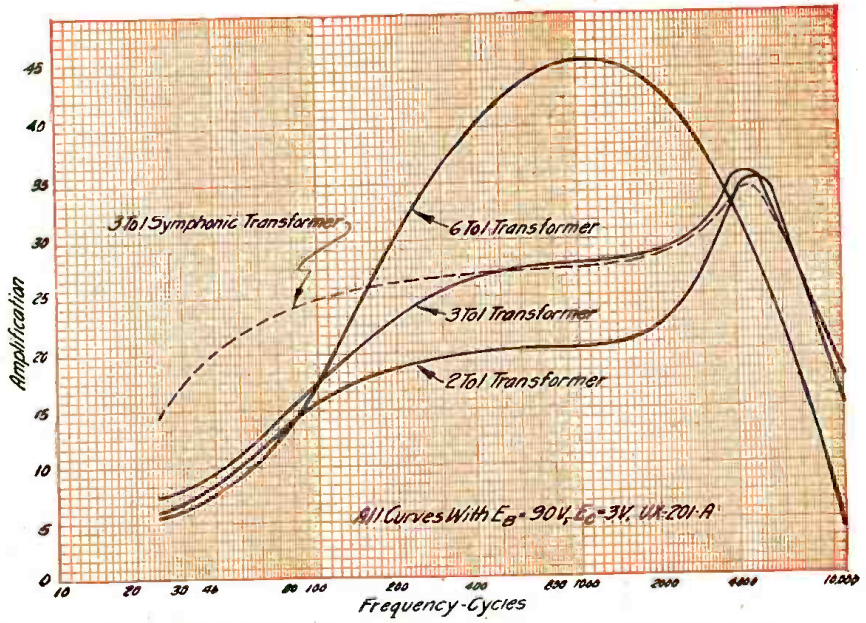
It will usually be found convenient to "bunch" the supply leads and to cable them, fanning out the cable to carry individual wires to their destination. Connections should be soldered at every point. Preferably, leads should be soldered directly to the binding post and not to a terminal held in electrical contact with the post by means of a nut.

A two-stage, transformer-coupled amplifier is shown in Figure 3. The transformers are arranged with jacks so that the reproducer may be plugged into either of the three places, the detector jack, the first stage jack, or the last stage jack. An additional refinement could be added in the form of a filament-control jack for the last stage, but this jack is sometimes the cause of trouble, owing to the complications involved. The questions of economy and practicality are for the user to settle.

The circuit is for three UX-201-a type valves or similar tubes with a UX-112 type valve in the last stage. This combination is, of course, only illustrative. Smaller valves might well be used for convenience. A larger tube such as the UX-171 type or UX-210 type may be used in the last stage. For the assurance of proper and continuous operation without the development of distortion due to the coupling through the common "B" battery (discussed in detail later) a choke is introduced into the detector "B" lead and a 1 to 4 mfd. condenser is connected from the B+ circuit of the transformer to the F+ circuit. Thus the low-frequency currents pass directly from the B+ of the transformer to the filament of the detector valve, and are restrained from passing through the "B" battery by the choke. For this reason the voice currents in the succeeding tubes which pass through the "B" battery do not affect the detector valve and therefore cannot cause squealing (oscillation) or feed-back distortion.

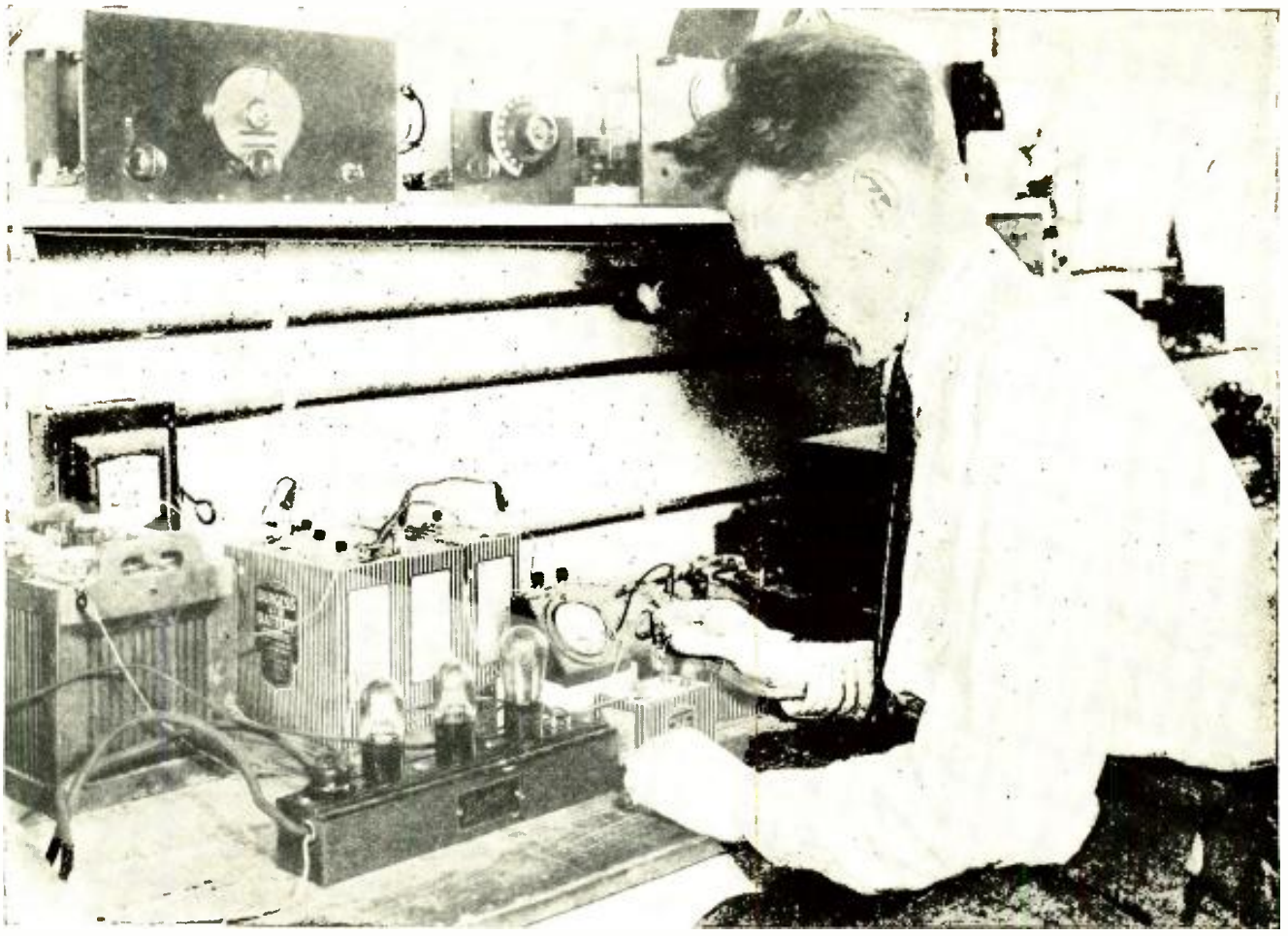
The use of a UX-112 type valve in the last stage as shown is not necessary. A UX-201-a type tube may be used instead.

(*Continued on page 254*)




HOW THE RATIO OF TRANSFORMER WINDINGS AFFECTS AMPLIFICATION

FIGURE 8: *The curves above show how transformers of different ratios vary in amplifying power over the audible range. Some transformers are many times more efficient at some frequencies than at others, thus producing distortion.*



From a photograph made for POPULAR RADIO

ADJUSTING THE "C" BATTERY

*For proper operation of a receiver the use of a power tube in the last stage with high "B" voltages is necessary. The correct "C" battery voltage applied to this last tube is equally as important for efficient operation.*

THE PRACTICAL USES OF . .

# Negative Resistances

Just what is a negative resistance? What part does it play in circuit designs? What is its significance to radio? These and other questions are taken up in this interesting article.

By A. A. BLUMENFELD

THE usual conception, on the part of the amateur radio experimenter, of negative resistance is the same as that of imaginary numbers that exist in theory but which do not admit of actual representation.

However, there are a few devices which have this so-called negative-resistance characteristic. These are:

1. Arcs
2. Vacuum tubes
3. Oscillating crystals

But just what is negative resistance?

A substance is said to possess negative resistance when an increase in voltage will cause a decrease in current through it and *vice versa*.

This is most easily shown by means of a characteristic curve such as that given in Figure 6. From A to B on the curve an increase in voltage will cause an increase in current, while from B to C an increase in voltage will cause a decrease in current. From A to B on the curve the substance has a positive resistance but from B to C it has a negative resistance.

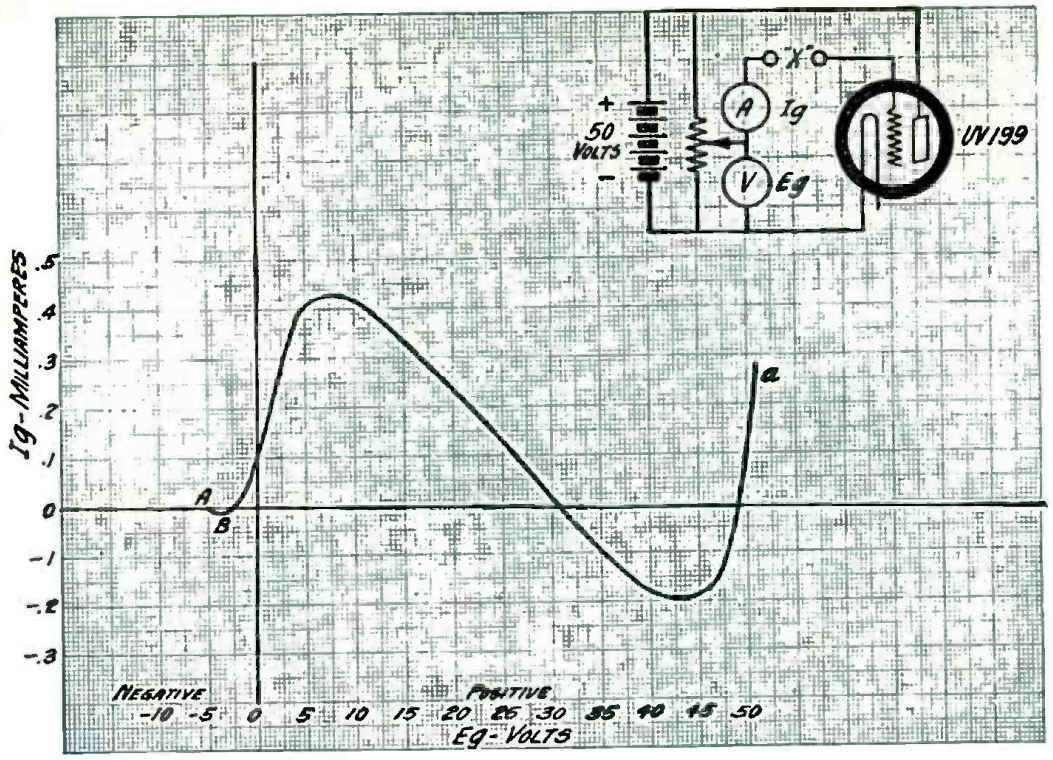
Or it may be explained mathematically by stating that when the derivative of the equation of the line is positive, the resistance is positive, and when the derivative is negative the resistance is negative. The equation is

$$4Y=4X-X^2 \text{ and } \frac{DY}{DX}=1-\frac{X}{2}$$

This is an exact way of saying that when the line goes up the resistance is positive and when the line goes down the resistance is negative.

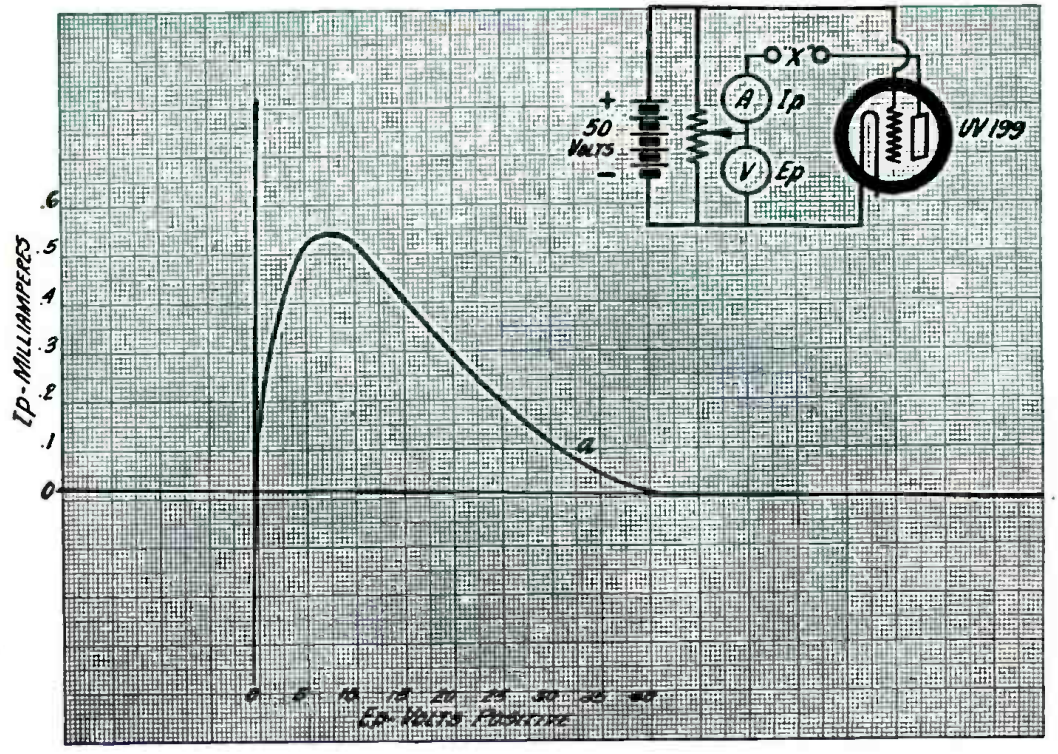
Now let us examine the characteristic curves of some negative resistance devices, taking first the oscillating arc.

The carbon arc is the most familiar and its characteristic curve is shown in Figure 7. The reason for its negative




A CURVE OF GRID CURRENT AGAINST GRID VOLTAGES

FIGURE 1: *This shows the peculiar change in grid current that is obtained when the voltage is made more and more positive. (The circuit for these measurements is shown in the upper right hand corner.)*




A CURVE SHOWING THE RELATION BETWEEN THE PLATE CURRENT AND PLATE VOLTAGE WITH A LARGE POSITIVE CHARGE ON THE GRID

FIGURE 2: *Notice how the current increases quickly from zero and then falls off at a somewhat lesser rate at about 7½ volts.*

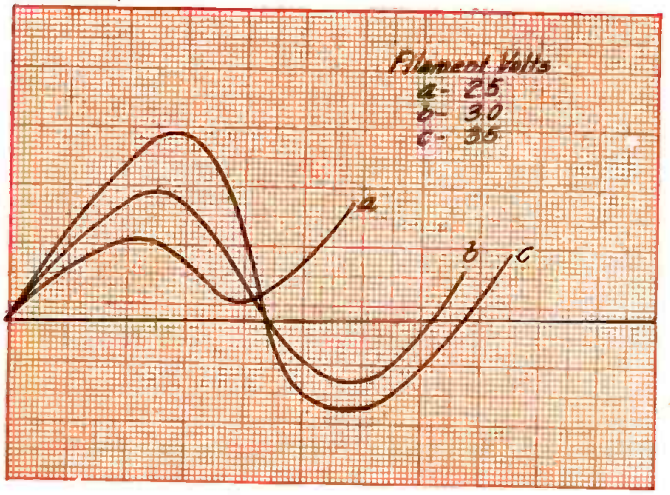



FIGURE 3: *This drawing shows the changes in the grid-current, grid-voltage curve when different filament voltages are used.*

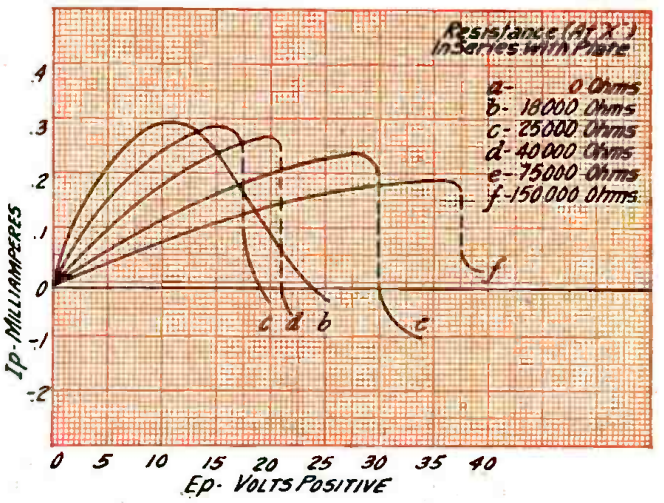



FIGURE 4: *The changes in the grid-current, grid-voltage curve as various resistances are included at "X" in the circuit in Figure 2.*

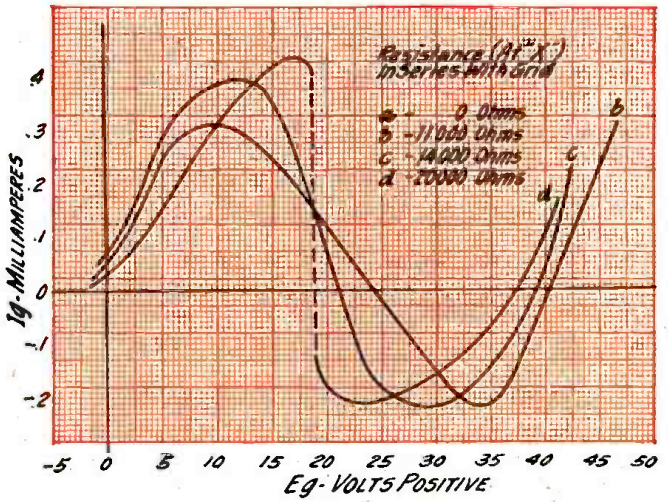



FIGURE 5: *The changes in the plate-current, plate-voltage curve when resistances are connected at "X" in the circuit in Figure 1. Notice the unstable portion of the curve, shown by the dotted line.*

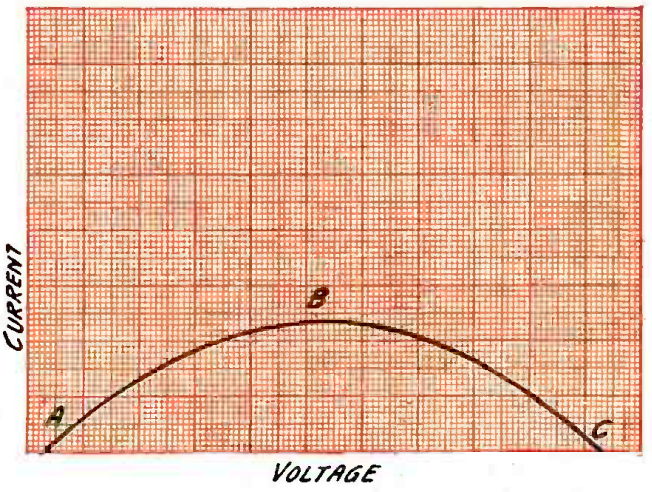



FIGURE 6: *A curve between voltage and current showing a positive resistance effect between A and B and a negative resistance effect from B to C, accompanying an increase in voltage.*

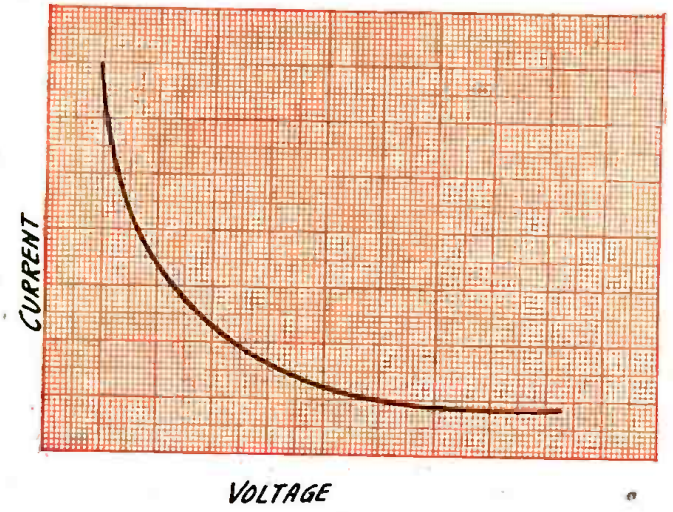



FIGURE 7: *Another curve between current and voltage showing the negative resistance effect in an arc as the current heats up the arc.*

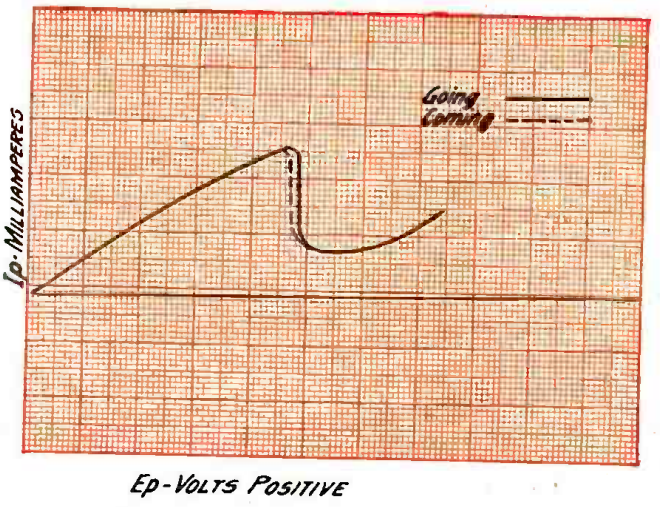



FIGURE 8: *An unstable effect in the plate-current, plate-voltage curve that affects the use of this critical setting as an amplifier.*

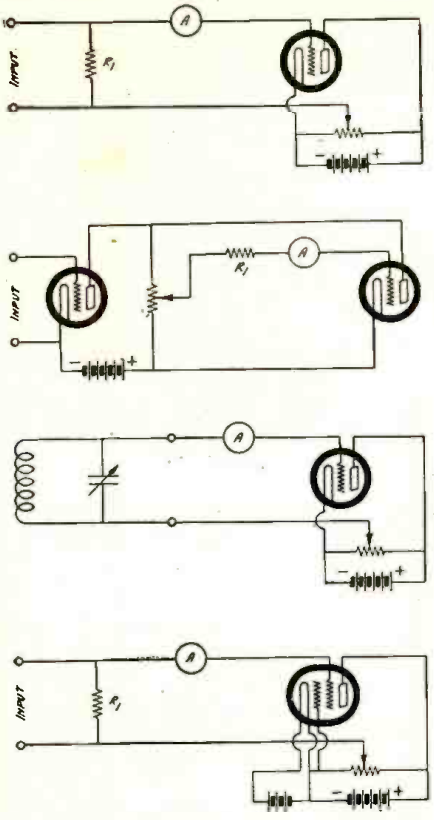


FIGURE 9: *Here are four circuits that make use of negative resistances for their operation. The last circuit employs a vacuum valve with two grids.*

resistance is the fact that an increase in voltage heats the arc, increasing its resistance and decreasing the current. Although this property makes it useful in radio (the poulsen arc), it is usually a detriment when the arc is used in industry. Should the voltage drop accidentally, the current might become excessive and do damage to the dynamos; for this reason a resistance is sometimes inserted to keep down the current.

