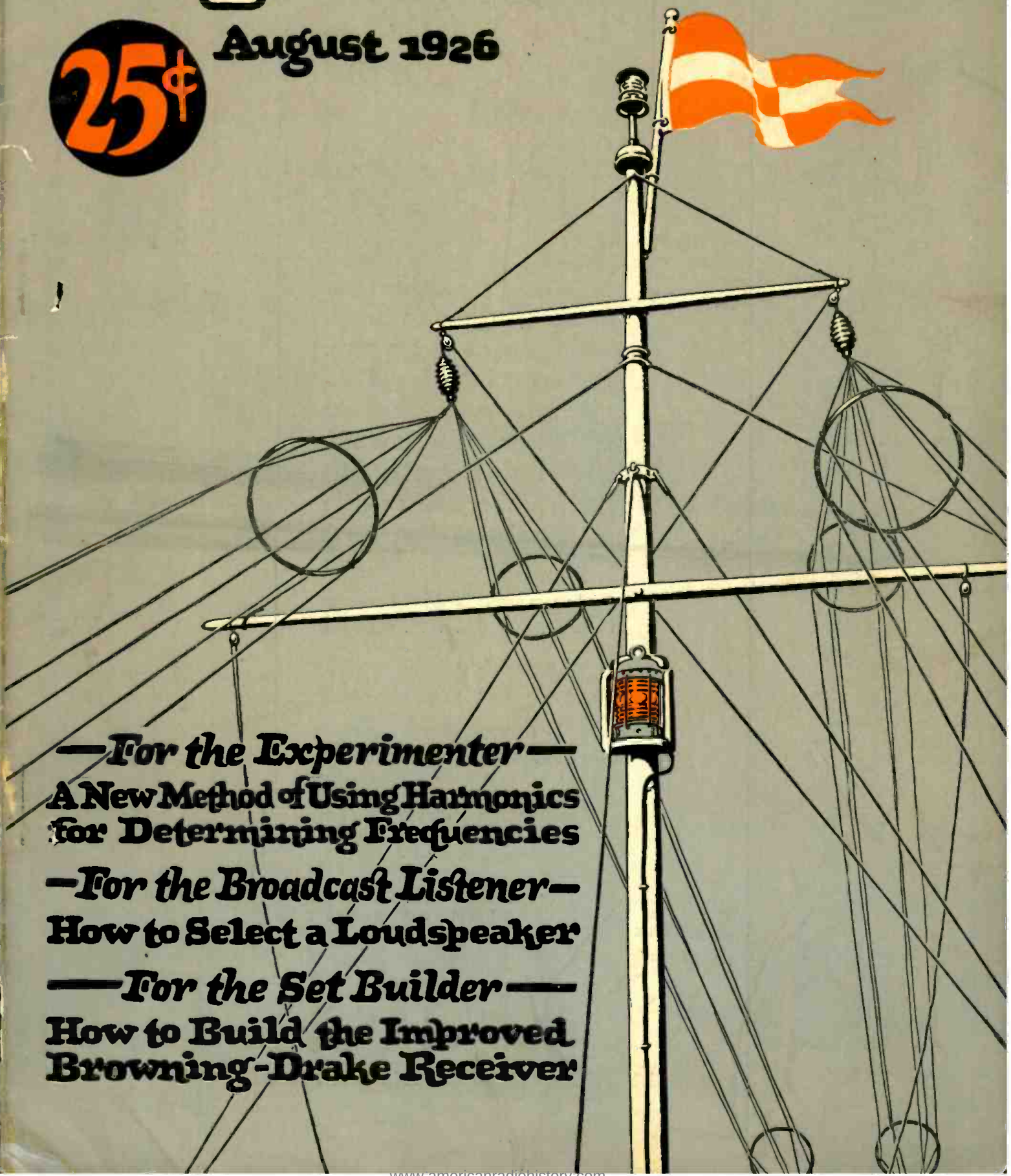
Popular Radio

25¢

August 1926



—For the Experimenter—

A New Method of Using Harmonics for Determining Frequencies

—For the Broadcast Listener—

How to Select a Loudspeaker

—For the Set Builder—

How to Build the Improved Browning-Drake Receiver

the power Radiotrons give volume clearly

With any number of tubes, it is generally the last one that stands the strain when the volume is turned up too high. It blasts and chokes and distorts the tone. But the power Radiotrons are made to stand all the strain at that last-tube position. They make possible greater volume—finer, clearer tone.

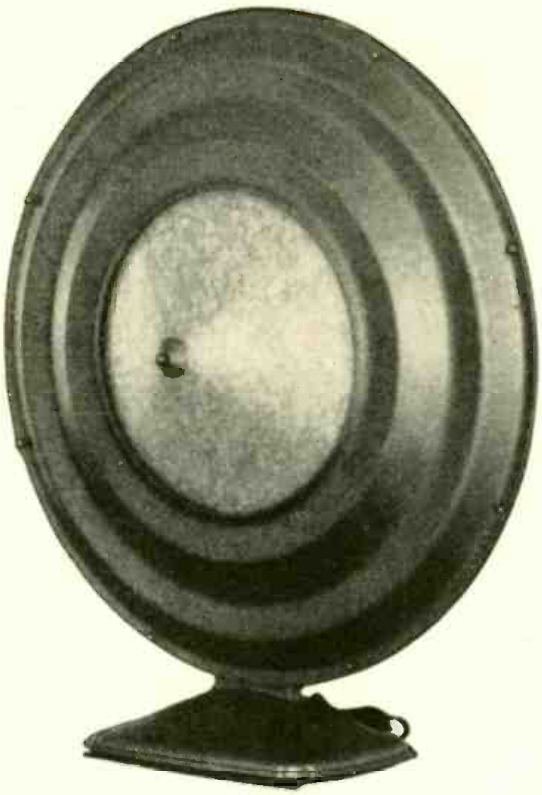
Dry battery power Radiotron UX-120	$2.50
Storage battery power Radiotron UX-112	$6.50
Storage battery or A.C. power Radiotron UX-171 . .	$6.00
Storage battery or A.C. super-power Radiotron UX-210 .	$9.00

Research is an important part of RCA business. In transoceanic wireless—and in the tiniest detail of vacuum tube making—RCA continually offers the world new developments in radio. Be sure *all* your tubes are genuine RCA Radiotrons! And keep a spare handy.

RADIO CORPORATION OF AMERICA
NEW YORK CHICAGO SAN FRANCISCO

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA



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A New Brandes Cone

for $12.50

THE latest Brandes achievement. Unusual performance at half the usual price. Wonderful tonal qualities, including the low tones, hitherto difficult. To hear this remarkable cone is to wonder at its very low price. Just hear it—you will be delighted.

Beautiful in appearance, too. Antique bronze finish. Adjustable. Fifteen inches in diameter.

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Brandes

means the ultimate in reproduction

Popular Radio

EDITED *by* KENDALL BANNING

FOUNDED 1911

VOLUME X August, 1926 NUMBER 4

CONTENTS

(Cover design by Frank B. Masters)

DEPARTMENTS

VOLUME X AUGUST, 1926 NUMBER 4

Published monthly by Popular Radio, Inc., 627 West 43rd St., New York, N. Y., telephone number, Chickering 1906; Douglas H. Cooke, President and Treasurer; Kendall Banning, Vice-President; Laurence M. Cockaday, Secretary; Joseph T. Cooney, 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. *For advertising rates address* E. R. Crowe & Company, Inc., 25 Vanderbilt Ave., N. Y., or 225 North Michigan Ave., Chicago. Printed in U. S. A.