The arc, however, is a cumbersome and unsteady piece of apparatus and is not suited to ordinary laboratory investigation. In order to understand the subject more fully then, let us consider the vacuum tube.

There are many ways in which the vacuum tube may be turned into a negative resistance device; of these the simplest is to use the *secondary-emission* effect. This effect was discovered by Hull, who used a special tube; but the ordinary thermionic tube works well in demonstrating these phenomena.

First examine the ordinary grid-voltage, grid-current curve in Figure 1. From A to B on the curve the tube is a negative resistance. This is due to ionization and is too small to experiment with. If we continue this grid-voltage, grid-current curve up to about twenty volts we find the tube again acting as a negative resistance; this time it is due to secondary emission from the grid. This secondary emission is due to the fact that when an electron hits the grid, it will knock out one, two, three and sometimes even twenty secondary electrons, depending upon the speed of the electron. The speed of the electrons depends upon the voltage on the grid; they are normally attracted to the plate, which has a higher voltage than the grid. The grid current is thereby lowered, causing the negative-resistance effect.

As the voltage on the grid is increased, these electrons are attracted back to the grid and the negative-resistance effect is lost. There is also a secondary emission from the plate, but on account of its high voltage the electrons are all diverted back to it. Here the plate is the diversion electrode. The grid can also be used as diversion electrode.

In Figure 2 is shown a plate-voltage, plate-current curve made in the same manner as the curve in Figure 1. They closely resemble each other.

There have been numerous other negative-resistance devices invented by Taggart, Turner and others. These use either a new kind of tube, or more than one ordinary tube and a complicated battery system. A diversion electrode inside the tube is usually used, as in the preceding examples, but the operation is more complicated. It is interesting to note the behavior of these characteristic curves when a positive resistance is inserted in the circuit.

Figure 5 and Figure 4 show the result of gradually adding different resistances each time and taking the characteristic curve in circuits shown in Figure 1 and Figure 2, respectively. It will be noticed that the curve gradually gets steeper and steeper; this immediately suggests its use as an amplifier in radio. Certain portions of these curves are seen to be vertical lines. This is because at a certain voltage the current simply drops without any further increase in voltage until it again reaches a stable value. The unstable portion of the curve is shown by the dotted line. It is impossible to operate the tube on this portion of the curve. When the curve has an unstable portion in it, it repeats itself, as in Figure 8. While this property is very interesting, it spoils the valve's value as an amplifier.

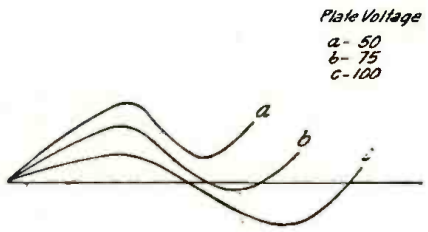



FIGURE 10: *Graph showing how various plate voltages raise or lower the current curve while the general shape remains approximately the same.*

The best condition under which to operate the tube as an amplifier is when the curve is as steep as possible without becoming unstable. Theoretically there is no limit to the amplification that may be obtained. When the positive resistance inserted is exactly equal to the negative resistance, the amplification is infinity, because the resistance of the total circuit is zero. This, however, is an unstable condition. The limit will be reached when it becomes unstable due to variations in the battery voltage. When it is used as a direct-current amplifier, the first circuit as shown in Figure 9 may be used.

If the tube is to be used to measure electrostatic voltages or to amplify radio-frequency currents, the second circuit shown in Figure 9 should be used. Phones may be included in the circuit if it is properly by-passed so that it will not oscillate at an audio frequency.

So far as oscillation is concerned, any negative resistance is capable of producing oscillations if it is set up properly. The third circuit in Figure 9 will oscillate, the frequency being determined by the inductance of the coil. The whole range from an audio to a radio frequency may be covered.

The best tube to use as a negative resistance is the UX-199. While it is not as powerful as the UX-201-a type of tube or as some other tubes, it works with less voltage; this is due to the fact that the elements are close together and the grid is close to the plate. The closer the grid is to the plate, the less voltage will be needed. Some UX-199 type valves may work on as low as 22 volts, but as a rule 45 volts should be used. When the UX-201-a type is used, it usually needs more than 45 volts.

It is interesting here to note the effect of changing the filament voltage or the "B" battery voltage. Figure 3 shows a set of curves obtained by keeping the "B" voltage constant and varying the filament voltage. It may be seen that the length of the curve is not changed, but the height varies. Figure 10 shows the effect of varying the "B" battery voltage and keeping the filament voltage constant; this shows just the opposite effect. However, as we want the curve to be as steep as possible, it will be best to adjust the tube with the highest filament voltage and lowest "B" voltage that the tube can be made to operate satisfactorily on.

A four-element tube would probably reduce battery difficulties. Here an extra grid is used to allow increased current at low voltages. The last circuit in Figure 9 shows a circuit that may be used with such a valve.

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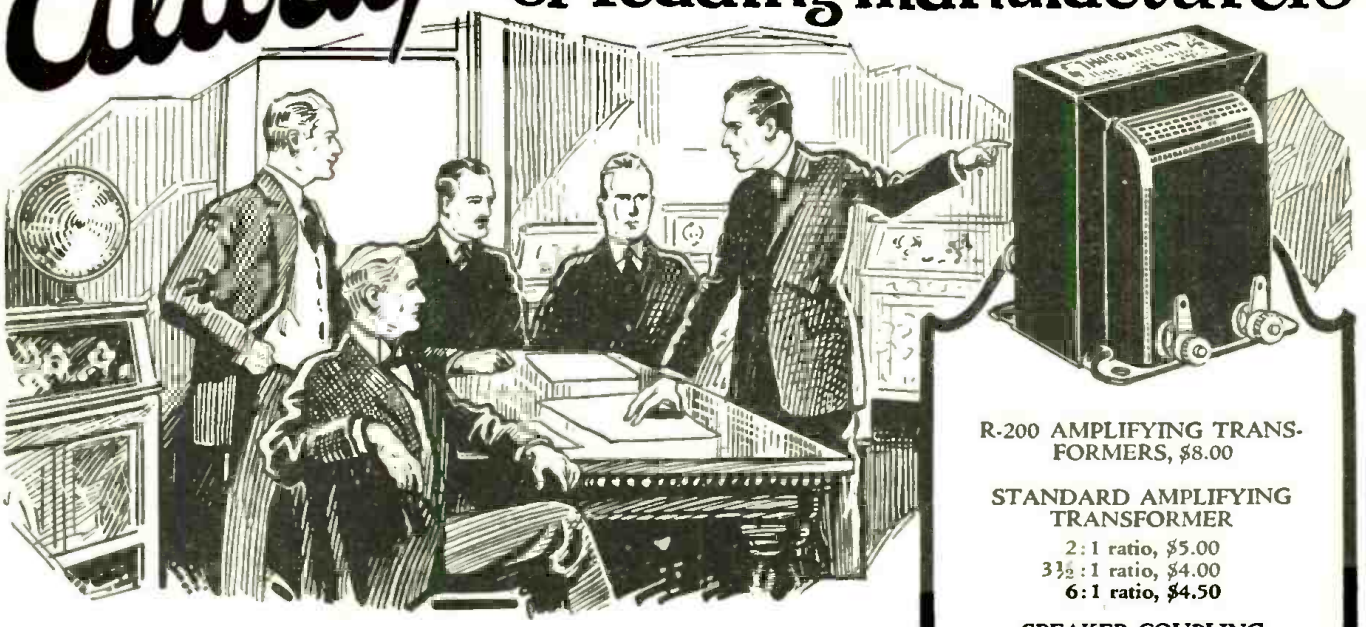

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POWER PUSH PULL TRANSFORMER AND CHOKE
T-2408 Input Transformer, $8.00
T-2420 Output Choke, $8.00

AUTOFORMER IMPEDANCE
R-190, $5.00

POWER COMPACTS
(for power amplifiers)
R-171, $15.00 R-210, $20.00

130 M. A. FULL WAVE RECTIFIER
T-2098 (Transformer) $20.00
T-2099 (Double Choke) $14.00

R. C. A. A. C. TUBE SUPPLY TRANSFORMER
T-2445, $10.00

McCULLOUGH A. C. TUBE SUPPLY TRANSFORMER
T-2504, $7.50

VAN HORNE A. C. TUBE SUPPLY TRANSFORMER
T-2370, $5.00

**MAIL THIS COUPON**

Thordarson Electric Mfg. Co., Dept. G
500 W. Huron Street
Chicago, Ill.
Gentlemen:
Please send me your free booklet on audio amplification and power supply.

Name.....

Street.....

Town..... State.....

## Advance Information About the Hi-Q Receiver

*(Continued from page 232)*

the tuning condensers of the Hammarlund Hi-Q receiver it is possible to obtain automatically a variable coupling between the primaries and secondaries so that when the circuits are tuned to the higher wavelengths the coupling has become closer than at the lower wavelengths, resulting in practically the same uniform degree of amplification at all wavelengths within the tuning band. In other words, the amplification obtained at say 200 meters is approximately the same as that obtained at 550 meters. The illustration in Figure 5 shows this point clearly. It will be noticed that curve A shows an ordinary circuit that has a high degree of amplification at 200 meters, but an increasingly lower amplification as the longer wavelengths are approached. Curve B shows the equal amplification which is obtained by the use of the automatic coupling in the circuit of the new Hi-Q.

*The Low-Frequency Amplifier*

The low-frequency end of the receiver consists of two stages of high quality transformer-coupled amplification. This is a further step in the attainment of good tone reproduction. Provision is made for the use of a power valve with the correct "B" and "C" voltages in the last stage of amplification.

Volume is regulated in the high-frequency end of the receiver; this permits the control of the amount of signal energy fed to the detector input circuit. By the use of this method of volume control, overloading of the detector valve, especially in the reception of signals from powerful local stations, is guarded against, with the result that the signal emitted from the reproducer is free from distortion which usually occurs from such overloading.

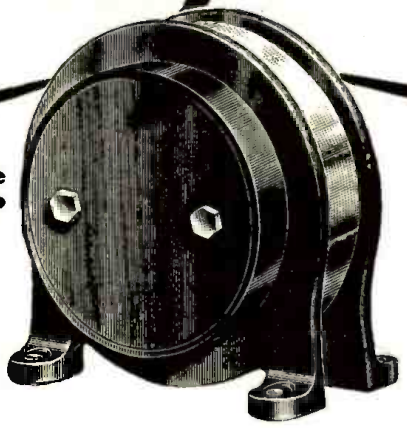
*The Exterior Appearance of the Hi-Q*

The panel appearance of the Hi-Q set is striking, in that it combines a simple beauty with an absence of complicated controls. In the center is located the double-drum control which actuates the movable plates of the condensers. This drum control is set in an escutcheon plate which lends grace and dignity to the general appearance of the receiver. Below the tuning control and to its right is the filament rheostat knob which controls the volume, while to the left is the filament switch. The connections to the reproducer are made in the rear.

It is possible in the construction of the receiver to assemble all the parts comprising the several tuned stages on the pressed steel baseplate with the box shields removed. Practically all of the wiring can be done in the same manner.

The next issue of POPULAR RADIO will contain complete and official constructional details of the new receiver.

# Magnaformer



**Price $8.50**

**Magna**—The dictionary definition of "magna" (Latin) is "great"; the definition of "former" is "creator". Thus, we have the Great Creator, truly a name emblematic of the astonishing accomplishments of the Magnaformer.

### Two Years Ahead in Design

At the Radio Trade Show in Chicago, the announcement of the Magnaformer was one of the few startlingly new ideas in radio development. We know from actual observation that the Magnaformer is two years ahead in design, for it incorporates advanced and evolutionary ideas throughout. It is distinctly different, with its self-shielding, matched units, double amplification for each R. F. stage and excellent laboratory construction. It is a fresh idea—the very heart of the new and better receiver in which its remarkable qualities are given full range. Coming, as it does, when the air has been cleared by the new rulings of the federal radio commission, it makes it possible to secure exceptional results, accomplishments heretofore unknown to radio fans.

## The Great Creator of True Tone Quality

The Magnaformer 9-8 circuit—Commander-in-Chief of the air—now being featured in complete constructional articles by G. M. Best in Radio, by L. M. Cockaday in Popular Radio, Kenneth G. Ormiston in "Radio Doings" and by the Chief Technical Editor in Citizens Radio Call Book and in numerous other magazines and newspapers—is two years ahead of the field in new, True-Tone Quality creating improvements. A Magnaformer 9-8 set possesses a fidelity and purity of tone that is actually marvelous. Mere words cannot define nor describe it. Only the ear itself can understand and appreciate its full, clear, natural sweetness. Women, musicians and experts—especially—are enthusiastic in their praise of the tone quality of the Magnaformer 9-8, for it represents the dawn of a new and far greater satisfaction in radio reception.

## Advanced Electrical Design—Absolute Mechanical Precision

The "soul" of any radio set is its tone quality. "For what shall it profit a man if he gain the whole world and lose his own soul." Likewise—what do we gain if our radio sets have the finest cabinets, the best speakers, batteries, tubes, aerials, etc., etc.—if they have no "soul"—if they lack True Tone Quality?

The most magnificent performance any radio will ever give is faithfully to reproduce the output of the broadcasting stations. This the Magnaformer 9-8 does very nearly to perfection. The difference between the tone quality of the Magnaformer 9-8 and ordinary radio sets—no matter how good looking or expensive—is the difference between the tone quality of an ordinary piano and a Steinway—the difference between the tone quality of the voice of a cheap vaudeville singer and the voice of a Caruso or a McCormack—the difference between the tone of the old style phonograph and the new Orthophonic Victrola.

The tone of a cheap piano is disappointing to those who have had the pleasure of listening to a Steinway. The tone of an ordinary radio set is equally unsatisfactory to the ears of all those who have ever heard the beautifully natural tones pour forth from a Magnaformer 9-8. Build a Magnaformer 9-8 for yourself or have one built for you and you will experience the supreme satisfaction of possessing the very choicest and most accurate reproducer of radio broadcasting possible to construct.

### Fidelity in Tone Reproduction

The thunderous tones of a mighty organ—the full, rich, resonant tones of the opera singer—the soft, appealing tones of the violin—the plaintive tones of the flute or piccolo—the perfect, individual tones of each musical instrument in a 100-piece orchestra—every iota of tone shading of the entire range of the human voice, from the lowest bass to the highest soprano and from the softest whisper or Pianissimo to the most massive Double Forte—all of these are FAITHFULLY reproduced by the Magnaformer 9-8. So clearly, distinctly and truly is every minute detail of the most elaborate and varied broadcast program reproduced by the Magnaformer 9-8 that you must marvel at its degree of perfection.

### The Secret of Its Success

The advanced electrical design and absolute mechanical precision of MAGNAFORMER Long Wave Radio Frequency Transformers accounts for the marvelously true tone quality of the Magnaformer 9-8 receiver. These R. F. Transformers are strictly a laboratory product—the result of a great many experiments and tests extending over a long period of time. The object of these tests was to develop and perfect a very superior precision instrument that could be duplicated by the thousands—each duplicate having EXACTLY the same characteristics as the master coil itself.

These tests and experiments have eventually, after a long period of time, proved highly SUCCESSFUL. Each Magnaformer is to all intents and purposes EXACTLY like every other Magnaformer. Only by the employment of elaborate Laboratory apparatus can even the expert technician discover a difference. It is this EXACT matching—and building them so carefully and mechanically perfect that they stay EXACTLY MATCHED under all sorts of conditions that insures the exclusive degree of True-Tone Quality that the Magnaformer 9-8 possesses.

### Super-Powerful Receiver

The Magnaformer 9-8, being an extremely powerful multi-tube receiver, the incoming Radio High Frequency signal must necessarily pass through several amplifying stages before it reaches the detector. If each and every Long Wave R. F. Transformer that is connected to each and every tube in each and every stage of the R. F. section of the receiver is not to all intents and purposes EXACTLY like each and every other Transformer in the set in electrical characteristics, it is absolutely impossible to secure True-Tone Quality.

Every Magnaformer is peaked to a certain definite wave length. This peaking is all done in the laboratory by thoroughly trained experts. Each and every Magnaformer can pass ONLY the same identical length of wave. Therefore, the full and complete wave-band with 100% of its vital, quality-producing, harmonic-carrying side-bands, is positively and easily passed through all of the Radio Frequency amplifying stages. This extraordinary performance of Magnaformers naturally results in as nearly true tone quality as is possible to achieve. And in no other manner can True-Tone Quality be achieved.

After Magnaformers are precisely peaked—every one alike—they are permanently sealed so that there can be not the slightest possibility of any change of wavelength at which they are peaked. They cannot be effected by moisture, dust, change of climate, age or jarring. They are so carefully and rigidly constructed mechanically as to preclude any possibility of change of electrical characteristics.

### Selectivity, Volume, D-X

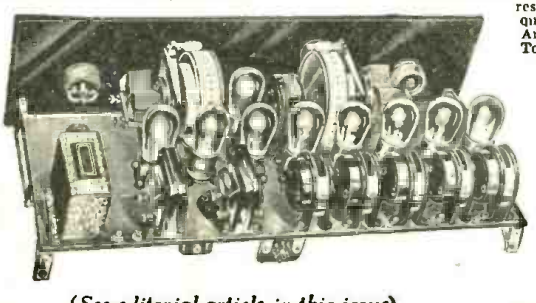
Naturally, the Magnaformer 9-8, besides possessing the very highest tone quality, also possesses in equally high degree the other three qualities necessary in a first-class receiver—selectivity, volume and distance-getting ability.

On account of the precise exactness of the electrical factors of Magnaformers, the set is exceptionally selective, although not critically so. Stations are easily tuned in or out at will without having to be located by a micrometer adjustment of the dials as is the case with sets whose long wave transformers are not EXACT.

Magnaformers were also designed to give the greatest possible amplification per stage. You will find that Magnaformers give nearly double amplification per stage. It is seldom ever necessary to use the entire 9 tubes—8 tubes give a world of volume even on distant stations. You will use 9 tubes only on very distant or very weak signals. The switching from eight to nine tubes and from nine to eight tubes is done instantly by means of a convenient little switch located on the front panel.

The precise matching of the Magnaformer Transformers and their great amplifying power naturally makes the Magnaformer 9-8 hypersensitive to even very weak signals that would be absolutely impossible of reception on ordinary sets. Probably no other type of set can log as many distant stations of an evening as can easily be brought in on a Magnaformer 9-8. It certainly hasn't a peer in great distance-getting ability.

Everyone now has the opportunity to enjoy the Magnaformer's exceptional performance. You can be one of the very first to build it and to enjoy its superb tone quality. After you once hear it you will appreciate why it is called Magnaformer—The Great Creator of True Tone Quality. You are privileged to secure all the facts. You are more than welcome to them. If you will merely mail the coupon below we will gladly send you complete Magnaformer 9-8 literature. Write today—surely.



*(See editorial article in this issue)*

Radiart Laboratories Co., 19 S. LaSalle, Dept. 47, Chicago.

Dear Sirs: Please send me your complimentary descriptive literature on the Magnaformer 9-8 receiver containing facts regarding its remarkable performance and true tone quality.

Your Name.....

Address .....

City .....

**Radiart Laboratories Co.** 19 S. LaSalle St., Dept. 47 **CHICAGO, ILLINOIS**

# How to Select Audio Amplifiers

(*Continued from page 246*)

It will give practically the same results *up to a certain volume of sound output from the reproducer.*

Good results will be obtained by using UX-112 type valves in both the third and fourth sockets of Figure 3; of course, the "B" and "C" battery values must be properly chosen. The use of two of these power tubes in a two-stage transformer-coupled amplifier results in an improvement in reproduction over the use of UX-201-a type valves by bringing in the low notes more intensely. Again, for even greater output a UX-171 type tube may be used in the last stage with appropriate plate and grid voltages.

Figure 4 covers the same general circuit as Figure 3, with the exception that there are no interstage jacks. This simplification has at least two things to recommend it. In the first place, the elimination of the jacks with moving contacts removes the possibility of open circuits or loose connections; and secondly, the most important, the volume is controlled with a graduation that is uniform and not abrupt as in the case of plugging out of one stage into another.

The volume is controlled in what the author believes is the most logical and correct way: by means of variable resistors connected across the secondaries of the transformers. These resistors may be special devices for the purpose with a uniformly variable resistance controlled individually or in tandem, or they may be made up of a series of fixed resistors as in Figure 5. The use of a two-contact, single-blade, rotary switch arranged as illustrated in Figure 6, makes it possible to regulate both transformers simultaneously. The variation of the resistance values of these resistors across the secondaries of each transformer simultaneously is a simple and proper thing to do in order to obtain the best quality.

Figure 7 brings out the importance of using resistors across the transformer secondaries to regulate volume. The curve of highest, overall amplification represents a 3 to 1 transformer. The successive curves below represent the effects of the different sized resistors. The lower the resistance used, the flatter or the more uniform the amplification as a function of frequency. The maximum value of the resistance of such a control resistor should preferably be about 0.75 megohm, capable of going down to about 0.005 megohm or 5,000 ohms.

Some variable resistors, made to go low enough in value, may not be capable of going high enough. They are very useful for control where the incoming station is near by, but their use cuts down the maximum obtainable amplification under other circumstances. This can be overcome by providing a means of disconnecting them or by adding an extra stage of amplification.

The arrangements of Figures 5 and 6 have the advantages that when the switch arms are on points marked "5" there is no resistance across the secondaries of the transformers.

The advantage of this means of volume control lies in the fact that as less and less resistance is shunted across the secondaries of the transformers, with the consequent decrease in volume, the quality improves, since the amplification of frequencies in the concert range becomes more uniform. This is brought out by the curves of Figure 7. By this resistance methods of control, the more powerful stations will be brought *down to the proper signal strength,* with improved quality.

Most other methods of control injure the quality in many cases, as we shall see later. An exception to this lies in the receiving circuit shown in Figures 3 and 4, where, if a variable primary coupling is used in the high-frequency transformer between the first two amplifying vacuum valves, the volume may be controlled by varying this coupling, without affecting the quality.

In order to realize the full advantage of the resistor method of volume control, it is necessary that the resistors be placed across the secondaries of all transformers, and that they be controlled to give approximately the same resistance across every secondary.

Where it is desirable for some good reason to control the volume of a transformer by connecting a variable resistor across the primary of the transformer, the operating characteristic of the amplifier will be practically the same as if the resistor were connected across the secondary terminals as in Figure 5. However, to obtain results corresponding to Figure 5 by means of a variable resistor across the primary, it would be necessary to use resistance values about one-twentieth as large as the values required across the secondary.

From the amplification curve for the special symphonic transformer, in Figure 8, it is evident that a two-stage transformer-coupled amplifier, built as outlined and with these transformers in either Figures 3 or 4, will give excellent results that will please even the super-critical. Here again a shunt resistor control of volume is suggested.

The importance of careful consideration of amplifier characteristics cannot be overlooked in the choice of a low-frequency amplifier if the best tone quality is desired. Not only must the amplification be sufficiently uniform at all important frequencies, but power considerations must be taken into account to eliminate overloading.

# TRUE MUSICAL RECEPTION

## Audio Frequency Transformers

HIGH AMPLIFICATION ratio with flat curve . . . High primary inductance maintained under normal operating conditions . . . Low leakage reactance resulting in uniform amplification at high frequencies . . . Primary winding of ample cross section to withstand continuously, plate currents resulting from all usual operating conditions . . . No compound or fibrous material used in construction, therefore low self and mutual capacity with durability and long life . . . Core of specially tested material of ample cross section . . . Primary shunted with built in condenser of correct capacity . . . Every transformer subjected to ten tests to insure uniformity of product . . . Tested to one thousand volts throughout.


**TYPE AF-4 $8.50**
Ratio . . . . 3½ to 1
Dimensions 2¼" x 3" x 3¼"
Weight . . . 1 lb. 8 oz.

**TYPE AF-3 $12.00**
Ratio . . . 3½ to 1
Dimensions 2¼" x 3" x 3¼"
Weight . . 1 lb 14 oz.

# FERRANTI A. F. 4 TRANSFORMERS

*Exclusively specified for the*

## Magnaformer 9-8 Circuit


**TYPE OP-1 $10.00**
Ratio . . . . 1 to 1
Dimensions 2¾" x 3" x 3¾"
Weight . . 2 lb. 10 oz.

## Output Transformers

High efficiency with low leakage inductance and self capacity improves loud speaker results . . . Insulates the loud speaker, preventing accidental contact with high plate voltages required with power tubes . . . Danger of burning out the delicate windings of the loud speaker and of demagnetizing its magnets is eliminated . . . Tested to 1000 volts throughout, therefore . . . Safe for use with highest plate voltages used in high grade radio receiving sets . . . Connect primary to Output of set, secondary to loud speaker.

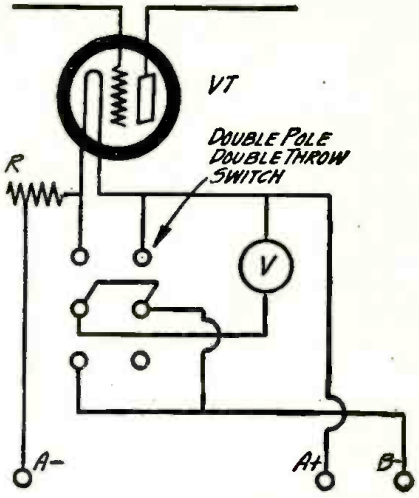
FERRANTI *Ltd.*
Hollinwood England

**FERRANTI *Inc.***
130 West 42nd Street, New York, N.Y.
(*Member Radio Manufacturers' Association*)

FERRANTI ELECTRIC *Ltd.*
Toronto, Ontario, Canada

## How to Build a Transmitter for Less Than $30

*(Continued from page 241)*




A HOOK-UP FOR OPERATING EFFICIENCY

FIGURE 4: *This wiring diagram shows how the voltmeter can be hooked up to serve both as a filament voltmeter and a plate milliammeter.*

leak of from 1,000 to 10,000 ohms resistance. The high-frequency choke coil consists of 60 turns of No. 22 double-cotton-covered wire, wound on a cardboard tube 1½ inches in diameter. The clips on the connection strip are, from left to right, "B" positive, "B" negative, "A" positive and "A" negative.

"Keying" in this set is accomplished either by inserting the key in the negative "B" voltage lead or by inductive coupling on the tenth turn of the primary coil. This tenth turn may be cut away from the other nine by a half-inch gap, and the two key connections are made at each end of the turn. This method of keying makes a key click practically a minus quantity.

The filament voltmeter, a DC instrument reading up to 10 volts, may be used as a plate milliameter by hooking it up as shown in the diagram in Figure 4. It will then read up to approximately 25 milliamperes.

Tuning the set is not difficult, although care should be taken to get maximum results with such a low-powered transmitter. A wavemeter is necessary. The clips on the coils are first set in positions similar to those in the Figures 1 and 3, and the set tuned without an antenna until it reads the correct wavelength on the wavemeter. The antenna can then be attached and the condenser and clips adjusted slightly to give maximum results.

This transmitter has been in use throughout this past winter with a variety of valves, and has maintained constant communication with stations in all parts of this continent, both at night and in daylight, and the results have been excellent.

## How to Build the Magnaformer 9-8 Receiver

(*Continued from page 229*)

type valves in all sockets except the two at the right-hand end. Insert a UX-112 type valve in the socket R8, and a UX-171 type valve in the socket R9. The battery cable may now be plugged into the plug-base at the rear of the receiver. This leaves everything ready for operation.

*How to Operate the Receiver*

The receiver should first be tested to see if the wiring has been done correctly. The filament-control knob, F, is first turned half way "on," or a little more. This should cause the filaments of the four intermediate-frequency amplifier valves and the two low-frequency amplifier valves to light. The two knobs, H and I, on the sub-panel, V, may also each be turned "on" half way, with the result that the balance of the valve filaments should light. If such is the case, the filament-control knob, F, should be turned "off" again and the reproducer and loop connected to the phone tip jacks—S1 and S2 for the loop and S3 and S4 for the reproducer. Now turn the filament-control knob, F, half way "on" again and stations may then be tuned in by slowly turning the tuning control knobs.

When the first signal from a broadcasting station is heard, the two tuning controls should be slightly readjusted, and the filament and volume controls, F and G, on the front panel, U, as well as the two rheostat knobs, H and I, on the sub-panel, V, should each be adjusted for maximum volume. Thereafter the rheostats, H and I, on the sub-panel will require little, if any, attention. All wavelength tuning will be accomplished by means of the two knobs which operate the drum dials, X1 and X2, while the sensitivity and volume of the receiver will be controlled by means of the volume and filament knobs, F and G, on the front panel, U.

The switch, L, at the bottom of the front panel, U, should be left set on figure "8" for all local and semi-distant reception. But for reception from extreme distances, this switch should be set on figure "9." While set on figure "8," this switch disconnects the fourth intermediate-frequency amplifier valve, which means that only eight valves are left in the circuit. When set on figure "9," the nine valves are left operating in the circuit, for distance reception.

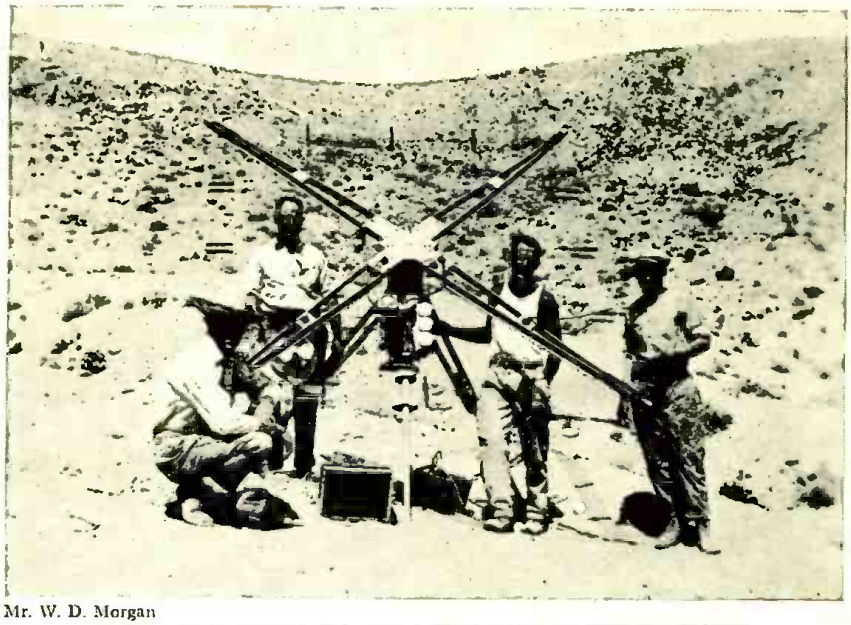
* *

## Announcers Are Prodded

ALTHOUGH intended for an entirely different purpose, the order of the Federal Radio Commission that each station announce its call letters and location as frequently as practicable is the first step ever taken in this country to prod the announcers.

## Radio Hunts for Buried Treasure

(*Continued from page 225*)



Mr. W. D. Morgan

A BROADCASTING STATION FOR RADIO PROSPECTORS

*This is the transmitting half of Mr. Morgan's outfit for radio geology, illustrated on a preceding page. Radio waves emitted from the frame antenna are directed downward into the ground. Their detection at distant stations by the receiving outfit may yield indications of underground rock conditions.*

nearby radio circuits, but their influence would be much less than that of equal weights of metal fused into a solid mass.

There is one astounding mass of treasure which the soil of Panama is said to conceal and to which this particular difficulty of discovery would not apply. This is the famous "golden Mary."

Legend tells of the presence in Old Panama of a life-size statue of the Virgin Mary, made of solid gold. No treasure such as this would have been overlooked or forgotten by the priests who were its custodians. There is no record of the statue's removal. Indeed, the transportation of so large a mass of gold would have proved enormously difficult for the facilities of the time. Certainly this famous statue is not now extant. Records of recollections of the Church authorities do not disclose its fate. Lieutenant Williams is said to believe, and he may well be right, that this enormous golden treasure still lies buried somewhere underneath the present city. Such a solid metallic mass as this would be an ideal object for the radio treasure finder.

The quantities of gold accumulated by these ancient South Americans are astounding. The Inca of Pizarro's time is recorded to have possessed whole rooms filled with solid gold, piled higher than the height of a man. It is probable that nowhere else in the world and never in the world's history, until the accumulation of the modern gold reserves in the Bank of London and in the Treasury at Washington, has so vast a quantity of the precious metal been gathered in one place as it was in the Inca capital four centuries ago.

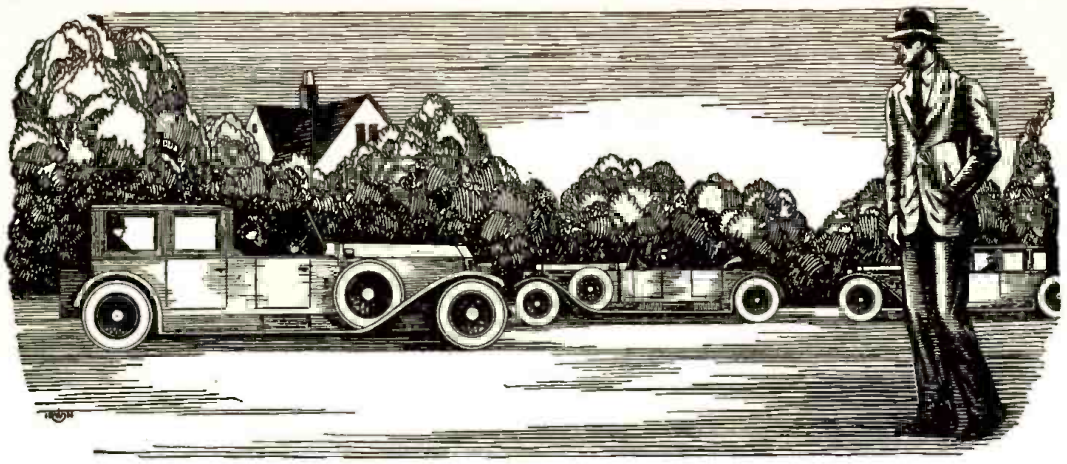
As rapidly as they could, the Spanish conquerors of Peru collected this gold and sent it back to Spain. Up the west coast of South America it went by sailing vessels to Panama. Across the isthmus led one of the famous *Caminos Reales*, or Royal Roads. Over this road mule-trains led by slaves and guarded by men at arms carried the flood of precious metal to the Atlantic and to the galleons which ferried it to Spain.

The city of Old Panama held one of the gates through which this golden traffic had to flow.

Who can doubt that the grandees who sat at that southern end of the Camino Real took toll, as chance might offer, of the gold that filtered through their hands? And it is this treasure that the arm of radio is now reaching out to disclose to man.

## How to Operate the Magnaformer

*Following the constructional article in this issue,* POPULAR RADIO *will run in the November number an article giving complete operating data on the powerful new Magnaformer 9-8 Superheterodyne receiver. This article will give exact information on the proper voltage and current requirements for most efficient service and the best power-packs to use.*



*Many times in the old days, while I trudged home after work to save carfare, I used to gaze enviously at the shining cars gliding by me, the prosperous men and women within. Little did I think that inside of a year, I, too, should have my own car, a decent bank account, the good things of life that make it worth living.*

# I Thought Success Was For Others

## *Believe It Or Not, Just Twelve Months Ago I Was Next Thing To "Down-and-Out"*

TODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my banker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home"!

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

I WAS a clerk, working at the usual miserable salary such jobs pay. Somehow I'd never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—but it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but *what* line? I've always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle." Mary didn't seem to be satisfied with the answer but I didn't know what else to tell her.

*It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself. A few burning words that were the cause of the turning point in my life!*

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me!

"Bargain counter sheik—look how that suit fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh, it's just 'Useless' Anderson," said another. "He's got a wish-bone where his back-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance"? *Did Mary secretly think that too?* And after all, wasn't it *true* that I had a "wish-bone" where my back-bone ought to be? Wasn't that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the table, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of 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. 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 real money. I drive a good-looking car of my own. Mary and I don't own the house in full yet, but I've made a substantial down payment, and I'm not straining myself any to meet the installments.

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. M-86, Washington, D. C.

*J. E. SMITH, President,*
**National Radio Institute,**
**Dept. M-86, 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 salesmen will call on me.

Name.....

Address.....

Town.....State.....

# *The* BEGINNER IN RADIO

CONDUCTED BY ARMSTRONG PERRY

## A Radio Mystery Partly Explained

A SPEAKER at a recent meeting of the Institute of Radio Engineers partly explained a mystery that has troubled many men since Adam.

He was discussing loudspeakers. He told how the distribution of harmonics differentiates the various musical instruments, and how the richness of a tone, at its original source or in its reproduction, increased in proportion to the number of harmonics. Then he made this statement:

The fundamental frequency of a man's voice is of the order of 125 cycles per second, and of a woman's voice 250 cycles. In order to reproduce a man's voice in its full richness, the reproducing device must handle frequencies only as high as 5,000. A woman's voice has more harmonics, so that it would be necessary, in order to reproduce her voice with equal richness, to handle frequencies up to 7,000. That is one reason why it is so hard to understand a woman!

A demonstration was given in which a loudspeaker reproduced speech with harmonics eliminated, in increasing numbers, first at the lower frequencies and then at the higher frequencies. It amused the audience by showing what is the matter with certain types of loudspeakers with which radio broadcast listeners are familiar.

* *

## Hints for Stringing Your Aerial

A NEW halyard is likely to kink unless the tendency is removed before the cord is rove through the pulley. Straighten out the whole length of the cord, place it around a tree and have two husky men pull as hard as they can on the ends for five minutes or more. This will stretch the cord and remove the tendency to kink. It is standard practice among men who put up halyards on flagstaffs and aerial masts.

To carry the end of halyard up a tree, tie it to the belt far enough to the rear so that it will not interfere with climbing. Go up a ladder as far as possible,

TEAMWORK MAKES BETTER ANTENNAS

*Taking the kinks out of a halyard requires muscle, as this picture shows, but it is important that every part of the antenna have the necessary tautness.*

A JOB FOR A "HUMAN FLY"
*Rigging antennas in such places as this requires a sure foot and plenty of nerve. Don't try to undertake it unless you know your "limbs."*

then shinny up a limb as high as safety will permit. Attach a pulley, put the end of the halyard through it, and run the cord through until a man on the ground has both ends secured.

Men who make a business of this kind of work usually are insured for $10,000 or more. The laws in some states make the owner of the property responsible for accidents to workers, even though the accident may be due to carelessness on the part of the worker. Therefore, workers should not be employed unless they are covered by insurance that relieves the property owner from his responsibility for any accidents that might occur.

Climbing always is subject to some dangers, so—safety first!

* *

## A Simple Set for Code Practice

J. W. S., of Alabama, asks how to build an inexpensive receiver for learning code with a view to becoming a commercial operator.

Such a set may be built on a cigar box cover with the following parts:

3-coil mounting with honeycomb coils for the desired wavelengths;
.001 mfd. variable condenser;
Rheostat;

Fleet

A RECEIVER THAT YOU CAN PACK IN YOUR GRIP

*By changing the honeycomb coils (shown in the center of the picture) it is possible to tune all the way from the broadcast range to the longer waves of the commercial transmitters.*

Grid-leak and condenser;
Valve and socket;
Phones;
"A" and "B" batteries.

It may be made even more simple by using a single honeycomb coil and mounting. A 1500-turn coil, shunted by a .001 variable condenser, will tune from 14,500 to 26,500 meters and bring in many of the high-power commercial stations. In shunt or in series it will bring in enough stations to provide plenty of practice.

These stations will give a beginner excellent code practice. Some of them use high-speed automatic sending apparatus, but there are always some on the air sending by hand at slow speed. Often each word is repeated. Under favorable conditions foreign stations are received on one tube with a set of this kind.

A simple and efficient circuit to use is the time-honored De Forest ultra-audion. Tracing this from the aerial downward, the connections are as follows:

Aerial to coil and grid-leak;
Grid-leak to grid;
Other end of coil to plate, phones and stator of variable condenser;
Rotor of condenser to negative terminal of "B" battery, negative terminal of "A" battery, and ground.

The positive terminal of the "A" battery connects with the rheostat, and the other end of the rheostat with the filament. The negative terminal of the "A" battery connects with the remaining filament terminal. The final connection, made after all others are checked up and found correct, is between the positive terminal of the "B" battery—which is the danger spot in all hook-ups—and the phones.

Only two double binding posts are needed and these can be eliminated by using other connectors. The tips of the phone cords can be attached directly to the plate terminal of the tube socket and to the positive terminal of the "B" battery if tips or terminals are provided with clips.

This set has several advantages. Coils of any size can be plugged in. A 600-turn coil will bring in the American end of the transatlantic radio telephone conversations, which may be interesting because of the novelty of the new service, although otherwise they are as deadly dull as all other one-sided conversations. A 100-turn coil brings in the ship-to-shore and ship-to-ship traffic. A 50-turn coil tunes to the broadcasting wavelength, but a condenser of lower capacity is needed to make the music and voices distinct.

This outfit may be built for $25.00 or less. Any type of receiving valve can be used. With low-voltage valves and small dry batteries, it is light and easy to carry in a grip. A short length of wire put up in any convenient place usually is enough of an aerial to bring in the high-power commercial stations.

* *

## A Unique "Circuit Building Contest"

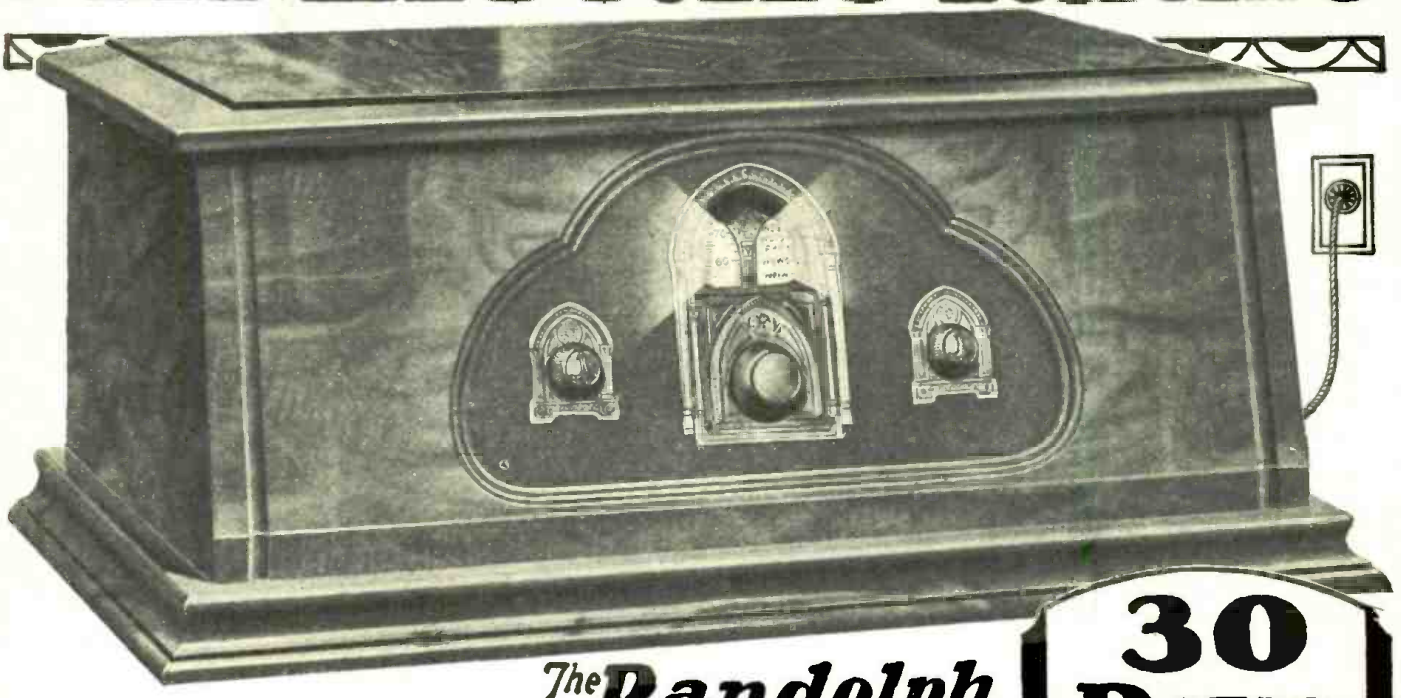
A circuit building contest was conducted at a recent gathering of the American Radio Relay League and caused much merriment. Try it at one of your social gatherings.