E. E. FREE, Ph.D., *Contributing Editor* LAURENCE M. COCKADAY, *Technical Editor* JOHN V. L. HOGAN, *Contributing Editor*

Steady "B" power without batteries

Pure full tone is possible only with "B" voltage kept constantly *up to standard;* All-American "Constant-B" *gives it to you*

YOU'VE had your "B" battery troubles; everybody has. Here's a permanent end to them—install an All-American "Constant-B," attach it to a light socket, and turn on the switch. You get a dependable, permanent supply of uniform, constant plate current; insuring full, pure tone.

There's no acid to ruin things; no annoying hum. And all inside units are permanently sealed against atmospheric conditions.

"Constant-B" has taps for 135, 90 and 67½ volts; and a 10 to 60 volt tap varied in output by a "Detector" control.

PRICE $37.50 *Complete with Raytheon Tube*

The "High-low" switch insures uniform voltage, regardless of the number of tubes used; "Low" for 2 to 5 tube sets, "High" for sets with 6 tubes or more.

"Constant-B," after passing the highest laboratory tests, carries the seal of approval of the Popular Science Institute of Standards and other testing laboratories. It measures up in every way to All-American's high standards of painstaking workmanship and satisfying performance.

Descriptive folder and interesting booklet showing how to build a "B" Power Supply similar to "Constant-B" sent free on request. Specify bulletin B-82.

ALL-AMERICAN RADIO CORPORATION
4207 BELMONT AVE., CHICAGO, U. S. A.

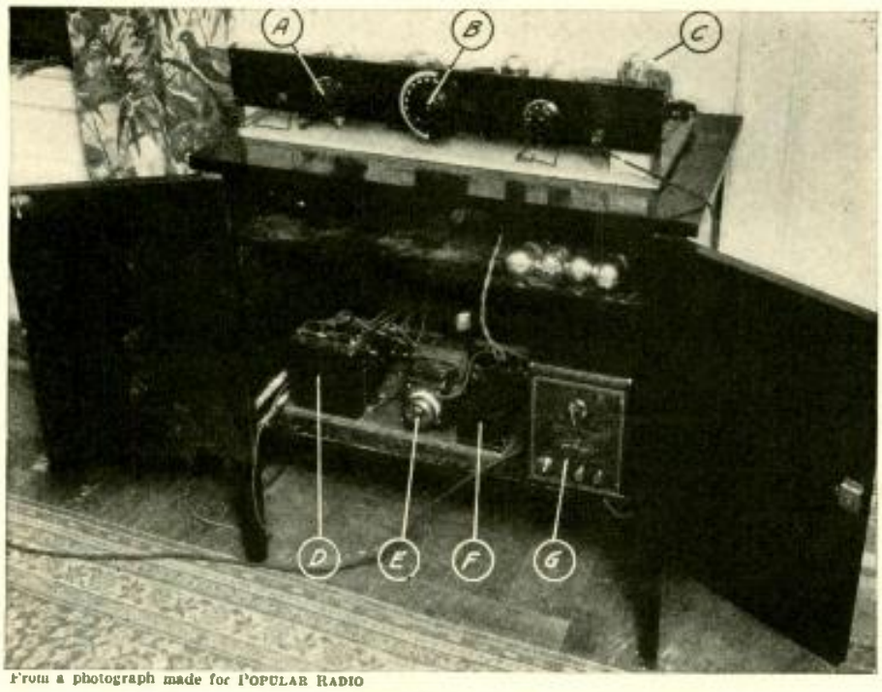
Station WENR—*266 Meters—is owned and operated by the All-American Radio Corporation*

Tune them out and KEEP *them out with* Filtrola STATION ELIMINATOR

This attractive compact unit, complete in itself, makes it a simple matter to tune out interfering stations you don't want—even the most powerful. No tubes, batteries or other units to install. A typical All-American product in its precision and quality of workmanship.

Price $15

A PAGE WITH THE EDITOR



From a photograph made for POPULAR RADIO

AN EARLY EXPERIMENTAL MODEL OF THE NEW LC-27

This was one of the first models of the new set to work without batteries of any kind. A is the resonator for the antenna, B, the main tuning dial, C, the large power tube and D, the filter for the "B" and "C" currents. E is the transformer that furnishes the energy from the lighting lines, F, the automatic relay that causes the whole set to turn "on" and "off" with one switch and G, the unit that transforms energy from an alternating current to a direct current for lighting the filaments of the first four tubes. The last tube uses alternating current for the filament circuit.

JUST a few days before these paragraphs were written, the publisher of POPULAR RADIO invited a group of eight friends to his home in New Rochelle, New York, to hear the first demonstration of the new LC-27 Receiver to be given to others than the staff of this magazine.

* *

THESE eight guests were all experienced radio fans; some of them not only owned several receivers but had built sets themselves. And all of them were business men. Two were bankers, two were manufacturers, one was a wholesaler, one a publisher, one a stock broker and one was a retired capitalist.

* *

THE purpose was to get the frank, unbiased, but intelligent opinions of men truely representative of the general radio public on this new set, operated under typical home conditions, rather than that of experts testing under laboratory conditions. The test was drastic to an extreme.

* *

THE Technical Editor of POPULAR RADIO tuned in on the laboratory model of his new development, the LC-27—obtaining the necessary electricity by simply plugging in on the ordinary AC electric light circuit, without the aid of any batteries at all.

* *

THE demonstration lasted two hours. At the end of that period every one of the eight guests volunteered the information—and volunteered it with genuine enthusiasm—that the LC-27 furnished the best radio reception they had ever heard. There was no exception.

* *

THIS remarkable new receiver, which is still in course of development by the POPULAR RADIO LABORATORY, will be announced at greater length in the September number of this magazine. And it will be described in complete detail, with full specifications, in the October issue.

* *

IN the meantime the general character of the LC-27 may be summarized as follows:

* *

1. It operates from the alternating current house-lighting line;
2. It requires no "A," "B" or "C" batteries;
3. It uses three UX-201-a tubes; one UX-200-2 tube and one UX-210 power tube;
4. It may be used with batteries if desired;
5. It tunes from 200 to 550 meters;
6. It utilizes simplified control;
7. It is non-regenerative;
8. It contains a non-distorting power amplifier;
9. It utilizes a higher ratio of inductance to capacity than heretofore used for tuning;
10. It has adequate selectivity for elimination of interference;
11. It is not too selective, so that side bands are not skimped;
12. It may be used with any type of antenna;
13. It may be used without any antenna at all;
14. It is equipped with non-distorting volume control, so that signals may be cut down to a whisper;
15. It produces enough volume, without distortion, to fill a large hall;
16. It is of such high sensitivity as to produce good volume on distance reception;
17. It causes no squeals, howls or radiation.

* *

IN Dr. Norman Thomas' article on "Radio Censorship" on page 335 of this number of POPULAR RADIO the author quotes Mr. Donald Flamm who, while connected with WMCA, withdrew the invitation to Dr. Thomas to broadcast from that station. When the Editor showed the proof of this article to Mr. Flamm he replied in part as follows:

* *

"I was at all times a guest of WMCA. The people whom I invited to WMCA were, in turn, my guests. To invite a guest who is likely to prove embarrassing to your host is a violation of the ethical code.

* *

"DR. THOMAS presented me with a copy of his proposed talk. When I had the chance to read it, I realized that the guest I had selected might prove to be an embarrassing one, and that it was my duty to consult my host, Mr. Gilliam, the director of WMCA.