Each contestant was given a sheet of paper, mimeographed, with spaces at the top for his name and call letters. Then followed these directions:

> Draw as many diagrams as possible from the apparatus listed below. No single piece of apparatus may be used more than once in any one circuit, but any one piece of apparatus may be used in any number of different circuits. Each diagram must be in working condition, and each must be labeled.
>
> 1 antenna
> 1 ground
> 3 receiving tubes
> 3 rheostats
> 1 6-volt "A" battery
> 1 pair of phones
> 1 "B" battery, variable to 90 volts
> 2 .0005 mfd. variable condensers
> 4 air core receiving coils
> 2 low-frequency transformers
> 2 sockets
> 2 high-frequency chokes
> 1 grid-leak and condenser

Radio apparatus was given as prizes.

# All Electric Radio



## The Randolph 7 Tubes-Single Control

JUST plug this Randolph Radio into the electric light socket—and tune in. A powerful, selective radio that gives dependable coast to coast reception. **No batteries, chargers, eliminators, acids or liquids.** Here is complete radio satisfaction whenever you want it. The easy tuning with one control brings on all stations. Illuminated drum allows you to operate the radio in the dark and has space for logging stations. Every detail of the Randolph is modern and perfected—it is the utmost in radio—unsurpassed regardless of price. It is this wonderful radio that you test and try for 30 days FREE before you buy. Listen to it in your own home. When it convinces you by actual performance it is the ideal radio—the one you have always hoped for—**you can buy it direct at factory prices.** Be sure you write for free descriptive literature today.

### Beautiful Ampliphonic Console

Illustrated here is one of the beautiful Randolph Seven Console Models—made of the finest carefully selected heavy solid walnut, hand-rubbed and with burl finish. Has built-in genuine large cone speaker that compares with any on the market. Assures unlimited reception of high notes and low notes clear as a bell. Completely electric—**uses no batteries of any kind.** Be sure you send for fully illustrated, full color folder giving complete details.

### Genuine Walnut Cabinets

The finest of heavy, genuine, solid burl finish walnut is used in the making of all Randolph cabinets. No picture can do them justice. You must see them to appreciate them.

### 6-Tube Radio

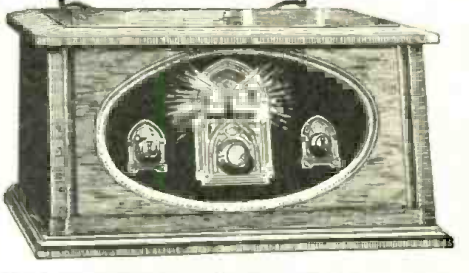
New, modern, single-control, six-tube radio. Do not compare this set with old-style, 2-dial, 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers. Comes in beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated drum with space for logging. Absolutely dependable and very selective. **Send for 30 days free trial. You test it before you buy.**

**All Sets Guaranteed**

## 30 DAYS FREE TRIAL

**6 Tube $55 Retail Price**

**Biggest Discounts To Agents**



### Biggest Discounts to Agents

Work either full or part time and make big money. Sensationally big discounts to agents. No experience required. Randolph All-Electric Sets sell on first demonstration. Tremendous advertising campaign helps you. Men and women both make big money this way. Demonstrating set sent on 30 Days TRIAL. WRITE NOW for proposition.

**RANDOLPH RADIO CORPORATION**
**711 West Lake Street Dept. 116 Chicago, Ill.**

### USE THIS COUPON TODAY!

**Randolph Radio Corporation**
**711 West Lake Street, Dept. 116**
**Chicago, Illinois**

Send me full particulars about the RANDOLPH Six and Seven-Tube Electric and Battery Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name.....

Address.....

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

Mark here ☐ if interested in Agent's proposition.

## Coils for the Home-Built Set

OLD-timers recall several types of inductance coils, each of which was in vogue for a season.

Straight wound coils were the first; they were simple to wind, and oatmeal boxes or cardboard tubes for forms were available everywhere. Longer waves began to be used for long-distance commercial services and the straight wound coils lengthened to as much as three or four feet. Sometimes the wire was wound one layer over another to make the coils shorter, but such bank winding introduced effects that some experimenters found undesirable.

The honeycomb coil created quite a furor. Its turns are put on in layers but they are well spaced and adjacent turns cross each other at angles that reduce the undesirable capacity between turns to low values. A 1500-turn honeycomb coil, which tunes up to 26,500 meters, is only about 4⅛ inches in diameter and all sizes are made of the uniform width of about one inch.

The radio amateurs were forced down to the 200-meter band with their traffic, and honeycomb coils lost some of their popularity because they were less efficient on these lower wavelengths. Straight wound coils for the 200-meter band were made to resemble the honeycombs. Spiderweb, basket-weave and similar light, flat coils were developed.

Still more recently, the manufacturers of radio apparatus started the "low loss" propaganda, which applied to coils, condensers and about everything that went into the set. There was one good idea and a lot of bunk in this hobby, which was ridden nearly to death. It is desirable to be rid of losses, but in some of the "low loss" coils a very small amount of dielectric resistance was eliminated by winding the coils "on air" while a much greater wire resistance was added in order to make the coils retain their shape without a supporting form or core.

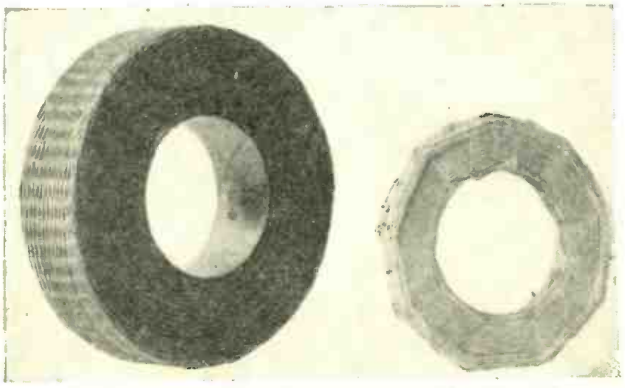
These mistakes in coil design may have resulted from a previous error—the idea that metal end plates were necessary in low-loss condensers. Radio engineers have shown that dielectric losses at high frequencies in coils or condensers can be made smaller than the losses caused by any known method of eliminating the dielectric. It all depends on good design and good dielectric.

The length and size of the wire in an inductance coil are the principal factors in determining its resistance. A circular coil has more inductance for a given length of wire than a coil of any other shape. Up to a certain point, resistance is reduced by increasing the size of the wire, but if the wire is too large the resistance is increased. No sizes of wire can be specified for all frequencies because the resistance depends to some extent on the frequency, or wavelength, received.

The most efficient coil for use in a broadcast receiver is said by many experts to be one wound on a cylinder of cardboard, pure bakelite or other

AN EFFICIENT PLUG-IN COIL AND MOUNTING

*This type of coil is practical, efficient and substantial. It is obtainable in three or four sizes for covering the wavebands between 30 and 600 meters.*



HONEYCOMB AND BASKET-WEAVE COILS

*The honeycomb coil at the left is capable of tuning up to 20,000 meters. The same coil if wound as a solenoid would be several feet long. The coil at the right is one of the "low-loss" type, which uses no solid support in its make-up other than the wire itself.*

good dielectric, with its length about equal to its diameter. The preferred sizes of wire are 20 to 26. Such coils have been found, in laboratory tests, to have only about half the resistance of some alleged "low loss" coils with no dielectric. The effect of the dielectric has been tested by removing the cardboard or bakelite tubes and in some cases the change in resistance could hardly be measured even by the most sensitive instruments.

Those who use plug-in coils, in order to facilitate changes of wavelengths, should not expect as high efficiency as can be secured by well-made soldered connections, but if the plug-in connections are kept bright and the contact tight, the difference may be so slight that the ear of the operator will not detect it.

It is natural to want to be up to date and have the latest types of apparatus, but there is fun in winding hay wire on an oatmeal box to make a coil while waiting for money to buy something better. Some of today's experts and millionaires were doing it only a few years ago. All the older types of coils are as efficient now as they ever were and there is good experience in making and testing them. There are radio stations on all wavebands from less than 5 meters to more than 20,000 meters, and even a crude set will bring in some of them if the fundamental principles of radio are followed.

* *

## Around the Dial

By FRANK ROMANO

(*When everyone carries his own portable broadcasting set*)

"—dog, come on, seven—it's the best bargain of the day, Madam, shall I—and a quarter's worth of liverwurst, *my*, how I like *liverwurst*—No, she did *not* shoot to *kill*—But your *honor*, I was only doing a hundred and eighty miles per hour—did you see *that?* Why, I never saw the man in my *life*—und he set: 'You make a pet on dot horse, und I set: 'Shoosh, how couldt I make a pet, I'm not a champermate'—Gentlemen!!!! Remember you *are* gentlemen—oh, tell them we're not home—How much? Two dollars? Why, I can get the very same quality at Dinkelspiel's for a dollar ninety-eight—yeh, I saw it in POPULAR RADIO—Oh, Sadi-e-e-e-e-e-e, come in der house once, tell der mens to vait—O, solo, mio-o-o-o—Poiper-poiper, Mister? Wuxtree prepaw!—Thanks, I shall—here he comes now—when he gits up under dis post, sap him wid de pipe, now—oh, say, cul, turn off y'er set, it's on—all right, you bet—Good morning, Harry, how—."

—FRANK ROMANO

* *

RADIO is described by United States Senator Dill of Washington as "one-way mass communication."

## What Radio Is Doing for Aspiring Musicians

RADIO is doing a tremendous service to young and aspiring musicians; it is "discovering" future stars, no matter how humble their environment, in great numbers. From the depths of the unknown they are being dug out, given hearings and boosted faster than through any other medium.

For example, take Jane Upperman.

Miss Upperman was unknown save in the little Kentucky town in which she lived and where she sang in a little church choir. She is tall, blonde, imposing, of splendid stage appearance. And she can sing, too. But for a long time it looked as if nobody in the outside world would ever know of her. Then WSAI, at Cincinnati, "discovered" her, took her into their studio as their *protégé* and had her voice registered over the air. So her fame has spread. Now she is under the training of one of the best vocal masters in New York City, and he has been so impressed with the possibilities of her beautiful *coloratura* voice that he has undertaken to teach her without pay and also to finance her training in Europe.

WCCO, at Minneapolis-St. Paul, also boasts a "find" in Howard Melaney, who has just quit shoveling coal on a Northern Pacific locomotive running between Glendive and Forsythe, Montana. He is a tenor of such promise that the WCCO announcers speak of him as "The Mountain McCormack." He has always enjoyed singing, but up to a short time ago he had no training other than what he could give himself and what he could get in the church choirs that he joined from time to time. It took about all he could earn on his railroad job to support his mother, his younger brother, a sister and himself. Through many a small economy he scraped together enough money to buy a phonograph and records of his favorite tenors. During the evenings he could spend at home he played these records over and over again, so that he might study the voices and their technique and so improve his own voice.

"Then," as they say at WCCO, "one day last winter he burst in on us."

That very evening Melaney was singing before the microphone. During the next week hundreds of applause letters swept into the office with requests for "more from Melaney."

But the fireman had to keep on his job for a while. He stoked the furnace on his favorite engine, singing at intervals from WCCO. But his name spread fast, and before long he found his time mostly taken up with calls for concerts and theatrical performances. And it was his income from these that finally made it possible for him to give up his railroad job and study music in earnest.

—RAYMOND HENDERSON

*The obverse of the medal; the original is two-and-one-half inches in diameter.*


*The reverse; the name of each recipient will be engraved in the space provided.*

# The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio, in that it shall be awarded not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An Advisory Committee, which shall co-operate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.
8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.

*All communications to the Committee of Awards may be addressed to—*

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 119 West 57th Street, New York.

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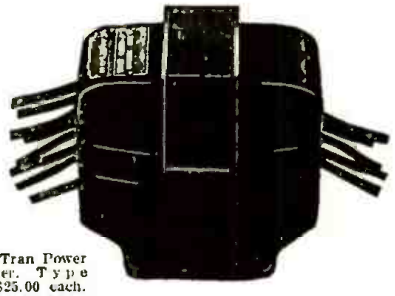
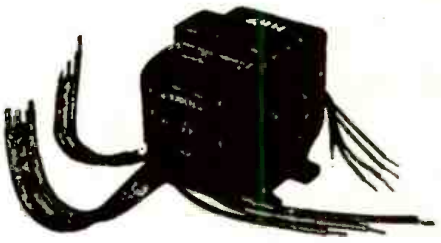
# AMERTRAN AMERTRAN



The AmerTran Power Transformer. Type PF-281, $25.00 each.



AmerTran Filament Heating Transformer, Type H-67, $12.00 each.

# New Transformers *for* A. C. Power Supply

As in audio transformers, AmerTran products stand first in the power transformer field. They are up-to-date in design, well-made and dependable.

Type PF-281, illustrated above, becomes virtually an A-B-C eliminator when used with AC tubes and the proper filter circuit for DC voltages of from 425 to 650 volts, plate current 110 milliamperes. This unit is designed for use with the new UX-281 rectifying tube, and has a 750 volt plate winding which enables it to be used with a UX-281 or 216-B rectifying tube. In addition, there are filament heating windings for the new AC tubes. Therefore, this single unit will convert AC house current into filament and plate current, and grid bias potential. Used with AmerChokes in the filter circuit, a receiver may be constructed to operate entirely from the house lighting circuit.

Transformer, type H-67, is intended for use with the new RCA UX-226 raw AC amplifier tubes and the new UY-227 detector tube. It also has a third filament winding capable of handling two UX-171 tubes. In connection with the new AC tubes, the type H-67 becomes the power source for the filament and is therefore a real "A" battery eliminator.

If you have a good plate supply system and a set with the new AC tubes and one or two UX-171 power tubes in the last stage, the H-67 AmerTran is ideal, transforming the 50 or 60 cycle, 110 volt AC house light current down to the lower voltages for the correct operation of the new tubes.

Write for booklet, "Improving the Audio Amplifier," and data on Power Supply Units.

## AMERICAN TRANSFORMER CO.

178 EMMET STREET NEWARK, N. J.

**We also make Audio Transformers, Choke Coils, and Resistors. Sold at any authorized AmerTran dealer.**

**American Transformer Company — Transformer Builders for Over Twenty-Six Years**

# WITH THE EXPERIMENTERS

CONDUCTED BY S. GORDON TAYLOR

## A System for the Rapid Matching of Units

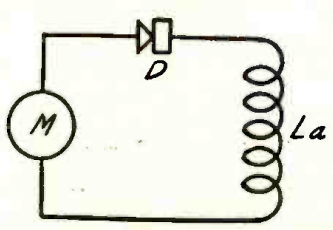
THE experimenter often wants to know if certain units match—or rather, how closely they do match. A simple example of this problem is presented when a set of high-frequency coils have been constructed.

The chances are that these coils are to be used with a set of tuning condensers all of the same capacity and the same type. If the coils match when they are connected in their respective circuits, these circuits will match and the dial readings for any particular station will be approximately the same.

If these coils could be matched by some rapid, simple means, it would save the constructor much time. Usually when unmatched coils are placed in a set, it is necessary to take off turns of wire from one or more of the coils until the dial settings are approximately the same for a given station.

Possibly a more important use of matching is found in the case of intermediate-frequency transformers for superheterodynes. The home constructor often wishes to build his own intermediates, and they must be matched before reasonable results can be expected from the set.

Figure 1 shows the circuit of a very sensitive absorber. The coil La may be a 25-turn honeycomb coil. D represents a crystal detector and M is a direct-current milliammeter. This meter should have a range of from 0 to 1, or not greater than 0 to 5 milliamperes.




A SENSITIVE RESONANCE INDICATOR

FIGURE 1: *When the coil La is placed close to a high-frequency circuit, the meter M will indicate a flow in this circuit. Resonance of the tuned circuit with a third (driver) circuit is indicated by the maximum deflection of the meter.*

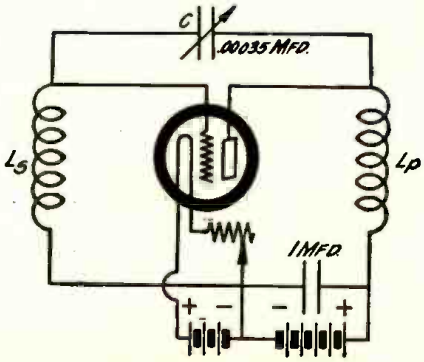
The honeycomb coil should be connected on a cord so that it may be conveniently coupled with the unit to be matched. This circuit of Figure 1 is aperiodic and will respond to any frequency. The purpose of the crystal is to rectify the current and allow it to flow through the circuit in but one direction. This absorber is so sensitive that coupling with high-frequency stage will produce heavy deflection of the meter M.

Figure 2 represents a simple oscillator that may be used in conjunction with the absorber in Figure 1. Any high-frequency oscillator will do. The one in Figure 2 is simple to construct; coils Ls and Lp may be of the honeycomb type and therefore may be changed for varying wavebands.

The coil Ls should be mounted on an extension cord so that it can be easily coupled with the unit under test. 25- to 50-turn honeycomb coils will cover the broadcast range, while coils in the order of 400 turns will be necessary in peaking the intermediate-frequency transformers of superheterodynes.

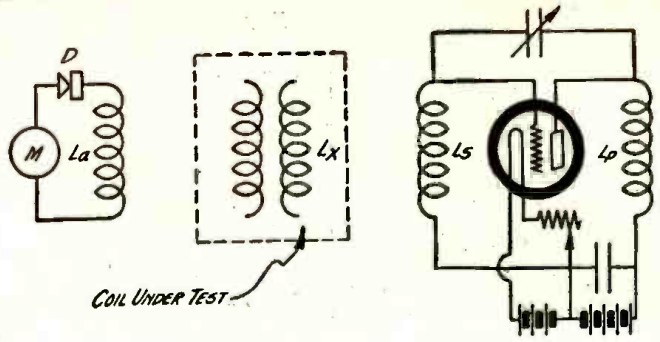
Both the absorber and the oscillator may be enclosed in one small box, thus making a very compact testing unit.

Figure 3 shows how the combination of the absorber and oscillator is used in matching units. The coil Lx represents one of the group of intermediate-frequency transformers or coils that are being matched. If the transformer Lx be loosely coupled to the grid coil Ls




A SIMPLE OSCILLATOR CIRCUIT

FIGURE 2: *The oscillator circuit shown above may be installed with the absorber circuit shown in Figure 1 in a small instrument box.*




THE COMPLETE HOOK-UP FOR TESTING COILS

FIGURE 3: *In matching coils, they should all show resonance at the same setting of the oscillator tuning condenser, shown at the upper right-hand corner of the diagram.*

of the oscillator and also coupled on its opposite side to the absorber coil La, when the tuning condenser C of the oscillator is turned, the meter M of the absorber will read a maximum at one particular setting of C. At this point the oscillator circuit is tuned to resonance with the natural frequency of the unit that is being tested. The reason for this is quite evident when we stop to consider what energy transfer actually takes place. For any given setting of the condenser C of the oscillator, the oscillator will develop a current of a given frequency. Since the grid coil Ls is loosely coupled with transformer Lx a certain amount of energy will be transferred to Lx. The amount of this energy depends entirely on how closely the frequency being sent out by the oscillator corresponds to the fundamental of Lx.

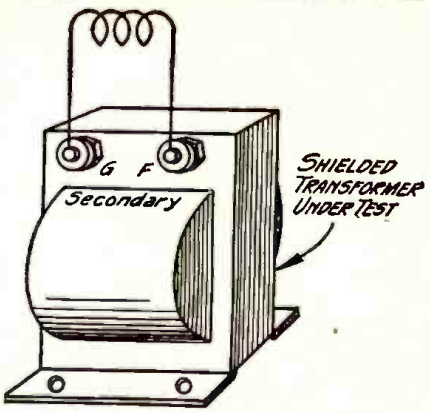
When the two absolutely correspond, maximum current will be transferred to Lx. Since La of the absorber is also loosely coupled to Lx, the absorber will have a certain current flowing in its circuit, this amount being dependant upon the amount of current transferred from Ls to Lx. It is therefore evident that when Ls and Lx are in resonance the absorber circuit will have maximum current flowing and the meter M will read a maximum.

Care should be taken that both Ls and La couple very loosely with the transformer Lx. If they couple too closely, it will be hard to determine when Ls and Lx are really in resonance. Extreme care should be taken that La and Ls do not couple directly. If this coupling should take place, it will be extremely hard to find the resonant point between Ls and Lx.

To actually match a set of coils the resonant point of each coil should be tested and the condenser scale reading of the oscillator unit noted for each coil. It will be found that one transformer will have the lowest reading on C of the oscillator, meaning that this particular transformer is of the lowest wavelength of the set. The other transformers should now be tested again, one at a time, and wire should be taken off their secondaries until they all read at the same point on C. It is much easier to take wire off the secondaries and match them all with the lowest transformer than it is to take one transformer at random and match the others to it, putting wire on some to gain this

THE TESTING OUTFIT IN OPERATION

FIGURE 4: *Here is the deviser of this system, Mr. Thomas McKay, testing a coil. Note the compactness of the device.*




THE METHOD FOR SHIELDED CIRCUITS

FIGURE 5: *An external pick-up (the coil shown above the transformer) must be added in testing transformers that are shielded in metal cases. The same pick-up coil should be used with all the transformers to be matched.*

match point and taking wire off others.

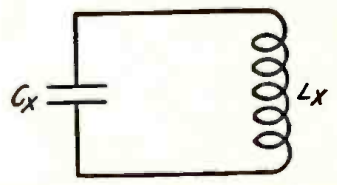
Using the system just described it is not necessary to calibrate the oscillator against a standard. This is a distinct advantage. In matching the filter transformer to a set of intermediate transformers it is simply necessary to substitute various fixed condensers across this filter primary until the desired point is reached. Condensers of the open type may be cut down until this proper capacity is found.

The above discussion holds only for transformers not built in a metal case. For transformers of the metal enclosed type a different system must be employed, as shown in Figure 5. A 25-turn honeycomb coil, Lx, is connected across the secondary terminals of the transformer. This coil is now used to couple with the oscillator and absorber and the testing is continued as before.