* *

"MR. GILLIAM suggested that I ask Dr. Thomas to defer his talk until both sides of the subject he proposed to talk upon could be presented in the form of a debate. Dr. Thomas insisted upon setting a definite date for the debate, but that was impossible as we did not know at the moment whom we could get to represent the other side. . . .

* *

"DR. THOMAS has stated on several occasions that the 'controversial nature' excuse is always used by broadcasting stations whenever they want to bar radical speakers. This does not coincide with my experience. In proof, I need only point to my introduction to the radio audience of Mr. Urbaine Ledoux, better known as 'Mr. Zero,' one of the most radical speakers of our day. . . . "

Kendall Banning

Editor, POPULAR RADIO

Dubilier Condenser
Type 901

Buy condensers *this way*—

IT is the *working* voltage that determines the life and efficiency of the condensers you use. Buy "working voltage" as well as capacity.

ALL DUBILIER CONDENSERS are clearly marked with their recommended maximum D. C. *working* voltage. This tells you exactly what voltage your condensers will stand in continuous service.

The new DUBILIER CONDENSERS—Types 901, 902 and 903 may be used for any purpose where the potential at *continuous operation* does not exceed their rated working voltages of 160, 400 and 600 volts D.C. respectively. Each type may be obtained in 1, 2, 4 and 6 mfd. sizes at prices ranging from $1.50 to $13.50.

Look for the DUBILIER name and the rated working voltage on the condensers you buy for battery eliminators, power amplifiers and receivers.

Dubilier

CONDENSER AND RADIO CORPORATION

"My wife insists on getting a radio set exactly like yours. Where did you get it?"

"THE Radio Shop put it in for me, Jim. I've never had anything that was less trouble or expense, or that gave us all so much pleasure. We don't see how we ever got along without it."

"How about batteries? I've heard you have to give them a lot of attention."

"Not if you get good ones, Jim. The service man from The Radio Shop who installed my set said that the Evereadys he was supplying were exactly the right size for the receiver and should last eight months or longer. I've had the set six months now, and as far as I can tell, the 'B' batteries are as good as new."

That's the experience of those who follow these simple rules in choosing the right "B" batteries for their receivers:

On all but single tube sets—connect a "C" battery. The length of service given here is based on its use.*

On 1 to 3 tubes—Use Eveready No. 772. Listening in on the average of 2 hours daily, it will last a year or more.

On 4 or more tubes — Use the Heavy-Duty "B" Batteries, either No. 770 or the even longer-lived Eveready Layerbilt No. 486. Used on the average of 2 hours daily, these will last 8 months or longer.

Follow these rules and you, too, will find that Eveready Radio Batteries offer a most economical, reliable and satisfactory source of radio power. How long they last, of course, depends on usage; so if you listen less you can count on their lasting longer, and if you listen more, they will not last quite so long.

Send for booklet, "Choosing and Using the Right Radio Batteries," sent free on request. There is an Eveready dealer nearby.

LEFT—*No. 486, for 4, 5 or more tubes,* $5.50.

RIGHT—*Eveready Dry Cell Radio "A" Battery, 1½ volts.*

EVEREADY
Radio Batteries
-they last longer

*NOTE: A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed by any competent radio service man to permit the use of a "C" battery.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
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Toronto, Ontario

Tuesday night means Eveready Hour — 8 P.M., Eastern Standard Time, through the following stations:

WEAF—*New York*
WJAR—*Providence*
WEEI—*Boston*
WTAG—*Worcester*
WFI—*Philadelphia*
WGR—*Buffalo*
WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WTAM—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
WCCO { *Minneapolis* / *St. Paul*
KSD—*St. Louis*

From a photograph by Foto Topics of Mr. David Loewe (left) and Dr. Lee De Forest

What Popular Radio Has Done for the Radio Industry

"POPULAR RADIO has consistently and courageously upheld the best engineering practices and the soundest scientific principles in radio, advocated the use of only the most approved of radio apparatus, contributed materially to the development of the radio art, and in many other ways assumed a leading part on the building up of the industry. For this invaluable service the gratitude of both the radio public and the radio industry is due."

David L. Loewe

Central Press

Radio Invades the Realm of Phrenology

That character can be read from the bumps or hollows on the human head is a form of quackery that has thriven for generations. Now it has drawn radio to its aid. The apparatus shown above is ascribed to a Ukrainian physician, Dr. Bissky. The electrode, held in Dr. Bissky's hand, is touched in succession to a series of points on the head of the subject; at each touch, a sound is heard in the telephones. The loudness of this sound indicates the completeness with which the subject possesses the "generosity" or "laziness" or what-not, corresponding to the particular spot touched on the head. As usual, the arrangements of the circuits and apparatus are not disclosed, but probably no radio fan would encounter difficulty in constructing an oscillating circuit which would howl pleasantly if used as Dr. Bissky describes.

Popular Radio

VOLUME X August, 1926 NUMBER IV

The QUACK DOCTORS of RADIO

To the edges of every science there clings a fringe of fakers who seek to capitalize the popularity of science to delude and defraud the inexperienced. Innumerable medical and financial quacks have claimed the benefit of radio science in their foolery. POPULAR RADIO believes that it is a duty both to radio and to the public to help expose this radio quackery; to this end it asked Dr. Free to prepare a series of two articles of which this is the first.

By E. E. FREE, Ph.D.

THE human mind delights to believe something that is "marvelous." Barnum said that the people like to be fooled. He might have gone farther. They like still more to be fooled scientifically. There is no scientific theory, no matter how utterly unbelievable, but that it has commanded the support and advocacy of someone—usually of many someones.

Quacks and fakers exist everywhere, but there are more of them on the fringes of science than anywhere else.

Radio has been an especially fertile field for quackery. Radio itself is so marvelous, so utterly unbelievable until one has grown used to it, that almost any extension of its realities seems reasonable. When one really can sit down at an instrument and listen to someone who is talking a thousand miles away it seems equally easy to believe that one might listen to the inhabitants of Mars or even to the spirits of men long dead. Quacks have not overlooked this opportunity. From the earliest days of radio there have been fakers who used its apparatus and its terminology to impress their victims and to extract money from the unwary.

The Great Electronic Reactions Fake Devised by Dr. Abrams

An example is the great Abrams fake, a piece of quackery which fooled many and which is still by no means dead, although its inventor is.

Dr. Albert Abrams was a physician of San Francisco, a skillful and well educated man, for years a well-known and reasonably respected practitioner of orthodox medicine. About ten years ago Dr. Abrams fell from the grace of orthodoxy. He evidently read a book on the electron theory, which was just then being formulated. He imbibed the words of this book, as a drunkard imbibes alcohol. Immediately he began to emit their aroma. Already he had invented a medical procedure called "spondylotherapy," which seems to have been a method of diagnosis by feeling the spine with the fingers. This word was a good one but the doctor found one that suited him better. He invented what he called his "electronic reactions."

These mysterious reactions were a combination of electronic forces with a still more mysterious variety of radio waves, a variety so mysterious that it never even acquired a name. The Abrams procedure of diagnosis made use of two electric machines like ordinary resistance boxes, which, indeed, is exactly what they were. Together with these boxes there was a kind of fixed condenser, some wire and a human body. The human body was called the "subject." It was on the bared abdomen of this subject that the "reactions" were made apparent.

A drop of blood was taken from the patient, placed on a bit of filter paper or blotting paper and inserted between the plates of the fixed condenser. The terminals of the circuit were connected to the subject. Sometimes only one terminal was connected, the other one being left free in the air. The switches or plugs of the resistance boxes were

set at specified values. Hard spots were then supposed to appear on the abdomen of the subject.