Figure 6 shows a system of matching fixed capacities such as small fixed condensers. The condenser to be tested should be hooked to any standard coil, Lx, as shown in the figure. Suppose it is desired to see how closely together a series of small fixed .00025 mfd. condensers match. These condensers would be tested one at a time and the resonant point on C of the oscillator would be found.

This matching system may be applied to numerous specific cases and it is found a handy and rapid method.

THOMAS L. MCKAY.




THE HOOK-UP FOR MATCHING CONDENSERS

FIGURE 6: *Using the same coil, Lx, all condensers of equal capacity will show resonance at the same setting of the oscillator tuning condenser.*

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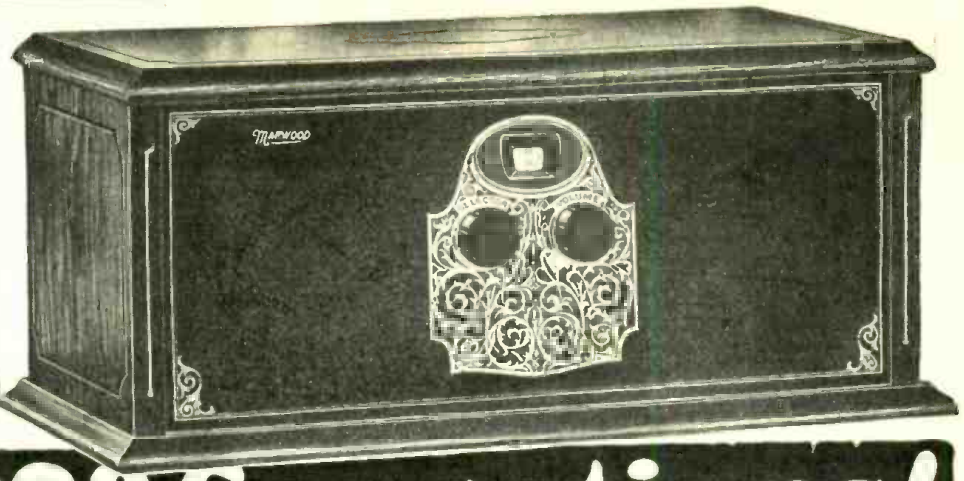


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## Heat Proof Resistors for "ABC" Power-Packs

THE rapid gain in popularity of the new "ABC" power-pack circuits has created a need for resistors of much greater current capacity than any thus far used in radio receiving sets. These new circuits dissipate much more energy in the resistances than has been the case in circuits used heretofore. This is obvious when we consider that we are now dealing with a pressure of 300 volts and a current of .3 to .4 ampere, while in the past, high voltages have been used for "B" battery circuits only, where the current seldom exceeds .06 ampere.

To have a sound understanding of the new resistances needed, it is advisable to refer to some of the fundamental laws of resistance in electrical circuits. The following laws are simple and accurate. They should be in every radio experimenter's notebook.

1. The *ohm* is the unit for measuring electric resistance. A resistance of one ohm in a conductor will cause a pressure drop of one volt at a current of one ampere.

2. *Ohm's Law* is a simple equation to determine resistance, current, or voltage drop in an electric circuit. If "I" is the current in amperes, "E" is the voltage drop through the resistance, and "R" is the resistance, the following relations are all expressed by ohm's law:

$$I = E/R$$
$$R = E/I$$
$$E = I \times R$$

3. The *watt* is the unit of electric power. It represents the energy expended when one ampere flows through a resistance of one ohm or through a drop of one volt. The amount of energy expended in any resistance, therefore, is the current in amperes multiplied by the drop in volts.

4. Electric energy is dissipated in a resistance as heat, and the amount of heat is in direct proportion to the watts of electric energy dissipated, regardless of the shape or kind of material used in the resistor. Rheostats or fixed resistors that are to dissipate a large amount of energy, therefore, must have ample size to radiate the heat generated, and must be constructed throughout of material that will withstand the temperatures that develop while in operation.

Rule No. 4 has been relatively unimportant in receiving circuits of the past, because the amount of energy dissipated by any single resistor was small. For example, a filament rheostat, controlling two UX-201-a type valves from a 6-volt storage "A" battery, will normally be required to dissipate about one-half watt. This energy is so small that almost any rheostat, regardless of size, will handle it without dangerous heating.

A little later in radio history there came a demand for fewer panel controls and it was partially answered by controlling the filaments of all the valves in the set with the same rheostat. For a 6-valve set, using one one-half-ampere power tube, this required a normal dissipation of slightly over 2 watts in the rheostat. Many of the small rheostats used in the older sets could not carry the current without burning out. New and larger rheostats of low resistance designed for this service were frequently called "heavy duty." These rheostats may confuse many purchasers today, because while satisfactory for the purpose for which they were designed, the maximum energy they are able to dissipate without breaking down usually does not exceed 10 watts.

The ordinary wire-wound rheostat does not break down because the wire burns out, for it is normally wound with the same kind of wire used in electric heaters that operate continuously at a red heat. However, the wire is wound on and insulated by fibre, for that material can easily be wound flat and then bent into the required shape. Since this fibre is covered up by the wire, however, it has little radiating surface and becomes the hottest part of the rheostat. The limiting factor, therefore, is the temperature at which the fibre breaks down. Fibre disintegrates slowly at the boiling point of water, 212 degrees Fahrenheit, and more rapidly at higher temperatures.

Most resistors needed for the new "ABC" power-pack circuits must dissipate from 18 to 35 watts normally, and should be capable of dissipating up to 50 watts for a short period of time to guard against burning out through an accidental short-circuit of the equipment. While it is possible to manufacture a conventional radio type of rheostat to dissipate this amount of energy at a temperature within the safe limit of fibre, it is scarcely practical, because such a rheostat must be so very large in size that it is difficult to find space enough for it in ordinary radio equipment. The alternative is to wind the resistance on material that will withstand high temperatures.

One good example of the new heat-proof construction is the new Centrolab variable resistors. In these instruments nichrome resistance wire is wound on a metal strip insulated by asbestos. This metal strip is then formed into the rheostat frame. It is welded to the contact shoe support in such a way that the entire assembly is practically heat proof, while the wire is open to free air circulation.

In conclusion it is evident that practical resistors for the new high current circuits should be wire wound, have a large area for heat dissipation, and be heat-proof in construction.

—H. E. OSMUN.

## What Voltage Rating Means in Paper Condensers

Two things should be noted in considering filter condensers for radio power applications, namely, the voltage rating and the capacity. The latter has to do with the electrical size of the device, but the former is more important in that it determines the reliability under given working conditions.

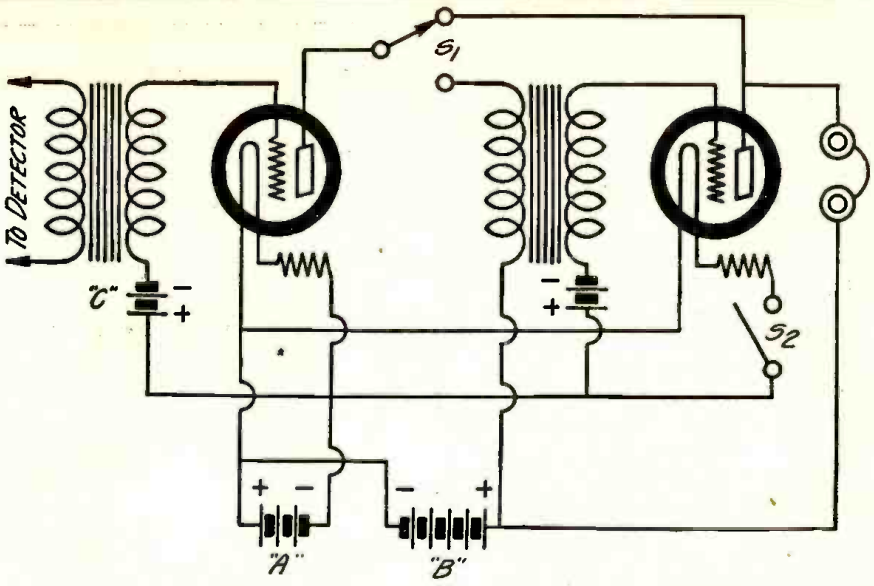
The making of high-voltage paper condensers is a relatively new art, which may account for the lack of established standards. Radio standardization committees have, thus far, contented themselves by specifying an undirectional working voltage for continuous duty for standard paper condensers of 150, 300, 500, 750 and 1,000 volts, and specifying that the standard 15-second single test shall be twice these voltages. However, long experience with condenser technique teaches us that the test specified is of little consequence beyond disclosing a virtually short-circuited condenser. Several times the rated working voltage should be employed for the test; and even so, these flash tests mean very little so far as reliability and long life are concerned.

The foundation of the paper condenser is a pure rag paper manufactured in mills specializing in this kind of paper stock. The paper, which resembles a thin bond paper, is produced in continuous rolls of the requisite width. Yet despite the most scrupulous care of the paper makers, the product has tiny metal particles and invisible defects which present weak electrical spots when incorporated in a condenser. In the research laboratory engineers examine samples of paper and get the "count" on the defects per square foot, which must not exceed a certain maximum. It is physically impossible to produce absolutely perfect paper; hence the necessity of using a plurality of "papers" so that weak spots may be scattered between the layers, with ample assurance that there is perfect paper between tinfoil strips at any given point. At least two "papers" should be employed, even in the small by-pass condensers, while more than two "papers" should be included for the higher voltages.

It follows that the safety factor of a paper condenser comes down to the number of "papers." The thickness of the paper cannot make up for the number of "papers," for the reason that defective spots are present in thicker paper just as well as in the thinner paper.

So, pending the establishment of generally accepted standards of practice, the voltage rating on the label of a paper condenser must be interpreted with due discretion.

—HARRY F. HOUCK.




A SIMPLE LOUDSPEAKER SWITCHING ARRANGEMENT

FIGURE 7: *By the simple arrangement shown here, the usual loudspeaker jacks are eliminated and the loudspeaker is left connected at all times. Changing over from one stage to another requires only the throwing of the switch S1. The switch S2 cuts off the filament of the last valve when it is not in use.*

## Amplifier Switching Scheme

A SIMPLE and inexpensive switching arrangement for changing the loudspeaker from the first to the second audio stage is shown in Figure 7.

The only extra parts that are necessary to add this stage-changing arrangement to the amplifier are a two-point inductance switch and a filament switch for the second audio stage.

The cost of these two switches is not great compared with the cost of filament-control jacks for the amplifier; also, the switches save the constant bother of plugging in the loudspeaker, which is necessary when jacks are used.

With this switching arrangement, the loudspeaker or headphones are left connected all the time to binding posts at the back of the set. When the switch marked S1 is on the lower contact, both audio stages are in operation. When it is on the upper contact, only the first stage is in use, and the filament switch S2 in the second stage should be opened to save the filament of the tube. There is no leakage of "B" battery current in the second tube when the filament switch is open.

This switching scheme is a very simple one to wire up and operate.

—CHARLES F. FELSTEAD, 6-CU

## What Magnetic Shielding Means to the Radio Fan

OUT of the present "chaos of the air" has come at least one advance in the radio art—a new line of development in the shielding of radio receivers.

Only a year ago the broadcast listener could "fish" to his heart's content with the simplest of radio sets and bring in distant stations all over the country without interference. Now the best set that one can buy may have difficulty in the reception of stations over a thousand miles away. The tremendous increase in the number of broadcasting stations during the past year demands even better selectivity.

As a rule, the higher the sensitivity of a set, the poorer its selectivity. Adding stages of high-frequency amplification to provide increased sensitivity usually broadens out the tuning so that, when the signals are delivered to detector valve, there are signals from other stations mixed with them.

Many schemes are used to prevent feedback without excessive damping. Setting the inductances at what is known as the "sacred angle" to prevent the fields of the coils interlocking is frequently used, as well as the addition of resistances in the grid circuits or a potentiometer control of the grid bias.

These methods, when carefully applied to a receiver comprising two stages of high-frequency amplification, produce fairly satisfactory results. Another method of attack has just been presented in the Loftin-White circuit, in which the inventors use capacitive as well as inductive coupling between the high-frequency units. It is claimed that this method provides more equal efficiency over the complete wavelength band.

When more than two stages of high-frequency amplification are employed, the problem becomes much more difficult and it is necessary to use magnetic shielding to prevent coupling between the inductances of the set and to prevent the loss in selectivity as the sensitivity is increased.

According to theory, perfect shielding to magnetic fields is almost impossible; yet in practice the proper use of metal shields of certain conductivity provides

excellent magnetic shielding. There are several carefully engineered sets on the market in which the shielding produces fine results. The Stromberg-Carlson, for example, is one in which the engineers have taken particular care to make the shielding complete, with copper "cans" entirely surrounding each tuning stage. In some sets, however, metals of too high resistance have been used as the shielding material, or the shielding has been so thin that it has very little effect.

Although the conductivity of the metal is most important, its value is lost if the shields are not designed to enclose properly and completely all the parts affected. An experiment is cited where a set containing three stages of high-frequency amplification, tuned to a powerful station fifty miles away, was enclosed in a copper case inside of an iron case. The cases enclosed the head-set and batteries as well as the receiver proper, so that there was no chance of pick-up from the leads. When a one-inch hole was made through both cases, signals were received with great audibility, and when the lid of the compound case was raised 1/16 inch all the shielding effect disappeared entirely.

An experiment carried out by the author some years ago showed the effect of shielding in no uncertain terms. A sensitive superheterodyne receiver was taken to the cellar of a bank and placed outside the vault, in which location good, audible signals were received. The set was then carried slowly into the vault. At a point just 16 inches inside the threshold of the door the signals ceased abruptly, showing that the set was surrounded by a perfect shield which the field of the transmitting station could not penetrate.

These experiments and others show that inter-stage shielding is in some cases not enough and we may expect a growing tendency to inclose some receivers in completely shielded metal cases of high conductivity.

—ROBERT F. GOWAN

## The New UX-240 Detector and Amplifier Valve

THE new UX-240 type valve operates on a 6-volt storage battery and requires the usual rheostat or other provision for reducing this voltage to 5 volts, at a filament current drain of ¼ ampere. It is intended to provide the highest practicable voltage amplification in a resistance-coupled amplifier. This method of amplification, in contrast with the transformer-coupled method, depends entirely upon the vacuum valve for its step-up effect. In transformer coupling, on the other hand, the step-up effect is brought about by the transformer as well as the valve.

The new tube has a ¼-ampere thoriated filament, and is equipped with

a standard UX-type base. The amplification factor is 30.

The overall amplification of one stage of resistance coupling, employing the UX-240 type valve, is substantially equivalent to the average stage of transformer coupling employing the UX-201-a type valve. This is contrary to the general belief, which holds that resistance-coupled circuits give such poor amplification that an additional stage or two is necessary to produce satisfactory volume. When a general purpose valve of moderate amplification is employed, this is admittedly the case. It may also be the case when valves of a lower "mu" than 30 are employed. However, with the UX-240 type valve in the detector stage as well as in the first stage, there is adequate output to operate a power amplifier at full volume.

The "B" or plate current drawn by the UX-240 type valve is about one-tenth that drawn by the average general purpose tube employed for the same purpose, even when operating at "B" voltages of 135 to 180 volts, which are essential for proper results with resistance-coupling.

The characteristics of the UX-240 type valve are as follows:

*Filament Voltage.....5.0 volts*
*Filament Current..... .25 ampere*
*Maximum Plate Voltage.....180 volts*
*Recommended "B" Voltage..135-180 volts*
*Voltage Amplification Factor (mu).....30*
*Plate Resistance.....150,000 ohms*
*Plate Current at Rated Voltages, .2 milliampere*

When employed in resistance-coupled amplification, the UX-240 type valve should have a negative grid bias, which may be obtained from a "C" battery, to ensure freedom from distortion. Only the highest grade blocking condensers and resistances should be employed. The condensers must have high insulation resistance, while the resistances must be capable of withstanding the necessary current flow without deterioration. Otherwise, noisy reception may result sooner or later. The UX-240 type valve is non-microphonic and otherwise free from noises.

—J. L. BERNARD

## More Data on the Retrosonic Receiver

NUMEROUS inquiries have been received from readers of POPULAR RADIO for further enlightenment regarding the specifications of the coils and the values of the parts used in the Retrosonic Receiver which was described by Mr. A. Dinsdale in the March, 1927, issue.

Here is this information. The reader is cautioned, however, before proceeding to construct this set, to realize that this is a freak circuit and the results that the designer obtained cannot be had without experimenting. The receiver described in the March issue was made up entirely of British parts and the substitution of American material might make the circuit act differently. It might be necessary to apply "cut and try" methods to get success.

Figure 8 gives the schematic circuit. Here are the specifications of the coils used:

Coil No. 5—64 turns of No. 24 DCC wire. Starting at the ground end, tap off at ten successive points, consisting of approximately 4 turns each.

Coil No. 9—64 turns of No. 24 DCC wire.

Coil No. 11—89 turns of No. 28 DCC wire.

The author's information in regard to Coil No. 12 is that it consists of 89 turns of No. 28 DCC wire. In experimenting this tickler coil may have to be cut down to as low as 30 turns.

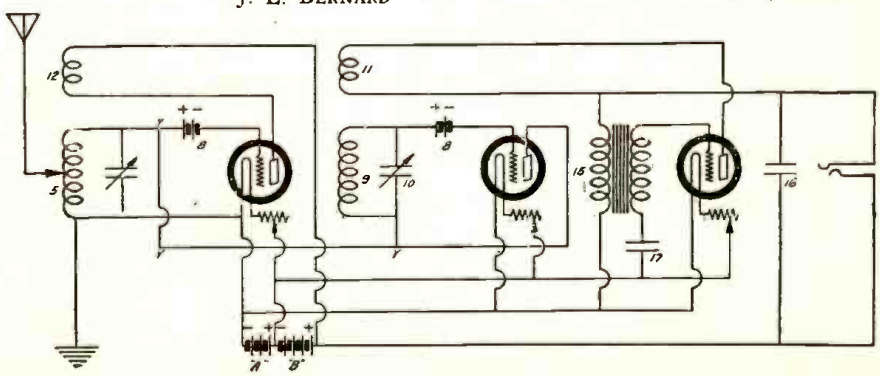
Coils No. 5 and No. 9 are to be tuned with .0005 mfd. variable condensers.

Coils No. 5 and No. 12 should be wound on a tube 3½ inches in diameter by 8 inches long. The coils are wound on opposite ends of the form. This leaves a separation of approximately 3 inches. Coils No. 9 and No. 11 should be wound on a separate tube of the same diameter and length.

The "B" and "C" voltages will be governed by the type of vacuum valves that are used.

If the UX-201-A type valves are used throughout, 45 to 90 volts should be used on the plate of the first valve, and from 90 to 135 volts on the last valve.

—CARL DORF



THE BRITISH "RETROSONIC" CIRCUIT THAT HAS AROUSED UNUSUAL INTEREST

FIGURE 8: *This circuit was originally described on page 246 of the March issue of* POPULAR RADIO. *For the convenience of experimenters who are interested, the circuit specifications are given above.*

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# General Electric
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## *now have peppy radio batteries – always*

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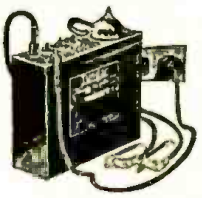

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5-ampere Tungar

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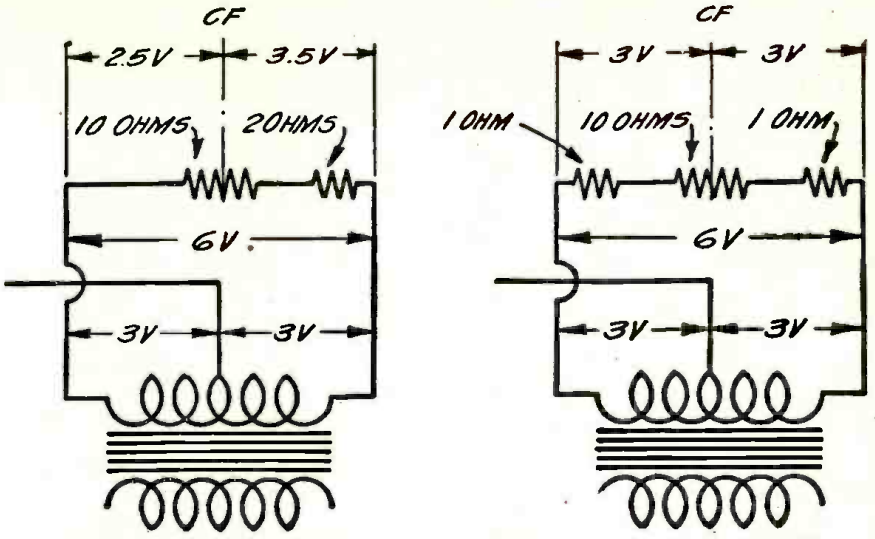
# GENERAL ELECTRIC




THE WRONG AND RIGHT METHODS OF REDUCING AC FILAMENT SUPPLY VOLTAGE

FIGURE 9: *The use of a rheostat in one leg of the filament circuit unbalances the voltage distribution in the filament and causes a varying relation between filament and grid—which results in a hum.*

FIGURE 10: *With a rheostat in each leg of the filament, the proper voltage relation is maintained, and the center point of the filament is likewise the voltage center and therefore a neutral point.*

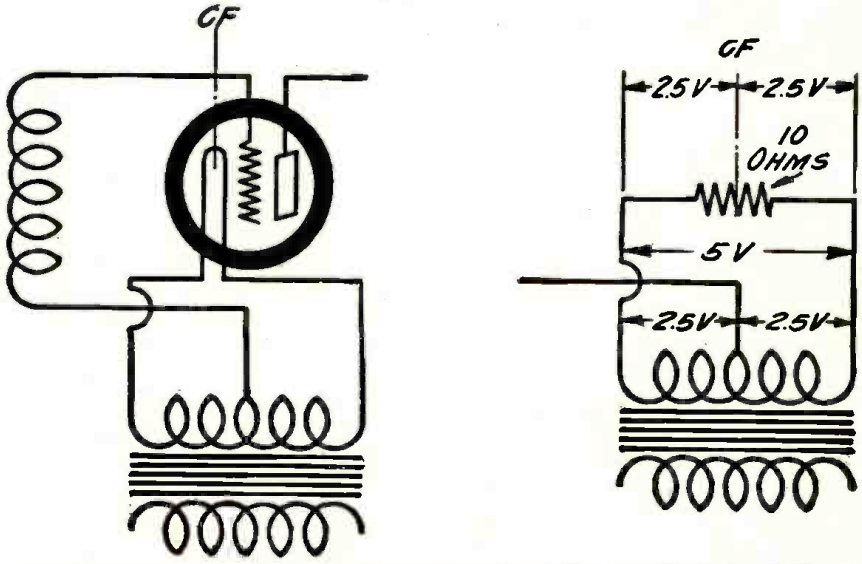
## A Pointer on AC Filament Supply

WITH the average "B" power-pack there is little to worry about in fluctuating AC line voltage unless the variation is extreme. Even if the line voltage varies as much as 10 volts during the day the increase or decrease in the output voltages of the "B" power-pack will be unimportant, because these voltages are not critical.