These spots indicated, by their appearance and position, whether the blood sample contained the indications of this or that disease.

The connection of all this with radio appeared in the explanation. It was said that each disease gave off or possessed—Dr. Abrams was never very clear about this—certain varieties of electrons. These electrons had definite emanations, apparently conceived as some variety of ether waves. These waves, quite analogous to radio waves, were supposed to follow the wire, pass through the resistance boxes and affect the stomach of the subject.

To any experienced radio man this was the completest nonsense. For one thing, there was no source of energy in the circuit, unless it be supposed to be supplied by the human subject. The metallic circuit was not complete. The resistance boxes, which were supposed to determine which "electronic" influence was operating, altered the "circuit" in ohmic resistance only, not in any factor which would have affected radio waves even had they been present. And finally, it was shown by innumerable tests that no perceptible electric energy of any kind was flowing in the wires of the apparatus. The only real element of radio in the Abrams procedure was in the words.

For a time the Abrams fake commanded the interest of many honest men. Among so many modern marvels anything *might* have merit. A number of reputable practitioners took it up. It was seriously investigated by a score or more of scientific and medical agencies. The result was its complete exposure. It is possible that Dr. Abrams was a fool rather than a knave. Be this as it may, he was not a discoverer. He invented nothing but words.

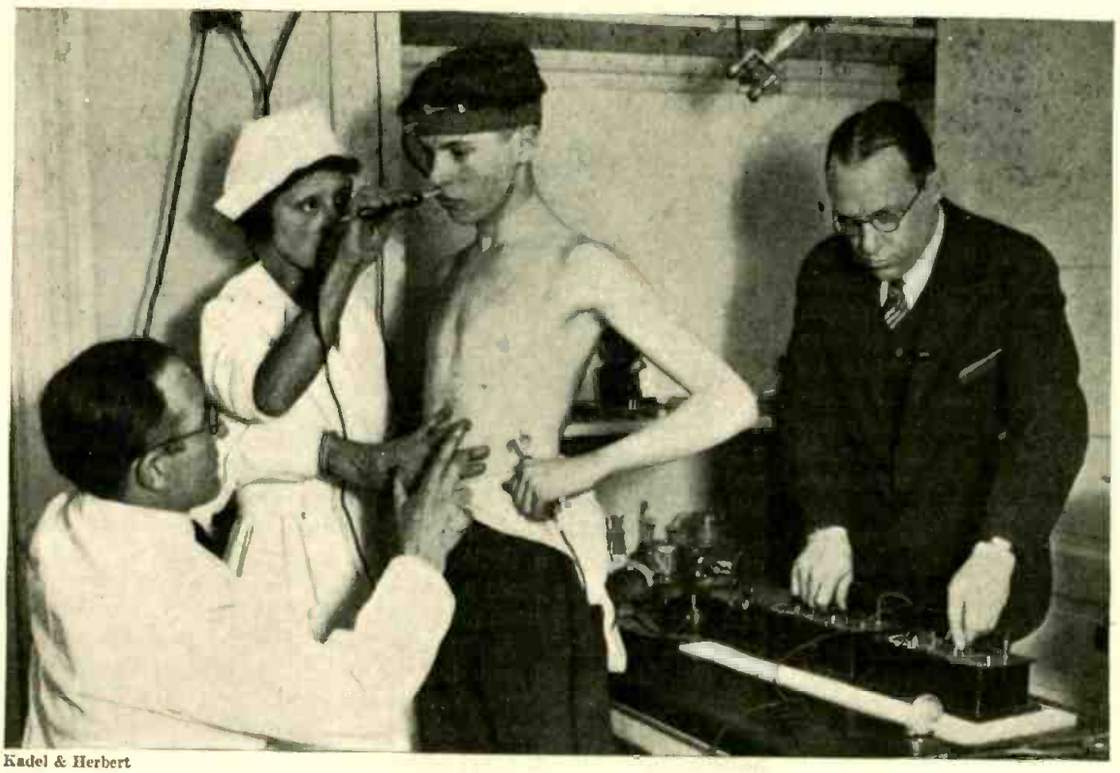
The Wonders of "Chromotherapy" for Curing Ills

With the death of Dr. Abrams some two years ago his cult declined but it has left a brood of successors. One of these is what is called "chromotherapy."

This, too, makes use of the terminology of science, especially of radio science. Its basic principle is that light rays of different colors, as well as other forms of ether-wave radiation, control the human body and all its humors and diseases. For some diseases the patient is advised to bathe his body in green light, for others purple light is prescribed. Some practitioners go so far as to consider the light bath unnecessary. All that one really needs to do, they say, is to *look* at the light of the proper color. Even a handkerchief of the correct hue, taken out and flecked once in a while before the eyes, may suffice. This last procedure, however, is frowned upon by the majority of the chromotherapists. It is too easy, perhaps for a patient to give this treatment to himself. An expensive lamp in a properly impressive office, full of electrical gadgets, is to be preferred. It is more profitable.

These chromotherapists have made good use of a radio dictionary. Prospective patients are assured that each disease has its peculiar "spectral frequency." This can be attacked by "chromatic interference." A proper "resonance" of the disease and the outside application is necessary. The light rays are "amplified" by passing through the color filter. Just how a ray can be "amplified" by a process which actually reduces its total intensity is not explained.

Perhaps the greatest sin of the chromotherapists is that they have borrowed, without any warrant whatsoever, the



Kadel & Herbert

What an Abrams Diagnostic Outfit Looked Like

Here is the "subject" on whose abdomen the "reactions" are being felt by the diagnostician. The assistant at the right is operating the pair of resistance boxes; the small round box at the left of the resistance boxes is the fixed condenser between the plates of which the sample of blood is inserted. One electrode is applied to the subject's forehead, but usually does not touch the skin; the other electrode is held by the subject against his side. The third electrode, which the nurse is applying to the subject's lip is not a usual part of the Abrams technique. Permanent magnets are placed in certain positions on the floor, yellow light is to be avoided, and there are many other detailed requirements, many of which are different for every two practitioners of the cult.

real truth that lies in the use of sunlight, of the heat rays and of ultraviolet light. These varieties of ether waves are well known to have effects on the human body, some of them beneficial. Sunlight has been a familiar curative agent for many generations of mankind. The newer ultraviolet rays, produced by mercury vapor lamps burning in tubes of fused quartz, have been found beneficial in certain cases and are in daily use by many physicians.

All this, as well as the proved facts of radio, the chromotherapy fakers have turned to account. It is too severe, perhaps, to call all of them fakers, for some, undoubtedly, are honestly deceived, equally deluded with their patients. For their methods, however, we can have no kind words. To imagine that the tint of a colored lamp will frighten off the germs of disease is as foolish as it would be to believe that actors turn into heroes or into villains when they assume their coats of grease paint.

The dangerous aspect of all these pretended "scientific" curative cults is not only that they take money uselessly from their victims but even more that they may delay and impede the treatment of some really dangerous disease. With people who merely imagine that they are sick—said to be more than half of the persons who consult physicians—it does not matter a great deal whether they receive encouragement and a tonic from their own orthodox physician or whether they are "cured" by a dose of rays having the latest fashionable shade. In either case the cure —like the disease—is a mental one.

But it is different with persons who are suffering from an acute germ infection or from some real affliction like cancer or tuberculosis. It is a part of the duty of every radio expert, I submit, to tell such persons the truth about "electrons" and "radiations" and the other words so glibly misused by the quacks. The flavor of science is an impressive flavor. It is an obligation of the radio public and of others who really understand these words to see that this flavor is not used to mask things that are really social poisons.