However, if the filament of one or more valves are operated from the AC line through a transformer, line variations may considerably shorten the life of these filaments. For instance, if the line voltage is 10 per cent above normal, there will be a correspondingly high voltage applied to the filaments.

If it is desired to regulate the output voltage of the transformer which supplies the filament or filaments, the logical place to control it is in the line side. This is accomplished by the use of a variable resistance in series with the primary of the transformer as shown in Figure 13. For this use an ordinary rheostat will not do, but there are now a number of heavy duty primary rheostats on the market that are intended for this purpose.

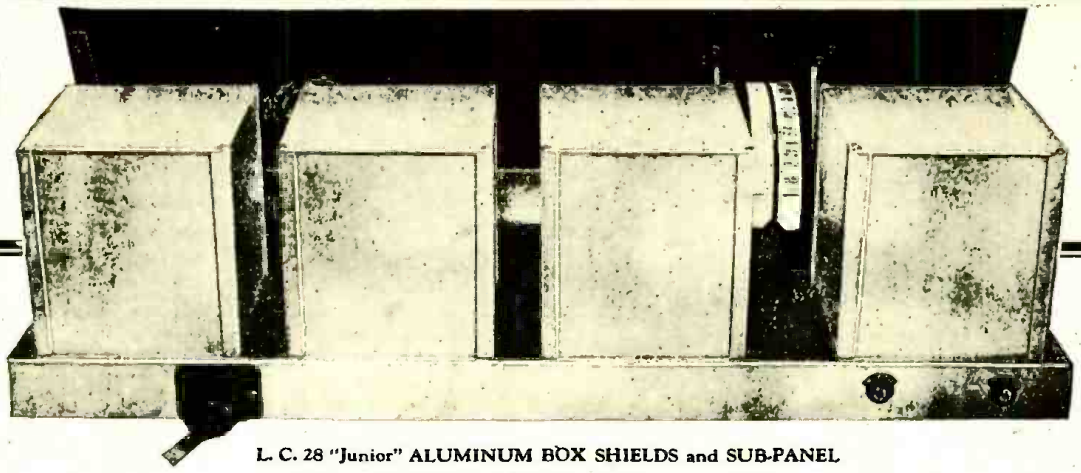
Another method is to make use of variable resistances in series with the filaments of the valves that are operated on the AC lines. This method is less desirable, because for proper results it is




THE CIRCUIT AND SCHEMATIC DIAGRAMS OF AN AC FILAMENT SUPPLY CIRCUIT

FIGURE 11: *The components of an AC filament supply circuit are indicated diagramatically above in order to make clear the schematic diagram of Figure 12. Note the center-tapped transformer secondary used for grid supply.*

FIGURE 12: *For simplicity the filament in Figure 11 is represented above as a resistance and the other elements are omitted. The numbers represent the voltage drops in the various parts of the filament circuit.*



L. C. 28 "Junior" ALUMINUM BOX SHIELDS and SUB-PANEL

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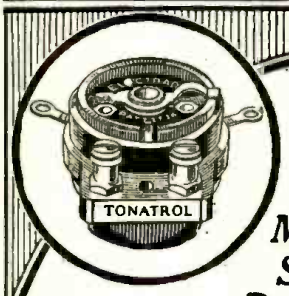


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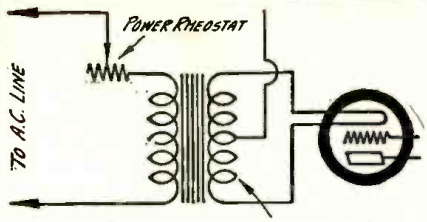



ANOTHER METHOD OF REGULATING AC FILAMENT SUPPLY

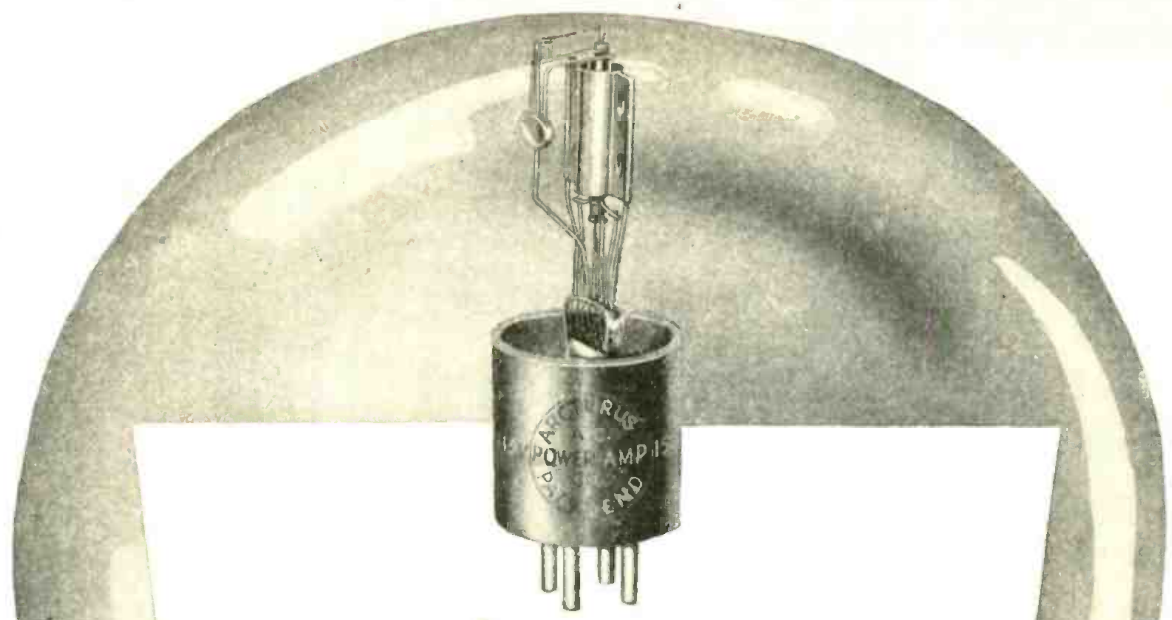
FIGURE 13: *A power rheostat in the AC line supply probably gives the surest results in regulating the amount of AC filament supply current.*

necessary to use a rheostat in each side of the filament and to keep the resistance of the two rheostats equal. Such an arrangement is shown in Figure 10. If a single rheostat is used it will in effect apply a varying voltage relation between the filament and grid, with the result that there will be a hum in the valve output as explained in Figure 9.

Figure 11 shows the usual connections of the filament and grid where the filament current is supplied with alternating current from a center-tapped transformer winding. Figure 12 shows this in schematic form with the grid omitted and the filament shown in the form of a resistance. For purpose of illustration this can be considered to represent the filament of a 171 type power valve, in which case the filament resistance is 10 ohms.

In operation the direction of current flow reverses 120 times a second, which means that the right-hand end of the 5-volt transformer winding and the right-hand end of the resistance will be alternately positive and negative with each reversal of the current. The center tap of the transformer winding must be kept neutral, and also the center of the filament (CF).

In Figure 9 is shown the same arrangement, but with a rheostat, R2, in one leg of the filament circuit. Assume that the transformer output is 6 volts and that it is necessary to cut this down to 5 volts for the 171 type of filament. A series resistance of 2 ohms (R2) will be necessary to accomplish this. Now there is a voltage drop of 5 volts across the filament R1 and of 1 volt across the resistance R2. Therefore, the center of the filament is no longer the neutral point, as it is not the center of the total resistance, and therefore cannot be the voltage center. The result therefore is that at one instant the center of the filament will be ½ volt positive in relation to the actual voltage center point and on the other half of the cycle will be ½ volt negative. Inasmuch as the grid remains always at the voltage center point, it is evident that the filament will be alternately positive and negative in its relation to the grid, thus causing a hum.

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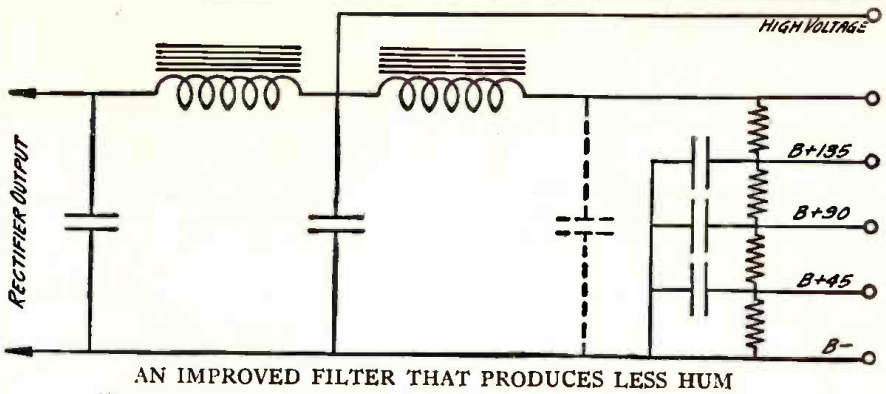



AN IMPROVED FILTER THAT PRODUCES LESS HUM

FIGURE 14: *This circuit is particularly adapted to power-packs that use the UX-216-b type of rectifier valve. The condenser shown by the broken line may be dispensed with entirely or it may be shunted across the middle condenser to furnish greater capacity at that point.*

## Reducing the Hum in "B" Power-Packs

THERE are some "B" power-packs in use which, although they are constructed of the finest parts, produce quite a hum in the reproducer when connected to a receiver. Usually this hum is not audible while signals are tuned in, but it does become noticeable during the quiet intervals between announcements at the broadcast station.

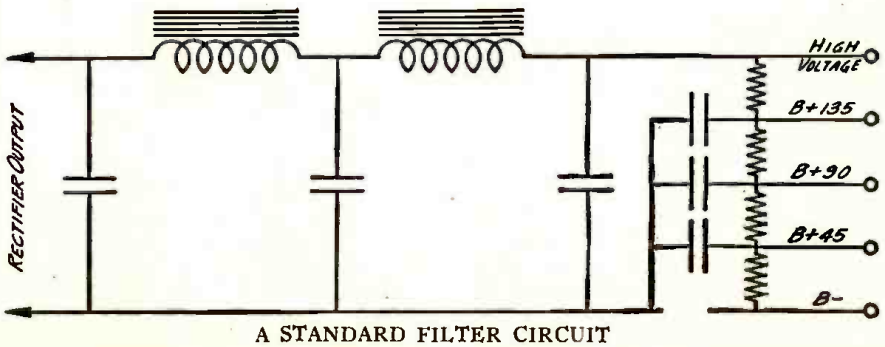
In experimenting with "B" power-packs of various types in which instruments of known quality were used, some interesting things were brought to light. Four distinct causes for hum were found and eliminated without any additional expenditure for extra equipment.

If the power-pack is placed close to the receiver with which it is used, it is possible to obtain a hum as a result of the electromagnetic coupling between the power transformer in the power-pack and the low-frequency transformers in the receiver—particularly the transformer in the first low-frequency stage.

To eliminate this source of trouble it is not always necessary to move the power-pack farther from the receiver. Moving the power-pack only a few inches one way or the other may do the trick, or it can sometimes be accomplished by turning the power-pack around at an angle of 90 to 180 degrees from its original position. If the power-pack is located in the battery compartment of a console, with the receiver on top, undesirable coupling can sometimes be eliminated by placing the power-pack at the opposite end of the console from its normal position.

Where a power-pack includes an automatic relay switch, this instrument may cause a considerable hum if it is too close to the power transformer. One power-pack tested produced a decidedly loud hum that could be heard twenty feet away from the loudspeaker when the set was in operation. In this the relay switch was placed within one-half inch of the power transformer. By removing the relay from the power-pack and placing it a foot away from the power transformer the hum was reduced to a point where it was scarcely audible. The hum from this cause results from electromagnetic coupling between the power transformer and the magnet windings in the relay and will disappear when this coupling is reduced.

Sometimes the relay need not be close to the transformer to cause this hum. In some cases the transformer field seems to follow along any extensive metal path provided for it, such as, for instance, the walls of the cans which inclose the filter condensers. To determine the best position for the relay it is well to unfasten the relay and move it around while the power-pack and receiver are in operation.




A STANDARD FILTER CIRCUIT

FIGURE 15: *This filter circuit is used in practically all "B" power-packs. The total current flows through both chokes in this arrangement, thereby decreasing their inductance and their filtering efficiency. Figure 1 shows an improved circuit.*

In cases where the current drawn from the power-pack is high, a reduction of hum can sometimes be obtained by taking the high voltage tap off between the chokes, as shown in Figure 14, instead of from the output side of the second choke, as shown in Figure 15. Less filtering action is neccessary in the case of the high voltage used to supply the plate of the last low-frequency valve, and there is no need of more than one choke and its attendant condensers to procure adequate filtration. The plate voltage for the other valves requires a higher degree of filtration, and therefore needs the two chokes, although the last filter condenser, indicated by a dotted line in Figure 14, may be eliminated.

By taking the high voltage tap off between the chokes the current drawn from this tap does not flow through the second choke at all. The inductance of a choke increases with a decrease of current flowing through it. If the comparatively high current drawn by the plate circuit of a power-amplifier valve in the last low-frequency stage is removed from the windings of the second choke the inductance of the choke is therefore increased and the filtering action on the current that passes through this choke is increased. The result of this change is to provide better filtering action on the "B" voltage supply for the circuits that are more susceptible to hum, and at the same time to provide adequate filtering action for the circuit of the last amplifier valve.

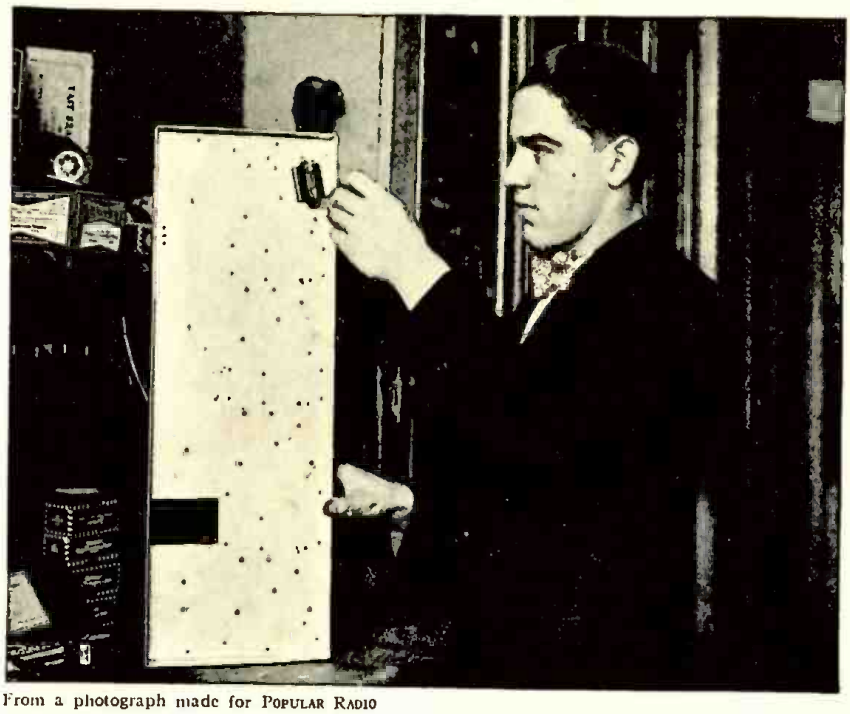
A fourth thing that sometimes causes a hum in a "B" power-pack which also supplies the "C" bias for a power-amplifier valve, is the improper adjustment of the "C" voltage. Improper adjustment of the "C" voltage control of the power-pack may permit excessive current to flow in the plate circuit of the power-amplifier valve, with the result that the power-pack is called upon to supply more current than its filter can properly handle. By adjusting the control to provide a higher "C" voltage the current drawn from the power-pack may be reduced to a normal value.

Most fans do not have the proper voltmeters on hand to permit them to adjust the "C" bias voltage by actual figures. As a matter of fact, this adjustment may often be made by ear. While the receiver is in operation at full volume the "C" voltage control should be varied until the sweetest and clearest reproduction is obtained. Many are under the impression that the "C" adjustment is correct when the greatest volume of reproduction is obtained. This idea is not necessarily correct; and in many cases judging the "C" battery adjustment by the volume of reproduction alone may be the cause of operating with too low a "C" voltage, with a resulting excessive plate current drain.

—S. GORDON TAYLOR

# How To Build The LC-28 Receiver

(*Continued from page 217*)



From a photograph made for POPULAR RADIO

A SCREW-DRIVER DOES THE ASSEMBLING

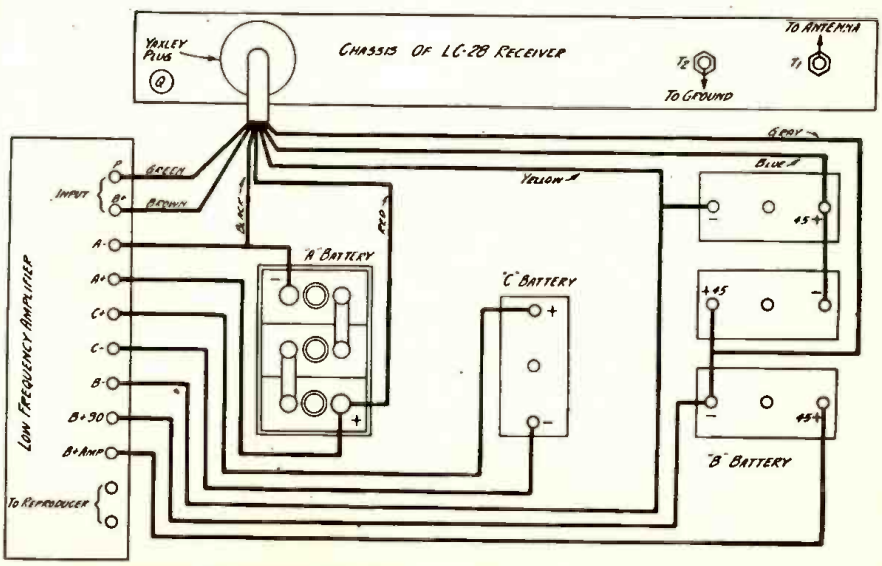
FIGURE 8: *The mounting holes in the drilled chassis exactly accommodate the instruments specified on page 214, and the mounting requires nothing but a screw-driver and a small socket wrench to fit the nuts, which are all of one size, 6/32.*

in Figure 3 for the exact connections that should be made. This carries out the theoretical circuit shown in Figure 5.

The best scheme is to start by wiring up the connections on the bottom side of the chassis, Y. This includes the connections on the chokes, E1, E2, E3 and F, and the fixed condensers, K1, K2, K3 and M, located under the chassis, as well as the connections to the Yaxley plug, Q. Following this the connections to the combination variable resistor and switch, S, and the wiring to the positive filament terminals of the sockets, P1, P2, P3 and P4, should be made.

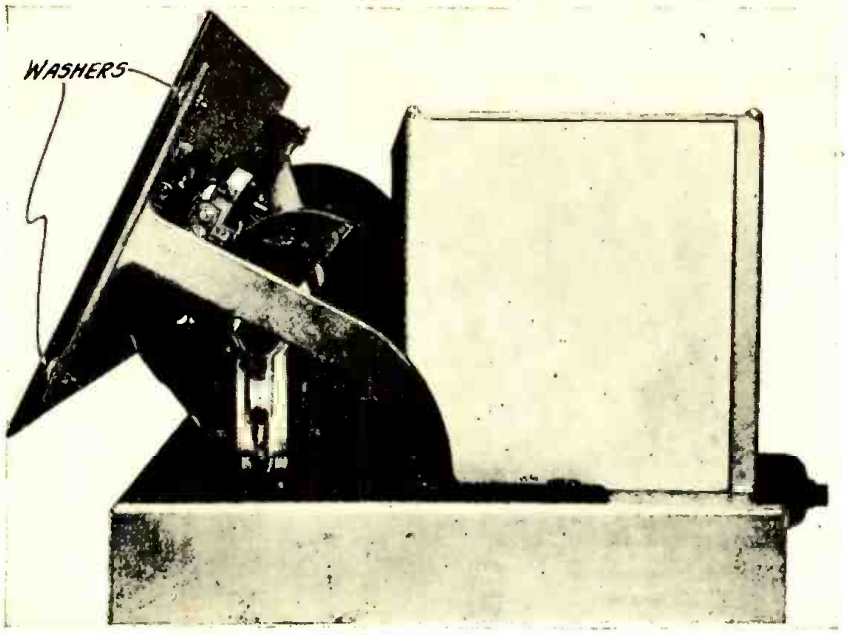
Next, complete the connections between the terminals marked "G" on the three sockets, P1, P2 and P3, and the adjacent ends of the resistors, G, H and I. These three connections take approximately ¼ inch of wire, and may be done with stiff bus bar.

Now wire the other ends of the three resistors, G, H and I, to the adjacent terminals of the three high-frequency transformers, A, B and C, leaving a




HOW TO HOOK UP THE RECEIVER FOR OPERATION

FIGURE 9: *This diagram shows the proper battery connections for the receiver, and the wiring to be made in connecting the LC-28 high-frequency pack with any low-frequency amplifier and reproducer.*




AN END VIEW OF THE SET

FIGURE 10: *This view shows clearly how the front panel is attached to the chassis by means of the sloping brackets.*

few inches extension that can be run over, later, to the three nearest terminals of the variable condensers, J1, J2 and J3.

Next, wire up the grid-circuit of the detector valve, including the grid-leak, N, and the condenser, L, as shown in Figure 3, leaving an extension to the variable condenser, J4, which can be made when the shields, R1, R2, R3 and R4, are attached.

This completes the wiring as far as it can be done and leaves open only one end of these for connection to the variable condensers.