The Harpies Who Employ Radio for "Communing with the Dead"

Outside the field of health and medicine radio has provided other opportunities for quackery. One of the most despicable is that of the harpies who prey on the desires of those recently bereaved. It is natural for the human mind to seek comfort, to wish to be assured that loved ones who have died are still alive somewhere, still to be met in the hereafter. This has provided, for centuries, an opportunity for fake spiritualists, for fortune tellers and for a thousand other types of what I might call "spiritual quacks," to distinguish them from the medical quacks.

Raffalovich, Paris

Applying the Mysterious "Radiation Preventer"

A chemical nostrum, recently exploited in France, was applied to the skin in order to prevent the escape of some mysterious "radiation" from the body. This was supposed to conserve bodily strength. The crucial place to apply the material was said to be the back of the neck. An application here would frequently operate to prevent "radiation" from the entire body.

Radio has its share of these. One of the most frequent is the claim to be able to communicate with the dead by radio. Instances have turned up in a dozen cities in the past two years. Radio apparatus lends itself easily to such deception. It is not difficult to construct a receiver which is connected with no wires but which will speak, apparently by some mysterious influence. The "influence" is, of course, merely a low-powered transmitter in the next room. Thus the voices of the supposed dead have thrilled thousands of deluded listeners, a confederate at a peep-hole somewhere supplying the necessary voice. In one of the first issues of POPULAR RADIO, the distinguished magician Mr. Harry Houdini, described some of the fake devices invented for this purpose, devices in which radio plays an essential, although regrettable, part.

In spite of frequent exposure, these delusions continue. Only last September, a meeting of spiritualists in Paris proposed and instituted a scheme for the construction of radio receivers with which it was proposed to communicate with the dead. In April of this year, a spiritualist of Chicago exhibited a "radio box" to which three persons had to be attached to provide the necessary "force emanating from the organisms." When thus provided with the three living force-producers, the mysterious

box delivered itself of messages supposed to come from the land of the departed.

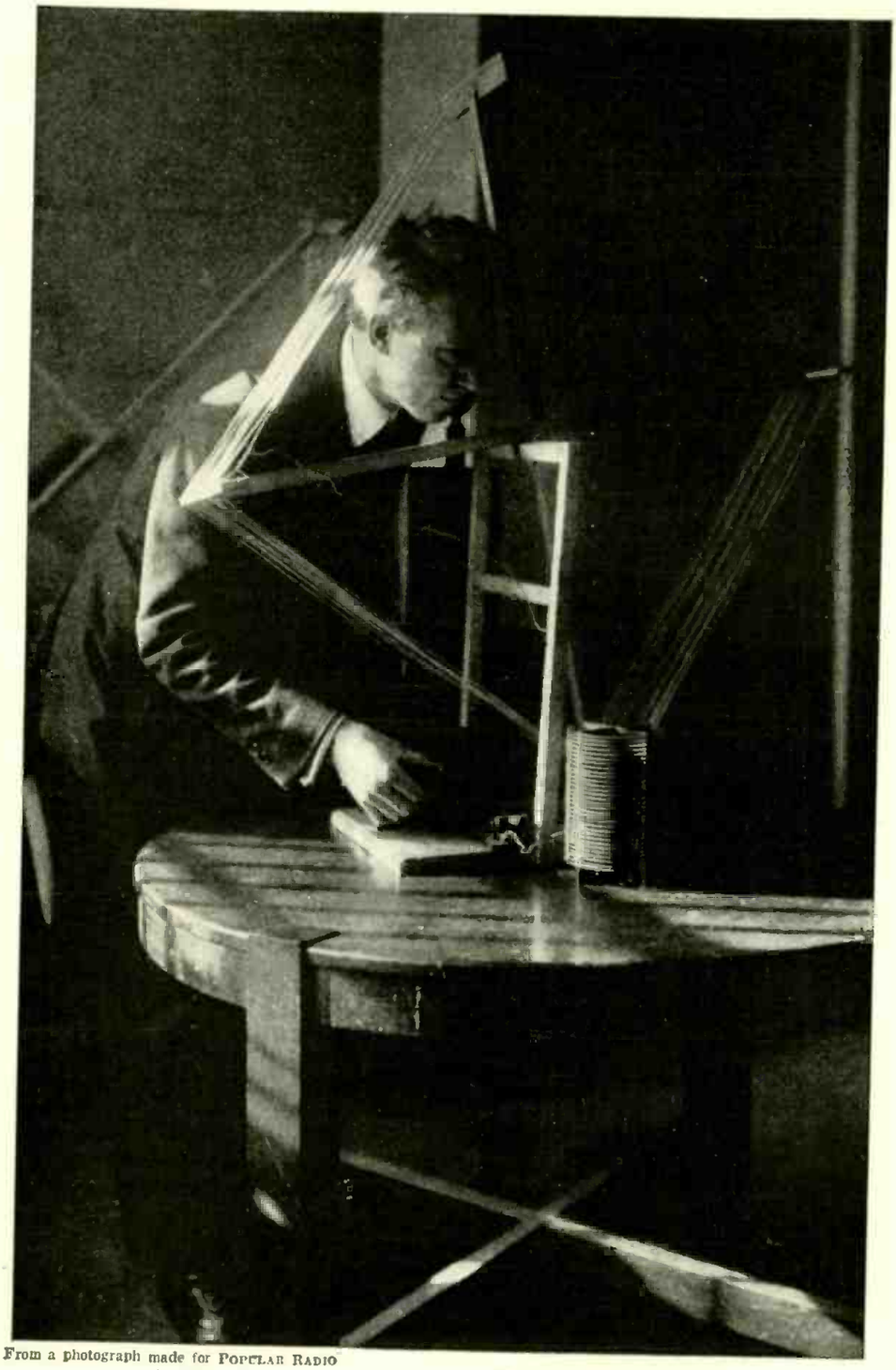
The radio scientist need not concern himself with the reality or non-reality of a spiritual existence. The thing he does need to consider is the use of these radio devices, and, as in the case of the health fakers, the use of radio terms and expressions, in order to prey upon the most sacred hopes of the human mind. Catching spirits for private profit is a despicable business at best. Let us not allow it to be done with a radio noose.

The Illusion of "Persecutions" by Radio Waves

Another delusion which has grown more and more prevalent since the introduction of broadcasting is that of persecution by means of radio waves. Many persons of feeble mentality have acquired the idea that radio waves sent out from the minds of evil individuals or even from the broadcasting stations are able in some mysterious way to cause illness or mental distress. I have been told by two persons, both obviously abnormal mentally, that the radio waves were "twisting" their internal organs. The real trouble, in both instances, was undoubtedly no more than plain old-fashioned indigestion. What the patients needed was a good digestive pill, not a radio expert.

In at least one instance which has come to my notice, this delusion was put to use by a faker to extract money from the victim. This quack encouraged the idea that the radio waves were doing internal harm. He prescribed a daily—and costly—treatment with his "radio opposer." Also he supplied some pills which tasted like bicarbonate of soda, and doubtless were nothing else. Of course, the patient recovered. The pills alone would have seen to that.

Such fakes are doubtless common. It is part of the duty of those who really know something about radio to see that such delusions are stopped, to teach the public that radio waves never caused internal "twistings" or any other disorder of the human body.



From a photograph made for POPULAR RADIO

A Radio Apparatus for "Spirit Messages"

Although some honest investigators have made experiments, the applications of radio to psychic matters have been mainly at the hands of the fakers and quacks. Trials honestly made have failed to detect the slightest evidence of psychic influences on radio reception.