The next job will be to install the sixteen corner posts of the four sets of shields, R1, R2, R3 and R4, by mounting them loosely in the four remaining holes left around each stage, with a screw inserted through the chassis, Y, from the bottom. When this is done, the sides of the shields are ready to be inserted into the slots in the corner pieces. However, the four sides of the shields that face the panel should be first drilled with a No. 17 drill for the hole necessary to run the wire out of the shields to the variable condensers, J1, J2, J3 and J4. This hole should be drilled exactly ¾ inch up from the bottom and centered in the middle of the shield, as shown in Figure 11. The four front sides should then be inserted and the four wires pulled through the holes and soldered to the adjacent terminals of the four condensers, J1, J2, J3 and J4.

Next, mount the two drums of the drum dial, U, by means of the flexible connections onto the extension shaft, V, which should be inserted through the three condensers, J2, J3 and J4, and onto the small shaft of the remaining condenser, J1.

The two brackets, X1 and X2, are then mounted loosely on the chassis, Y, and the front panel, W, attached to the brackets with four flat-head machine screws, spacing washers and nuts.

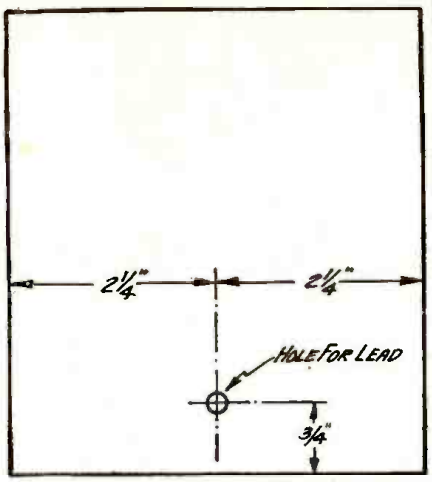
Next, attach two flat-head brass screws into the supporting arms of the drum through the proper holes in the panel and attach the pilot light and the front escutcheon of the drum, U. Then tighten up all screws and adjust the front panel, W, for correct position at the same time, so that the dials run smoothly. To connect the pilot light only one wire is necessary; it should run from the right-hand terminal of the pilot light (looking from the back of the set) over to the terminal connected to the frame and shaft of the switch-rheostat S.

Next, insert the other three sides to each of the four sets of shields, R1, R2, R3 and R4, and attach the tops securely with four screws, so that good contact is made all around. The set is now complete and ready for operation.

### *Operating Data for the LC-28*

The LC-28 high-frequency pack may now be inserted in its cabinet or console, and the Yaxley cable, Q, should be attached first to the batteries or "B" power-pack, as shown in Figure 9. Then the connector may be inserted in the plug, Q, at the back of the high-frequency pack, being first sure that the combination switch rheostats are turned "off." A ground wire should be attached to the tip jack, T1, marked "Aerial," if no antenna is to be used. If, on the other hand, an antenna is employed, it should be connected to the tip jack, T1, marked "Aerial," and the ground wire should be moved over to the tip jack, T2, marked "Ground."

The high-frequency pack may be used temporarily, if necessary, with the amplifier of a previous set by connecting the two output wires to the input




HOW TO DRILL THE STAGE SHIELD

FIGURE 11: *This diagram shows the correct position for the hole to be drilled in the front side of each stage shield for the wire that connects to the stator of each condenser.*

terminals of the amplifier with which it is to be used, as shown in Figure 9.

The LC-28 high-frequency pack may also be used with any complete low-frequency amplifier in the same manner. Any of the amplifiers described in the series, "How to Get Quality Amplification," now running in POPULAR RADIO, will be found exceptionally well suited to the LC-28.

Or, if the reader has any particular preference in amplification, whether it be transformer coupling, impedance coupling, resistance coupling or a combination, an amplifier embodying these principles may be connected with the LC-28 within a few minutes' time and the set put into operation.

The tuning of the antenna circuit is accomplished with the left-hand knurled disc of the double-drum dial, U, and the three remaining stages are tuned with the right-hand knurled disc of the drum dial, U. All volume control is accomplished with the switch, S.

Place three Zetka RF valves in the sockets, P1, P2 and P3, for maximum results. These valves are really power valves and are designed with an exceptionally low value of plate impedance; they draw slightly less than ¼ ampere in the filament circuit and give a very high order of amplification.

However, the ordinary standard UX-201-a type valves may be used with excellent results.

In the detector socket, P4, a Z-200-a or a UX-200-a type valve should be used.

To insert these valves, it is necessary to take off the tops of the four shields, R1, R2, R3 and R4, after which they should be replaced and tightened down securely.

This set, in New York City, *without an antenna*, has been able to duplicate, with a large margin to spare, the results obtained with the LC-27 *on a very satisfactory antenna.*

Without using an antenna the LC-28 has brought in, during summer in New York, stations from the Pacific Coast, from northwestern Canada, from Mexico, Florida, Maine, Chicago, and intervening locations. And it is possible to obtain these through local broadcasting under ordinary conditions.

In the November issue of POPULAR RADIO will be described "How to Build and Operate the LC-28 Unipac," the first of a series of combined amplifiers and power-packs for use with the LC-28 for varying conditions of quality, volume and price. This coming series will include transformer-coupling, resistance-coupling, impedance-coupling and push-pull amplification, and combinations of both, so that every set constructor may have just the type of amplification that he wishes to use with the LC-28.

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ADVANCE INFORMATION ON

## The LC-28 Unipac Amplifier

FOR those who must do most of their radio shopping out of town, and who want to be ready to complete the LC-28 receiver as soon as the November issue of POPULAR RADIO is issued, the Editors are publishing below the list of parts specified for this unit:

1 S-M 328 full-wave, super-power transformer;
1 S-M 331 Unichoke filter system;
2 S-M 240 audio transformers;
1 S-M 241 output transformer;
1 Tobe 662 condenser bank;
5 S-M 511 valve sockets;
1 Ward-Leonard S-651 resistor kit;
4 Frost 253 tip jacks;
1 Van Doorn 661 steel chassis and cabinet with hardware;
3 Eby binding posts (B—, 45+, 90+);
20 feet of Kellogg hook-up wire;
2 Frost FT 64 resistors;
1 Frost F 1500 resistor;
1 CX-326 1.5 AC amplifier valve;
1 CX-310 power amplifier valve;
1 CX-374 glow valve;
2 CX-316B rectifiers.

NOTE: The use of two CX-381 rectifiers is to be preferred instead of CX-316-b's due to greater life and slightly higher output voltage.

The unit the parts for which are listed above is a complete two-stage low-frequency amplifier with "ABC" power supply and receiver "B" supply, operating entirely from a 105-120-volt, 60-cycle light socket. Designed especially for use with the new LC-28 receiver, it will serve as a very high quality and powerful low-frequency amplifier and "B" power-pack, in connection with any standard receiver that contains no low-frequency amplifier. It will also function as a complete light-socket-operated phonograph amplifier, upon the addition of a reproducer and magnetic phonograph pick-up, such as the Pacent Phonovox. Thus the amplifier, loudspeaker and pick-up allow the complete electrification of any existing mechanical phonograph, with results equal or superior to those obtainable from the more expensive phonograph models that are now on the market.

# BROADCASTS

## Photo-Electric Cell Performs Novel Stunt

BY means of a photo-electric cell, a one-candlepower flashlight in New York recently turned on the 1,380,000-candlepower searchlight erected at Charlottesville, Va. When the flashlight beam fell on the light-sensitive cell, an electric current was sent over wire and actuated an electric relay that turned on the power for the searchlight. In like manner, the first glow of the searchlight at Charlottesville operated a photo-electric cell that turned on a flood light in City Hall, New York City; this light illuminated a portrait of Thomas Jefferson, in whose honor the Charlottesville beacon was named. The beacon is intended as a guide post for airplanes and is the largest searchlight ever constructed.

* *

## An Automatic Radio Ship Announcer

A PATENT has been granted to Elmer Sperry, of Brooklyn, for a radio device that automatically broadcasts the name, position and speed of a ship.

The device is a cylindrical machine, about the shape of a top hat, which is connected with the compass of the vessel. As the compass gives the position of the ship, impulses are sent out by radio to shore stations in communication with the ship. Similarly, the machine is geared to the propellers of the vessel and the speed of the ship is ascertained from this connection. The device also sends out the name of the vessel.

* *

## An Outdoor Radio Game

FROM England comes an outdoor sport centering about radio. At a recent meeting of a British radio society, a small radio broadcasting station was set up secretly in one of the houses of a farm to broadcast radio signals at intervals. The members of the society, scattered about in the surrounding country, sought to locate it. Mr. Maurice Child, using an apparatus to detect the direction from which radio waves are arriving, made three readings at points a few miles apart, combined these on a map according to the well-known surveyor's method of triangulation, and located the "quarry," winning the prize offered by the *Wireless World*, a British radio magazine.

* *

## Radio and Movies Combined for Broadcast Lectures

A METHOD has recently been perfected in Germany for combining movies with radio for the purpose of illustrating broadcast lectures. In each auditorium where the broadcast lecture is to be heard, the illustrative films are run on a projector geared to a motor that is synchronized with all the other motors in the lecture hook-up. The lecturer watches one of the projections, or a private projection in his study, and times the remarks he is broadcasting to fit the scenes being illustrated.

* *

## The First Book on Radio Law

THE first book to deal with the complexities of radio law has been published by the McGraw-Hill Company of New York. It is entitled "The Law of Radio Communication," and was written by Judge Stephen B. Davis, formerly a solicitor in the Department of Commerce and aide to Secretary Hoover in the control of radio. The book considers most of the controversial legal phases of radio today, such as federal jurisdiction, state jurisdiction, conflicting rights in reception and transmission, property rights, the broadcasting of copyright matter, the control of broadcasting programs, libel and slander, and international law.

* *

## Caucasus Priests See "Deviltry" in Radio

RADIO progress in Svanetia, a wild district on the slopes of the Caucasus Mountains, is not encouraged by the Mohammedan priests, or Mullahs, who look on the strange "spirit-speaker" from the West as an instrument of the devil. Recently a receiving set was publicly damned before a huge crowd and then thrown down a precipice.

## Radio Enters the Show Business

BROADCASTING, which started as a part of the electrical business, has developed into an important member of the show business. Payrolls of from $500 to $2,000 a night are paid out for talent alone on the big chains; outstanding entertainers are reported as getting as much as $2,000 for a single short appearance before the mike. And radic is making its own artists, too. So great has been the demand of the public to see radio artists face to face that a broadcasting chain has established a bureau to provide personal appearances for its own artists.

* *

## A New Station for Transatlantic Radio

CONSIDERABLE improvement in the transatlantic radio telephone service is promised by the construction of a new radio station now being built by the British Government at Cupar, Scotland.

Measurements and tests carried out in 1925 indicated that the north of the British Isles was the ideal situation for transmission and reception of telephonic conversation with the United States, and Cupar was decided upon as the best available location. This station will supersede the present station at Wroughton, Wiltshire, which is about eighty miles from London.

* *

## Feeding Lines to the Announcer

THE introductory remarks which appear to fall so extemporaneously from the announcer's lips are, according to the most modern studio technique, written down beforehand and carefully planned. Broadcasting has to be run according to a schedule in which every second counts. The words that are spoken must be timed.

* *

## Radio "Mileposts" for Airplanes

THE radio beacon system for use in airplane navigation has been progressing under the experimentation of the Bureau of Standards at the demonstration station at College Park, Md., on the New York-Atlanta airway. The system as it will be developed will incorporate three radio devices. The first is the directive radio beacon that sends out a special type of radio beam by which airplane pilots are able to follow the designated course in total darkness or fog. The system also makes use of marker beacons placed at intervals of about 25 miles along the air route; these will act as radio mileposts. Supplementing these, radio telephony will be used to inform the pilot of landing conditions and weather expectations. The control of all these devices will be centered at the airports. The control center will also be equipped with receiving apparatus to receive messages from such airplanes as are equipped with transmitting apparatus.

* *

## An All-European Broadcast Program

AN all-European musical concert, to which a dozen widely separated cities contributed, recently was broadcast by Copenhagen radio stations.

During a period of three hours, by means of relaying, the Danish radio public was able to hear London, Paris, Toulouse, Berne, Prague, Langenberg Moscow, Daventry, Bruxelles, Oslo, Frankfurt and Lyons. The concert was exceedingly popular with the Danish radio public.

* *

## Radio Broadcasts a Song Unheard by Human Ear

THE superiority of modern radio apparatus to the human ear, considered as a listening device, was demonstrated recently in England during an attempt to broadcast the song of that seldom-heard bird, the nightingale. A feathered songster far off in the distance burst into song while the experiment was going on. The engineers at the microphone heard nothing, but the song was picked up by the especially sensitive microphone that was being used and was broadcast, without the knowledge of the engineers.

* *

## A Radio "Shadow"

AN American destroyer division reports that there is a radio "shadow" along the north side of Haiti, which makes it impossible for ships cruising along the north side of the island to communicate with vessels on the south side during the times when the high mountains of Central Haiti intervene.

* *

## A Correction in the July-August Number

DAVID LAY'S mathematics were in error in the article entitled "The New Exponential Horn," in the July-August number. At the bottom of the second column, on page 23, the article reads:

"If roots are to be expressed instead of powers, the exponent is negative. For example, an exponent of —2 indicates the square root, an exponent of —3 indicates a cube root, and so on."

This should have read:

"If roots are to be expressed instead of powers, the exponent is fractional. For example, an exponent of ½ indicates the square root, an exponent of 1/3 indicates the cube root, and so on."

A negative exponent indicates that the reciprocal of the number is to be raised to the power indicated.

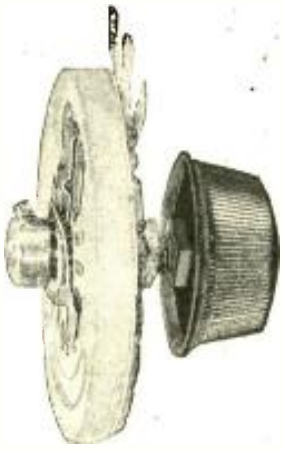
# VITROHM RESISTORS *and* RHEOSTATS

## *Vitrohm Radio Resistors*

WARD LEONARD Resistors and Rheostats are now available to the experimenter and home constructor in 93 types and styles covering the resistance demands of *every* current supply circuit.

A few of these products are listed on this page. A full description is contained in Radio Bulletin 507 which will be sent you without charge.

"Vitrohm News", a monthly Bulletin covering circuits and items of interest to the radio fan, was first published in September. This copy and subsequent issues will be sent you upon request.

THE ADJUSTAT

### *The Adjustat*

The Vitrohm Adjustat is a 15-step potentiometer connected rheostat adapted for use in all current supply circuits. Like all Vitrohm Products, the resistive element, wire, is embedded in and protected by fused-on vitreous enamel.

The Adjustat is priced at $3.00.

TYPES

| | | | | | |
|---|---|---|---|---|---|
| 507-79 | 1 ohm | 4000 m. a. | 507-81 | 600 ohms | 180 m. a. |
| 507-71 | 2 ohms | 3000 m. a. | 507-75 | 1000 ohms | 125 m. a. |
| 507-72 | 6 ohms | 1500 m. a. | 507-76 | 2250 ohms | 90 m. a. |
| 507-73 | 20 ohms | 1000 m. a. | 507-84 | 7500 ohms | 50 m. a. |
| 507-74 | 30 ohms | 800 m. a. | 507-77 | 10,000 ohms | 40 m. a. |
| 507-80 | 50 ohms | 650 m. a. | 507-78 | 25,000 ohms | 20 m. a. |

### *Resistor 507-66*

Vitrohm Resistor 507-66 is a transmitting grid leak for circuits up to and including 1000 watts inputs. It is particularly recommended for circuits employing the R. C. A. UX852 Tube.

Total resistance 15,000 ohms, tapped at 5000 and 10,000 ohms. $6.00

RESISTOR 507-66

RESISTOR 507-9

### *Resistor 507-9*

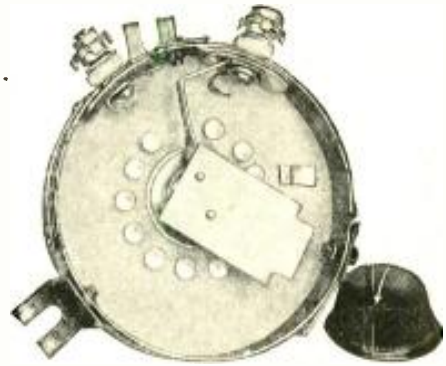
This resistor is for use in B & C Supply Circuits having an output under load of 180 volts. At this voltage, intermediate voltages of 22, 45, 67, 90 and 135 are available. Priced at $6.75.

### *Vitrohm HEAVY DUTY Rheostat*

The Vitrohm *heavy duty* Rheostat has 11 steps of adjustable resistance. It is particularly adaptable for use in series with transformer primaries to compensate for line voltage changes. These Rheostats are 4 inches in diameter and are arranged for either base or panel mounting. $5.50.

TYPES

| | | |
|---|---|---|
| 507-83 | 12.5 ohms | 2200 m. a. |
| 507-59 | 20 ohms | 2000 m. a. |
| 507-63 | 50 ohms | 1000 m. a. |



VITROHM *HEAVY DUTY* RHEOSTAT

## Ward Leonard Electric Company

31-41 South Street Mount Vernon, N. Y.

*resistor specialists for more than 35 years*

# Transoceanic Calls Heard

POPULAR RADIO has just received a card from W. B. Jennings (NU-1ON), 26 Tapley Street, Lynn, Mass., thanking us for forwarding to him some calls heard (QSL) cards from station EF-8EZ in France.

POPULAR RADIO is doing this same service for all other American amateurs. Arrangements have also been completed for forwarding American QSL cards for their proper destinations in foreign countries. This delivery is made through local agents in those countries who have or can obtain the present address of foreign amateurs. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Transoceanic Calls Heard" department.

Address your cards to the foreign amateurs by call numbers and enclose them in an envelope to—

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

THE following stations were received and logged at the amateur station of Roger Pieton (EF-R390) at 92, Rue Riquet, Toulouse, France, using a Bourne receiver with one stage of low frequency:

NU-2CUZ—July 13, 1927; signal strength R8; stable DC note on 20.65 meters;
NU-6BJF—July 14, 1927; signal strength R6; rectified AC note on 20.30 meters; fading;
NU-2BBB—July 14, 1927; signal strength R8; steady rectified AC note 21.65 meters;
NU-6ASZ—July 14, 1927; signal strength R8; steady rectified AC note on 20.50 meters;
NU-8ARO—July 14, 1927; signal strength R9; steady rectified AC note on 20.65 meters;
NU-1DM—July 11, 1927; signal strength R7; stable DC note on 18.8 meters;
NU-2AUE—July 11, 1927; signal strength R6; stable rectified AC note on 20 meters;
NU-1CJH—July 11, 1927; signal strength R7; stable rectified AC note on 20.4 meters;
NU-1AD—July 11, 1927; signal strength R8; stable rectified AC note on 21 meters;
NU-1AXX—July 10, 1927; signal strength R4; DC note on 20 meters; fading;
NE-1BY—June 6, 1927; signal strength R3; stable rectified AC note on 20 meters;
NA-9KV—June 8, 1927; signal strength R8; stable rectified AC note on 20 meters;
NT-8AF—June 26, 1927; signal strength R7; rectified AC note on 20 meters; fading;
NU-1CTU—July 11, 1927; signal strength R8; steady rectified AC note on 20.3 meters;
NU-8BEN—July 19, 1927; signal strength R8; steady rectified AC note on 20.9 meters;
NU-8BAG—July 19, 1927; signal strength R6; steady DC note on 19.8 meters;
NU-2DR—July 19, 1927; signal strength R8; steady rectified AC note on 20.3 meters;
NU-1BBO—July 14, 1927; signal strength R7; steady rectified AC note on 18.4 meters;
NU-1BKP—July 15, 1927; signal strength R5; steady rectified AC note on 20.5 meters;
NU-1BAT—July 16, 1927; signal strength R4; DC note on 20.9 meters; fading.

THE following stations were received and logged at the amateur station of L. Berger (EF-8OEO), at Villa Babiole, Cambo, Basses Pyrenees, France, with a cage antenna and counterpoise and one stage of low frequency:

NU-3IU—April 6, 1927; signal strength R6-7; rectified AC note on 41 meters; bad static;
NU-8ANC—April 6, 1927; signal strength R4; DC note on 40 meters; bad static;
NU-1CD—March 13, 1927; signal strength R6; DC note on 40 meters; atmospherics;
NU-5EK—March 13, 1927; signal strength R6; good rectified AC note on 42 meters; much static;
NU-2GU—March 13, 1927; signal strength R6; rectified AC note on 42 meters; much static;
NU-2CVJ—April 17, 1927; signal strength R8; rectified AC note on 40 meters; no fading;
NU-1BGD—April 17, 1927; signal strength R6; rectified AC note on 40 meters;
NU-8CWT—Feb. 27, 1927; signal strength R2-3; DC note on 41 meters; much interference and static;
NU-2BCM—Feb. 27, 1927; signal strength R6; rectified AC note on 42 meters; interference;
NU-1CD—Feb. 27, 1927; signal strength R2-3; rectified AC note on 42 meters; much interference and static;
NU-1BBM—Feb. 27, 1927; signal strength R6; rectified AC note on 42 meters; atmospherics;
NU-1CSX—April 14, 1927; signal strength R6; rectified AC note on 41 meters; atmospherics;
NU-1AIX—April 14, 1927; signal strength R1; DC note on 40 meters; much static;
NU-3JU—April 14, 1927; signal strength R6-7; rectified AC note on 40 meters; bad atmospherics;
NU-8AXA—April 26, 1927; signal strength R1; DC note 41 meters; much static;
NU-1BZQ—April 14, 1927; signal strength R3-4; rectified AC note on 41 meters.

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THE following stations were received and logged at the amateur station EF-8HIP, Paris, France, using a Schnell receiver with one stage of low frequency:

NU-8AXA—July 21, 1927; signal strength R3; good rectified AC note on 20 meters;
NU-8CFR—July 19, 1927; signal strength R4; steady rectified AC note on 20 meters;
NU-1AXA—July 1, 1927; signal strength R7; steady rectified AC note on 20 meters;
NU-1BYV—July 1, 1927; signal strength R5-6; rectified AC note on 20 meters;
NU-2AOL—July 1, 1927; signal strength R4-5; rectified AC note on 20 meters;
NU-2AGN—June 28, 1927; signal strength R5; steady rectified AC note on 20 meters;
NU-1BEB—July 1, 1927; signal strength R4; very fine rectified AC note on 20 meters;
NU-2UR—July 1, 1927; signal strength R4-5; good rectified AC note on 20 meters;
NU-2AYJ—July 11, 1927; signal strength R3-5; rectified AC note;
NU-1BIV—June 30, 1927; signal strength R3-4; rectified AC note on 20 meters;
NU-8ADG—June 29, 1927; signal strength R8; good rectified AC note on 20 meters.