Facts and Fancies Concerning the "Death Rays"

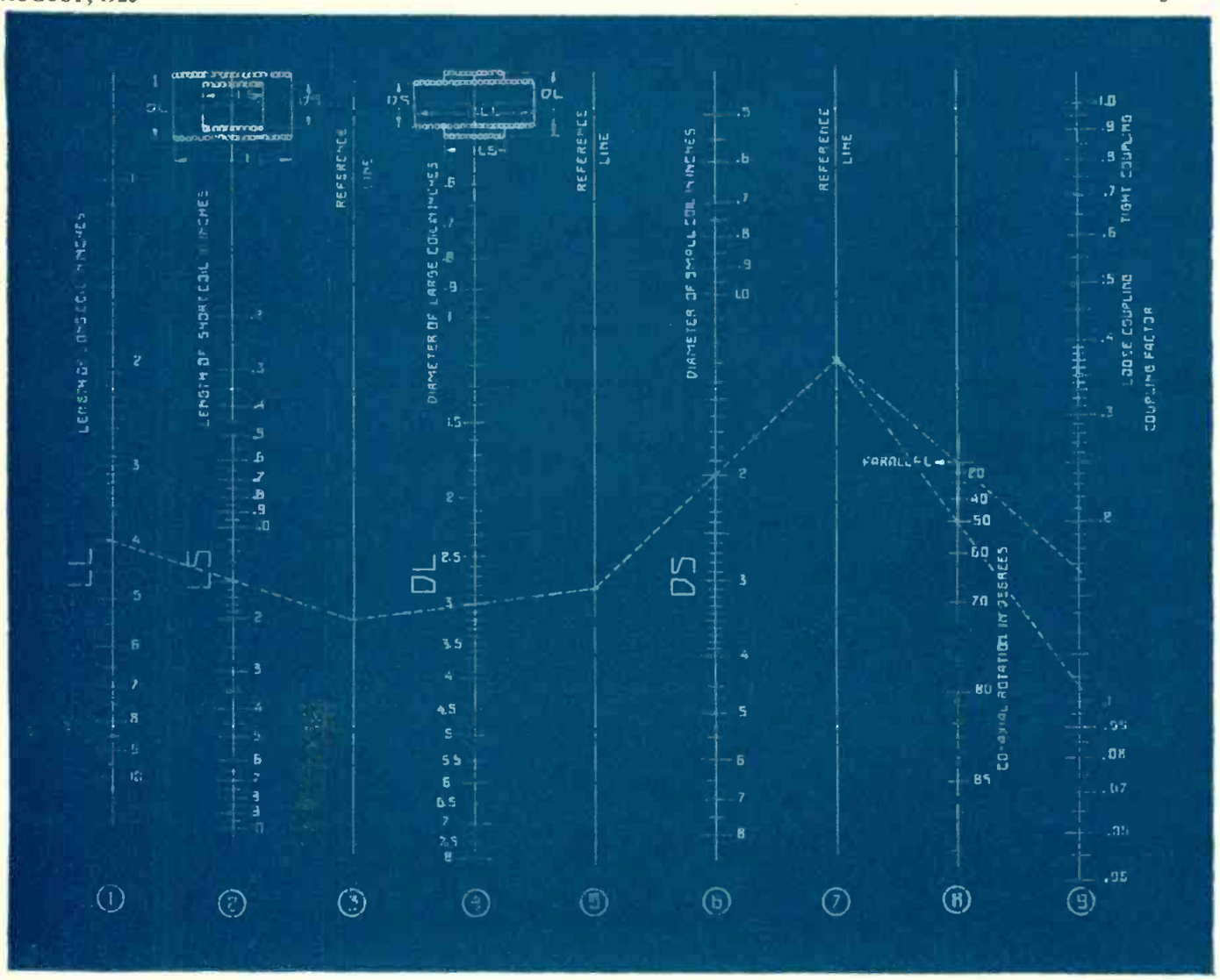
There was an epidemic of such delusions two years ago, after the publicity given to the supposed "death rays," rays said to operate by some radio principle. There do exist, of course, such things as violent electric discharges, some of them in the form of short-distance beams or rays. Dr. W. D. Coolidge, of the General Electric Company, has induced intense streams of electrons to leave the vacuum tubes in which they are produced and to come out for a few inches or even for a few feet into the air. This makes a "death ray" of a sort. Dr. Coolidge can kill a mouse with it. But it is a far cry from such laboratory experiments to the claims of inventors who propose to annihilate cities or to destroy armies by intense beams of destructive energy sent by radio or otherwise.

Still more nonsensical is the claim to be able to damage or annoy persons by "death rays" emanating from the eye of an evil adept in the art. This is no more, really, than the ancient fable of the mythical beast who could kill with one glance of its eye, or the less ancient belief in the "evil eye." Let us see to it that radio is not used any longer to support these long-exploded superstitions.

A Curious Nostrum for Preserving Strength by Reducing the Body's "Radiation"

A curious form of radiation fake turned up last year in France. This was a chemical supposed to be rubbed on

(*Continued on page 354*)



A MEASUREMENT CHART

FOR USE IN CALCULATING THE COUPLING FACTOR FOR CO-AXIAL AND CONCENTRIC COILS

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

THIS chart has been prepared to serve as an easy means for calculating the coupling factor for co-axial and concentric coils.

The mutual inductance of two coils follows the equation

$$M = K\sqrt{L_1 \times L_2} \quad \ldots\ldots 1)$$

in which M denotes the mutual inductance, L_1 and L_2 the self-inductance of the coils and K, the coupling factor.

If the coils are connected in series so that a variometer is formed the inductance will vary between

$$L = L_1 + L_2 + 2M \quad \ldots\ldots 2)$$

and $$L = L_1 + L_2 - 2M \quad \ldots\ldots 3)$$

according to the direction of the winding.

It is a somewhat difficult thing to estimate the coupling factor for various coils; but in some cases formulas are known which give a result that is exact enough for most practical purposes.

The coupling factor for co-axial and concentric coils may be calculated from the formula

$$K = DS^2 \times LS / DL^2 \times LL \quad \ldots 4)$$

All the dimensions and symbols for this formula are taken with reference to the chart which is reproduced above.

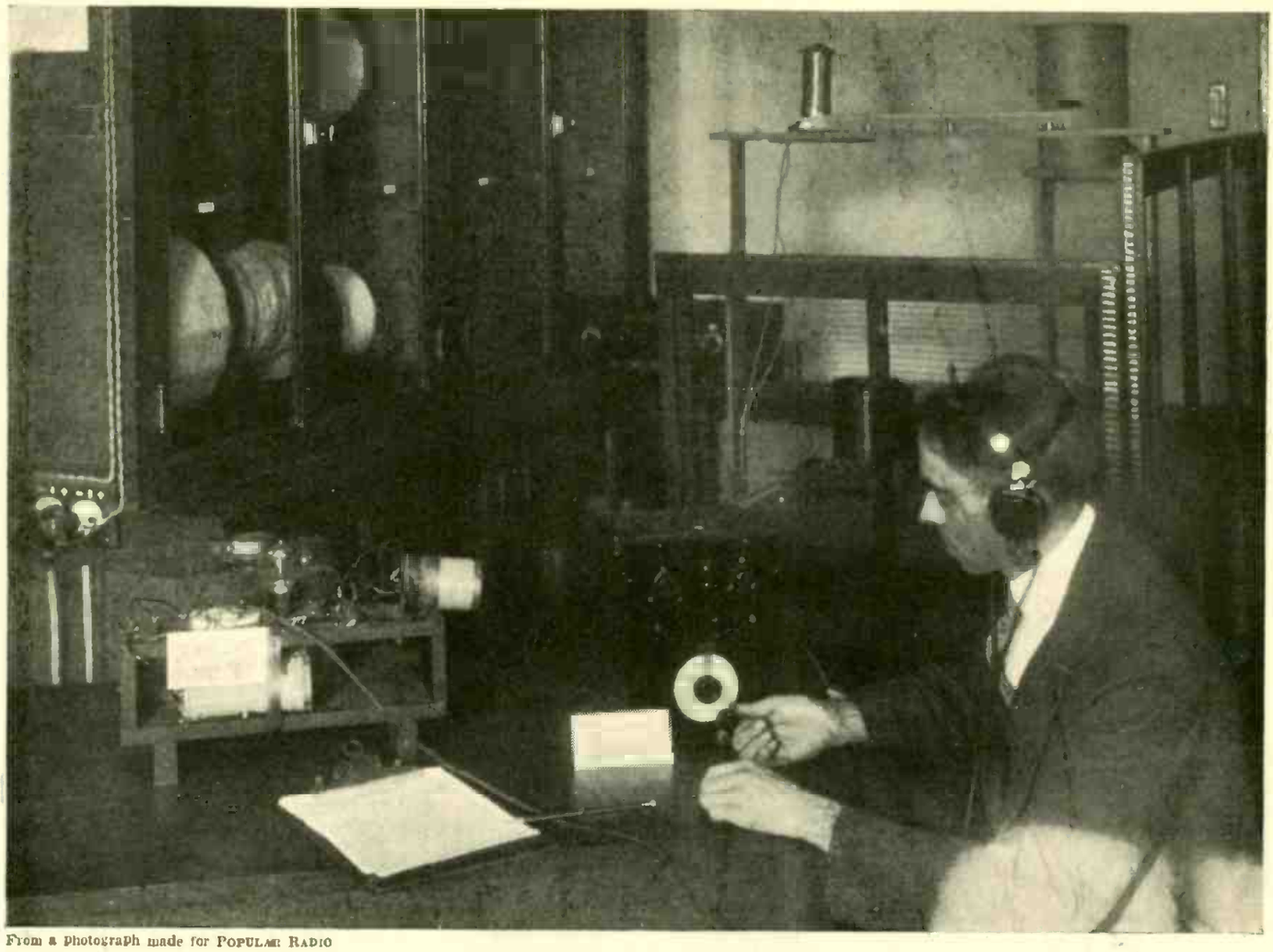
Tight and loose coupling are only relative terms; but it is generally understood that, if the factor is less than .5, the coupling is loose. For simple co-axial rotation the coupling factor is proportional to the cosine of the angle. This variation is plotted on scale No. 8 on the chart.

The chart given above provides a simple and rapid means for calculating the coupling factor of coils of this type. It acts as a substitute for Equation 4 when the length of the outside coil (in inches), on scale No. 1, is connected with the length of the inside coil (in inches), on scale No. 2, and the intersecting point on reference line No. 3 is connected with the diameter (in inches) of the outside coil, on scale No. 4. The intersecting point on reference line No. 5 is then connected with the diameter of the inside coil, on scale No. 6 and this line intersects reference line No. 7. Then, connect the relative location of the coils, on scale No. 8, with the intersecting point on reference line No. 7 and this line will intersect scale No. 9 at a point which gives the coupling factor.

The mutual inductance and the values between which the inductance will vary may then be calculated by means of Equations 1, 2 and 3.

Example: To find the coupling factor of a coil 2 inches in diameter and 1.5

(*Continued on page 367*)



From a photograph made for POPULAR RADIO

HOW HARMONIC FREQUENCIES ARE USED FOR CALIBRATION

The oscillator at the left is adjusted to a frequency of 1,000 kilocycles; a third harmonic, of course, is 3,000 kilocycles. The oscillator at the right is then adjusted to zero beat by matching its second harmonic of 3,000 kilocycles with the third harmonic of the first oscillator. When zero beat has been obtained the experimenter knows that the fundamental frequency of the oscillator at the right is 1,500 kilocycles or 200 meters as against the 1,000 kilocycles or 300 meters of the first oscillator.

A NEW METHOD OF USING HARMONICS FOR

DETERMINING FREQUENCIES

Here is a way of harmonic heterodyning that is of great value to the experimenter who wants to calibrate a wavemeter or to determine the value of a frequency or wavelength. By the use of a crystal oscillator in conjunction with a vacuum-tube oscillator—as described in this article—practically any wavelength or frequency may be determined.

By MORRIS L. STROCK

RADIO experimenters often need a method of obtaining electrical currents of numerous accurate frequencies in their experimental work. These frequencies are required to have known values and the separation between them should be small compared to their actual values.

Sometimes it is merely necessary that these frequencies have a known relationship; occasionally it is desirable to obtain numerous frequencies regardless of their values or relationship.

All of these requirements are met in the use of harmonics which are present in the usual type of electron tube generating circuit. (Such a circuit, variously known as an "oscillator," "heterodyne" or "driver," will hereafter be called a "generator"). It is possible to obtain any number of frequencies from a single value.

Probably the greatest use of harmonics is to supply the numerous frequencies required for the calibration of frequency meters, or to use the older term, "wavemeters." In this case it is necessary that the fundamental frequencies which produce the harmonics, should be of accurately known values. A method

for obtaining these fundamental frequencies that is available to radio listeners is found in the signals from certain transmitting stations known as "Standard Frequency Stations" which are listed monthly in the *Radio Service Bulletin*.*

This article describes the utilization of known frequencies and a description of a method for obtaining harmonics from them.

Many experimenters hesitate to use harmonics because the process appears to be rather complex. It is true that this work requires some time and patience but if it is undertaken with a knowledge of the principles involved and if proper methods are employed it will not be found difficult. One will find that this study of harmonics opens up a fascinating field of experimentation.

The discussions in this article are based upon "kilocycles" rather than "meters." The reason is that this usage is much simpler. In case conversions are required they may be readily made by dividing 300,000 (299,820 for greater accuracy) by the given value of kilocycles or meters.†

Assuming that harmonics are required for a frequency-meter calibration, the first step in obtaining them involves the reception of a known frequency from a transmitting station. The receiving set (Figure 1) may or may not be of a type which can be adjusted to generate (oscillate). The generator should be of sufficient power to satisfactorily operate the resonance indicator of the frequency meter. (Generator A, Figure 1. Generator B is ignored for the present).

How the Apparatus Is Set Up

The generator is placed a distance of from two to six feet (depending upon its power) from the receiving set and the frequency meter is placed sufficiently close to the generator to obtain satisfactory resonance indication. This ideal arrangement could not be shown exactly in Figure 1, owing to difficulties in photographing.

The receiving set is tuned to the transmitting station and the generator is adjusted exactly to this frequency by the "zero-beat" method, *care being taken to see that the beat is not produced by the receiving set itself being adjusted to generate or "oscillate" and thus produce radiation*.

The received frequency may now be transferred to the frequency meter to supply a calibration point or to check a previous calibration. This is done by adjusting the frequency meter to secure a maximum deflection of its resonance indicator while observing the following precautions to insure minimum error:

(1) By avoiding coupling between the generator and the frequency meter which is close enough to cause a reactive effect that is sufficient to throw the generator off zero-beat. (In some cases, particularly with a low-power generator, this reactive effect will cause a slight deviation from zero beat but this may be corrected by a slight readjustment of the generator.)

(2) By the observer placing himself as far as possible from the apparatus, thus reducing the body-capacity effect to a minimum.