THE following stations were received and logged at the amateur station G. Baron (EF-8BRN), at Rouen, France, using a Schnell receiver and a single-wire antenna:

NU-9ADK—March 23, 1927; signal strength R5; DC note; slight interference;
NU-8BAJ—March 24, 1927; signal strength R3; heavy static;
NU-8ADM—March 15, 1927; signal strength R7; rectified AC note;
NU-4HY—March 15, 1927; signal strength R7-8; no fading;
NU-2LE—Feb. 27, 1927; signal strength R5; DC note; some interference;
NU-2AKJ—March 21, 1927; signal strength R6; some static;
NU-1ID—April 3, 1927; signal strength; rectified AC note;
NU-4TV—April 20, 1927; signal strength; R7; rectified AC note;
NU-2AVR—April 30, 1927; signal strength R6-7; rectified AC note;
NU-2AFM—May 2, 1927; signal strength R6;
NU-2AHM—April 26, 1927; signal strength R5; DC note on 36 meters;
NU-2AEF—April 30, 1927; signal strength R4; rectified AC note; some interference and much static;
NU-1AVL—April 30, 1927; signal strength R7; rectified AC note;
NU-1AFL—May 2, 1927; signal strength R7;
NU-2BOW—May 1, 1927; signal strength R8; some fading;
NU-1MV—March 25, 1927; signal strength R6;
NU-1CD—March 26, 1927; signal strength R6; slight interference;
NU-1CKP—March 15, 1927; signal strength R8; interference; slight fading;
NU-1RN—March 15, 1927; signal strength R5; much interference; slight fading.

THE following stations were received and logged at the amateur station of A. Cremailh (EF-8JZ), at 15, Rue de Vitre, Rennes, France, using detector and one stage of low frequency:

NU-3TN—April 7, 1927; signal strength R5; good rectified AC note on 39 meters; no fading;
NU-2AO—April 7, 1927; signal strength R6; AC note on 38 meters; no fading;
NU-9BCL—April 7, 1927; signal strength R6-7; good rectified AC note on 37 meters;
NU-4LD—April 7, 1927; signal strength R6-7; good rectified AC note on 36 meters;
NU-3AGM—March 27, 1927; signal strength R6; 41 meters;
NU-3UD—April 3, 1927; signal strength R6; AC note on 42 meters; no fading;
NU-1BKE—April 2, 1927; signal strength R6; 37 meters;
NU-2AVG—March 27, 1927; signal strength R6; good rectified AC note on 37 meters;
NU-3LL—March 29, 1927; signal strength R6; good rectified AC note on 41 meters;
NU-1AVG—March 27, 1927; signal strength R6; DC note on 36 meters;
NU-1VZ—March 27, 1927; signal strength R6; DC note on 36 meters;
NU-2AZK—March 29, 1927; signal strength R5; rectified AC note on 37 meters;
NU-2ATX—April 3, 1927; signal strength R6-7; very good rectified AC note on 37 meters;
NU-2FC—April 3, 1927; signal strength R7; good rectified AC note on 36 meters;
NU-2BEM—April 3, 1927; signal strength R6-7; AC note on 41 meters.

THE following stations were received and logged at the amateur station of Dr. L. Bailleul (F-8EZ), 119 Boulevarde de Belfort, Roubaix (Nord), France, using a single-wire antenna and counterpoise and a Schnell receiver:

NU-4HY—March 13, 1927; signal strength R7; good rectified AC note; no fading;
NU-8DRJ—March 13, 1927; signal strength R7; good rectified AC note; no fading;
NU-1NQ—March 13, 1927; signal strength R6; good DC note; no fading;
NU-1RF—March 12, 1927; signal strength R7; good DC note; no fading;
NU-4TK—March 14, 1927; signal strength R6; good rectified AC note; no fading;
NU-1AVG—March 14, 1927; signal strength R4; good rectified AC note; much static; no fading;
NU-2CS—March 13, 1927; signal strength R4; good DC note; no fading;
NU-2AG—March 21, 1927; signal strength R6-7; good DC note; atmospherics;
NU-2AHM—March 21, 1927; signal strength R7; poor DC note; very bad interference;
NU-1AKM—March 26, 1927; signal strength R6; good rectified AC note;
NU-2AKJ—March 31, 1927; signal strength R4; good rectified AC note; bad static and interference;
NU-1ON—March 29, 1927; signal strength R3; good rectified AC note;
NU-9CIA—April 7, 1927; signal strength R4-5; good DC note;
NU-5OA—April 7, 1927; signal strength R3-4; rectified AC note, with fading.

THE following stations were received and logged at the amateur station of Paul Gauthier (EF-8PMT), Nancy, France, using a Schnell receiver with a detector and one stage of low frequency:

NU-8AJU—April 16, 1927; signal strength R5; 35 meters; no fading;
NU-2BUY—April 16, 1927; signal strength R6; good note on 30 meters; no fading;
NU-4OC—April 16, 1927; signal strength R5; good note on 31 meters;
NU-3AUV—April 4, 1927; signal strength R6; very good note on 30 meters; no fading;
NU-4SI—April 4, 1927; signal strength R6; 30 meters; no fading;
NU-1ARV—April 4, 1927; signal strength R5; 31 meters; no fading.

The following stations were received and logged at the amateur station EF-8ARO in Belfort, France, using a low-loss receiver with detector and one stage of low frequency, and a double cage antenna:

NU-1RD—April 6, 1927; signal strength R3-5; rectified AC note on 20.5 meters; much static; fading;
NU-1BUX—April 2, 1927; signal strength R4; rectified AC note on 19.5 meters; static and fading;
NU-2AGQ—Feb. 12, 1927; signal strength R3-4; rectified AC note on 21 meters; much static; fading;
NU-4WE—Feb. 22, 1927; signal strength R3; DC note on 20 meters; static and much interference; no fading;
NU-1SW—March 4, 1927; signal strength R6; rectified AC note on 21 meters; much static and interference;
NU-1ADM—Feb. 22, 1927; signal strength R5; DC note on 21 meters; static and fading.

FACTORY PRICES~SAVE 50%
Choice of beautiful cabinets offered

TRY IT 30 DAYS FREE
BEFORE YOU BUY

ALL METAL SHIELDED CHASSIS

3 Year Guarantee

# 8 tube~one dial MIRACO

TRADE MARK REGISTERED

Only $69.75 Retail List Completely Assembled

## MAGNIFICENT TONE~SUPER SELECTIVE~POWERFUL DISTANCE GETTER

## All Electric~or Battery Set!

America's big, old, reliable Radio Corporation* (8th successful year) *guarantees* its big, powerful, latest 6, 7 and 8 tube Miraco sets to give "the finest, most enjoyable performance obtainable in *high grade* radios." Unless 30 days' use in your home fully satisfies you and everybody who hears it that a Miraco is unbeatable at any price for beautiful, clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc.—*don't buy it! Your verdict final*—absolutely no strings to this. Save or make lots of money on sets and equipment by writing for testimony of nearby users and *Amazing Special Factory Offer.*

### Run from Light Socket or Batteries

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

### Deal Direct with Big Reliable Makers

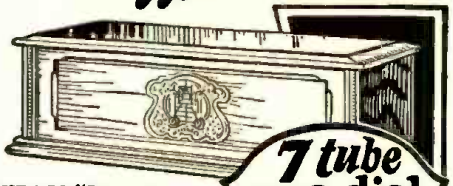
Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. *30 days free trial.* 3 year guarantee if you buy. Choice of beautiful consoles [with latest built-in orthophonic type speakers having 8 feet of tone travel] and table cabinets, also offered. You take no risk, you insure satisfaction, you enjoy *rock-bottom money-saving prices by* dealing direct with one of radio's oldest, most successful builders of fine sets.

*Dealers Write!*

USER-AGENTS! *Make big profits showing your Miraco set to friends*

*MIDWEST RADIO CORPORATION, Cincinnati, O.

## Big Discounts to User-Agents



MIRACO "Powerplus" sets—both in 8 and 7 tube models—have magnificently beautiful, clear cathedral tone quality. Turn one dial for stations everywhere. Ultra-selective. Miraco multi-stage distance amplification gives "power-plus" on far-off stations. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. *Try one free for 30 days!* Choice of beautiful cabinets.

**7 tube one dial** METAL SHIELDED CHASSIS $49.75 RETAIL LIST


**Free!**

Famous powerful big Miraco Super 6, 1928 model—ultra selective. Thousands find it outperforms and outdistances sets of much higher price. Fully Guaranteed.

BEAUTIFULLY ILLUSTRATED CATALOG AND AMAZING SPECIAL OFFER

SEND NO MONEY.—30 DAYS' TRIAL
Special Wholesale Price Offer to User-Agents, Bank References and testimony of nearby Miraco users—sent with calalog.

**Electrify Any Radio with MIDWEST NO-BATTERY "A" "C" Light Socket Power Units**

"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Midwest Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed.

Mail Coupon Right Now

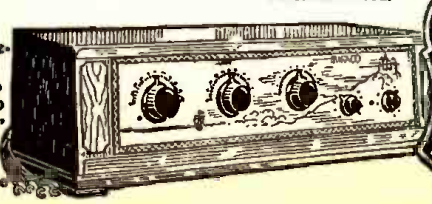
MIDWEST RADIO CORPORATION
*Pioneer Builders of Sets*
479-A Miraco Building, Cincinnati, Ohio.

THIS COUPON IS NOT AN ORDER

Without obligation, send free catalog, AMAZING SPECIAL OFFER, testimony of nearby Miraco users.

NAME

ADDRESS



Amazing value as 30 Days' Trial Will Prove

**6 tube Super $36.75 RETAIL LIST**

# Trickle charge or full-rate charge—

## *You get either or both with*

# Westinghouse Rectigon Battery Charger

YOUR battery needs two kinds of charging!

Under ordinary conditions, a low-rate charge, "trickled in" during the hours that the set is idle, will keep the battery full of pep. Then, for occasions when prolonged use of the set drains more power than trickle chargers can replace, you need a high-rate charge. The Westinghouse Rectigon gives you *both kinds of charging*. Rectigon charges at a high rate and at a low rate—and it charges wet "B" as well as automobile batteries.

~~$18.00~~

*Now*

**$14.00**

Rectigon is a Westinghouse product—and you know Westinghouse knows radio. Back in 1920, the first program ever broadcast came from radio station KDKA. Rectigon is safe—uses no acids or chemicals. Long-lived, with no moving parts to break or wear out. Does no harm if you tune in while charging, nor if the light company turns off the power while Rectigon is in the circuit. Get away from charging station expense with Rectigon Home Charger. At your dealer's, now $14.00.

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

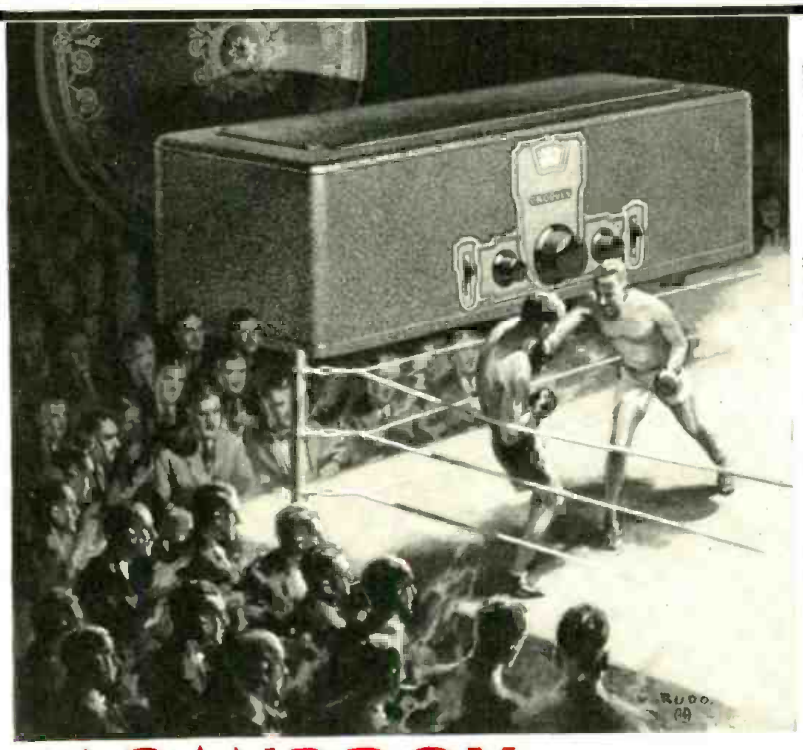
For trickle charging only—the long-lived little Rectox. No guesswork, no acids or chemicals, no trouble. Leave Rectox permanently on charge and replace during "silent hours" the power used during average "operating hours." Two rates of charge—½ ampere and ¾ ampere. At most dealers', $11.50.

See the Westinghouse exhibit of Rectigons, Radio Instruments, and Micarta Radio Panels at the Sixth Annual Radio Show, Coliseum, Chicago, October 10th to 16th, inclusive: Booth I, Section AA.

W WESTINGHOUSE ELECTRIC

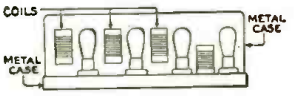
—when the crown stands or falls....

# "— You're *there* with a Crosley ..."



The Crosley Radio Corporation:
Folks who buy radio are vitally intereated in what they get for their money. Why don't you radio manufacturers stop talking like a lot of doctors and tell us what it's all about in one cylinder words! What's this "shielding" business anyway?
Yours truly
Belknap Hdwe. & Mfg. Co.
Louisville, Ky.

Shielding is necessary in a modern radio receiver. The more sensitive the set is, the more you need it. Some sets are merely




housed in a metal case. This helps to keep strong local signals from breaking through, but it is even more important to keep them where they belong after you get them the proper way from the antenna.

A set has tubes, condensers and coils. Here is a coil. The lines around it are the magnetic field. You know the earth's magnetic field will work a compass down in a mine, or up in a plane (it certainly worked for Lindbergh) and the fields around unshielded coils get all mixed up and the set howls and squeals and has to be choked off by turning down the filaments in the tubes.

Now if the coils are housed in copper shields the fields can't mess each other up, and the tubes can do a real job of amplifying. The coils in Crosley sets have these copper shields, and there isn't anything better.


Then there are the condensers, and if it wasn't for the shield around them, the fields would act like those in the coils, and the results


would be just as bad, or worse. It isn't enough to shield the coils and the condensers, because even the wiring of the set has fields around it. This too is shielded, as it is in all really high grade sets.


Of course, it's all in knowing how to do it, but that's why Crosley sets can be as good as the best without costing half as much.


CONDENSERS PROPERLY HOUSED

## The BANDBOX

### A 6 Tube Receiver *of* unmatchable quality at $55

Many features of this set have been found heretofore only in the most expensive radio. Since Crosley is licensed to manufacture under nearly all important radio patents, this combination with Crosley leadership and experience, naturally produced an amazing radio, the remarkable value of which can be judged by the following features incorporated and by seeing it and hearing it at your dealers.

1. Completely shielded coils, condensers and wiring. 2. Acuminators for sharper tuning. 3. Completely balanced genuine neutrodyne. 4. Volume control. 5. Single tuning knob. 6. Illuminated dial. 7. Single cable outside connections. 8. Designed for easy installation in consoles. 9. Beautiful frosted brown crystalline finished cabinet.

AC model using new R.C.A. AC tubes and working directly from electric light socket through Crosley Power Converter is $65. Power Converter $60 extra.

Hear this wonderful new contribution to the enjoyment of radio. If you cannot find one of the 16,000 Crosley dealers near you, write Dept. 16 for his name and literature.

*Crosley is licensed to manufacture under licenses of the Radio Corporation of America and associate companies, also The Hazeltine Corporation and Latour Corporation.*

*APPROVED CONSOLES*

*Selected by Powel Crosley, Jr., as ideal, acoustically and mechanically for the installation of the Crosley "Bandbox" Genuine Musicone built in. Crosley dealers secure them from their jobbers through*

*H. T. ROBERTS CO.*
*914 S. Michigan Ave., Chicago, Ill.*

*Sales Agents for Approved Console Factories*
*Showers Brothers Co.*
*The Wolf Mfg. Industries*

$35

$65

$85

*IMPROVED MUSICONES*

*Musicones improve the reception of any radio set. They are perfect affinities in beauty and reproductive effectiveness for Crosley Radios. A tilt-table model, with brown mahogany finish, stands 36 inches high, $27.50—16-inch Super-Musicone as pictured above with "Bandbox", $12.75—12-inch Ultra-Musicone, $9.75*

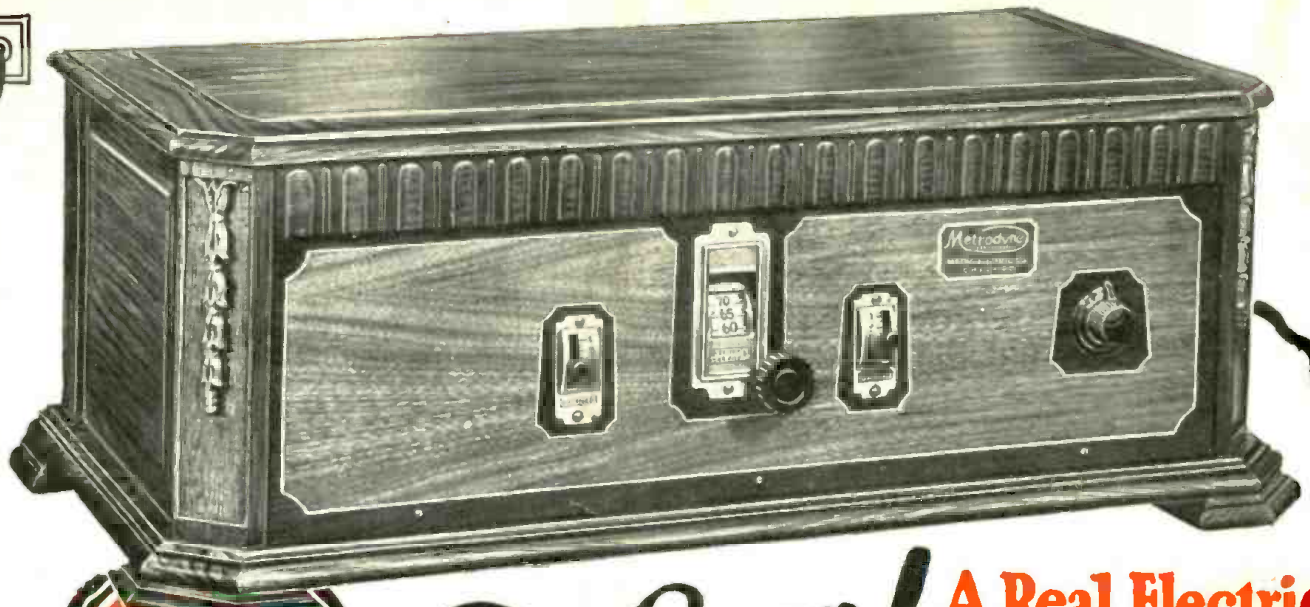
# CROSLEY RADIO

NEUTRODYNE

*The Crosley Radio Corporation, Powel Crosley, Jr., Pres., Cincinnati, Ohio.*

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

*Prices slightly higher west of the Rocky Mountains*



# 30 Days Free Trial

# Now! A Real Electric Radio Set

**Three Year Guarantee**

**Shipped direct from our factory at rock bottom prices—cost less than most battery sets**

**No Batteries, Chargers or Eliminators**

**No Acids; No Liquids—Plug In—Press Button—"Tune In"**

# Metrodyne

## ALL ELECTRIC RADIO

**AGENTS! DEALERS! BIG PROFITS!**

**Make big money taking orders for Metrodynes. All or part time. Metrodyne All Electric Radios are in a class by themselves. Unequalled for quality, performance and price. Demonstrate at home and take orders. Lowest wholesale prices. Your demonstrating set on 30 days' free trial. Mail coupon below for details.**

## 7 Tubes—Single Dial Set

### 100% Electric Radio

At last! The radio you've dreamed about! If you have electricity in your home you can now really enjoy coast to coast radio reception without the care, bother and muss of batteries, chargers, eliminators, etc. The Metrodyne All Electric is a real, genuine batteryless radio set. Simply insert the plug in the socket, press the switch button and "tune in." You could not possibly buy a better radio set than the Metrodyne All Electric, no matter what price you paid.

### BEAUTY—EFFICIENCY DEPENDABILITY

The Metrodyne All Electric Radio is a 7 tube, single dial set. Only the highest quality low loss parts are used throughout. Solid walnut cabinet, beautiful two-tone effect, with handsome gilt metal trimmings. Size of cabinet, 28 inches long, 13 inches deep, 10 inches high. Has electrically lighted dial so that you can log stations in the dark. Only one dial to tune in all stations. Excellent tone qualities—wonderful volume—very selective.

**Gorgeous Console Electric Radio**

Here is the Metrodyne All Electric Console Radio—a gorgeous, genuine walnut cabinet, in a beautiful two-tone finish. Has a built-in genuine Metro-Cone large size speaker. Brings in programs with great volume, reproducing the entire range from the lowest to the highest notes with remarkable clearness and distinction. All metal parts are finished in old gold. Wonderful electric radio, in a cabinet that will beautify the appearance of any home.

## Costs Less Than Most Battery Sets

Do not confuse the Metrodyne electric radio with ordinary light socket sets, because the Metrodyne is truly an all electric radio—consumes less than 2c worth of power a day. Comes to you direct from the factory. Its low cost brings it down to the price of an ordinary battery set. We are so confident that you will be delighted with this wonderful, easy-to-operate batteryless radio that we offer to ship it to your home for thirty days' free trial—you to be the judge.

## Mail This Coupon

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal 30 days' free trial offer, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis—**WRITE TODAY!**

**METRO ELECTRIC COMPANY**

**2165 N. California Ave. Dept. 611 Chicago, Illinois**

**METRO ELECTRIC COMPANY**
**2165 N. California Ave., Dept. 611**
**Chicago, Illinois**

Gentlemen:
Send me full particulars about Metrodyne All Electric Radio and your **thirty days' free trial offer.**

Name _____

Address _____

If you are interested in AGENT'S proposition place an "X" in the square ☐

**MAIL COUPON NOW!**

QUADRI-COLOR CO., JAMAICA, N.Y.C.