The Zero-beat Process

In this process of obtaining zero-beat with the frequency from a distant transmitting station, it will be noticed that the tuning of the receiving set has no effect upon the accuracy of the zero-beat adjustment. The receiving set merely serves to collect a sufficient amount of power from the transmitting station so that the beat note produced by the interaction of the local generator and the received frequency may be detected and made audible. Except in the case of a local station, it is of course desirable to tune the receiving set so that a beat of maximum intensity is obtained. If this beat is produced by the carrier wave of a broadcasting station, identification may be more difficult than in the case of a beat obtained from a standard frequency signal. In the former case, as an aid in identifying the broadcasting station, it will be noticed that the modulation is badly distorted.

After thus obtaining known frequencies, the method of harmonics between two generators (see Figures 1 and 2) is used to give numerous other frequencies. Both generators should have sufficient power to satisfactorily operate the resonance indicator of the frequency meter. If this is not possible, the required frequency may be transferred to the frequency meter after it has first been transferred (by the zero-beat method) to the generator of higher power. Increasing the plate voltage of a generator which is equipped with a dry-cell tube will often give sufficient power.

The Use of the Chart

The chart (Figure 2) suggests the method of obtaining numerous frequencies by means of harmonics between two generators. Two facts about this chart should be mentioned at the outset:

First, the chart shows the method only and therefore gives only a few of the numerous frequencies possible to obtain between the limiting values shown (500 and 2,000 kilocycles).

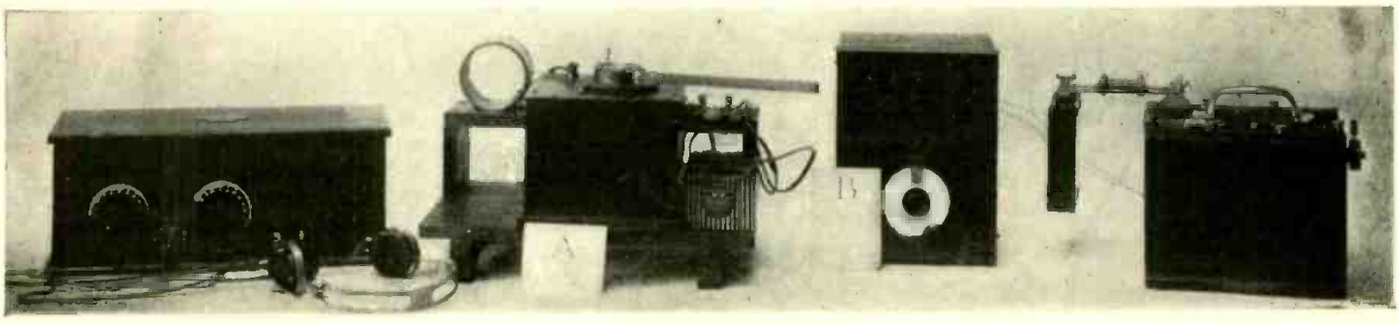
Second, although harmonics are used to obtain new settings of the generators, the fundamental frequencies *only* are transferred to the frequency meter.

The fundamental frequencies of generator A are indicated in large circles with "A" in the center; harmonics are indicated in smaller circles. The fundamental frequencies of generator B are in large squares with "B" in the center; harmonics are in smaller squares. Approximate wavelengths are shown in parentheses.

The greatest accuracy will result from this work by making as few changes as possible in the generator adjustments, particularly in the adjustment of generator A, that gives the initial fre-

*A monthly publication obtainable from the Superintendent of Documents, Govt. Printing Office, Washington, D. C. for 25 cents a year.

†Accurate conversion tables may be obtained for five cents from the Supt. of Documents.



A CALIBRATION SETUP

FIGURE 1: *The receiver to be calibrated is placed at the left; generator A is then adjusted to zero beat with the set. The wavemeter at the right is used to obtain the calibration point or to check previous calibrations; generator B is used to produce the heterodyne beat that is employed to determine another frequency.*

quency. Hence the procedure will be carried out with this idea in view.

It is assumed than an initial frequency of 1,000 kilocycles has been obtained on generator A by adjusting to zero-beat with the frequency of a distant transmitting station as tuned in on the receiving set. This frequency is transferred to the frequency meter, (arrow No. 1).

Generator A is also producing harmonics (2,000, 3,000 and more kilocycles) which are exactly two times, three times and so on, the fundamental frequency of 1,000. It is customary to call the fundamental frequency (in this case 1,000) the "first harmonic." The second harmonic is then 2,000, the third harmonic is 3,000, and so on.

Applying these ideas to wavelengths, the fundamental of the generator is 300 meters, the second harmonic is 150, the third harmonic is 100, and so on.

If generator B is now adjusted near the fundamental frequency of A, a beat note with a pitch corresponding to the difference in frequencies of A and B will be produced in the headphones in the plate circuit of either generator or in the phones connected to the receiving set. This beat is produced by the fundamentals of the two generators; hence the frequency of B is increased to very nearly 2,000 until a second beat note is heard. This is caused by the second harmonic ($= 2 \times 1{,}000$) of A beating with a new fundamental (2,000) of B. B is now adjusted to exactly 2,000 kilocycles by zero beat and this frequency is transferred to the frequency meter (arrow No. 2, Figure 2).

The frequency of B is now decreased to 500 kilocycles (arrow No. 3, Figure 2) and a zero-beat obtained between the second harmonic of this frequency and the initial frequency of 1,000 kilocycles from generator A. To obtain a new fundamental frequency of 750 kilocycles (arrow No. 4, generator B), a zero-beat is obtained between the third harmonic of A and the fourth harmonic of B.

A Check on Accuracy

Generator B may now be set to 1,500 kilocycles (arrow No. 5) and after this frequency is transferred to the frequency meter, generator A is thrown slightly out of adjustment and again set to zero beat (arrow No. 6) thus duplicating the initial frequency.

It is an excellent plan to duplicate frequencies in this manner as a check.

Again leaving generator A at 1,000 kilocycles, B is once more adjusted to 2,000 kilocycles and generator A is readjusted for a new fundamental of 666.7 kilocycles (arrow No. 7). This frequency may be selected as a new starting point, comparable to the initial frequency of 1,000 kilocycles, and a repetition of the process just described may be made. Another fundamental frequency which would be very good for this purpose is shown by arrow No. 8, and the method of obtaining it is similar to the method of obtaining the 666.7 kilocycle frequency.

A brief reference to the procedure described above shows that four frequencies were obtained from generator B without disturbing the initial setting of A. Two of these frequencies (arrows 2 and 5) are higher than the initial frequency of 1,000 kilocycles, while the other two (arrows 3 and 4) are lower than the initial frequency. This suggests a possible variation in the procedure according to the required frequency values. Arrows 7 and 8 suggest satisfactory values of new initial frequencies; arrow 6 represents a check upon the initial frequency of 1,000.

The process of obtaining harmonics may—at least theoretically—be continued indefinitely, subject to the limitations in frequency range of the generators. Actually, the higher harmonics become rather too weak to be readily detected.

This work gives greater accuracy if the harmonics are obtained immediately after the generator is set to zero-beat with the received (initial) frequency, a condition assumed in the descriptions given above. This may not always be possible, as for instance in the case of standard-frequency signals when a number of successive frequencies are being received. In this case the following procedure may be used:

The frequency meter is carefully tuned to the generator (set to zero beat) until a mean of several settings is obtained. Other known frequencies may then be recorded in the same manner. Later, when the method of harmonics is applied, these frequencies are reproduced in turn on the generator by tuning it to the frequency meter adjusted to the predetermined settings.

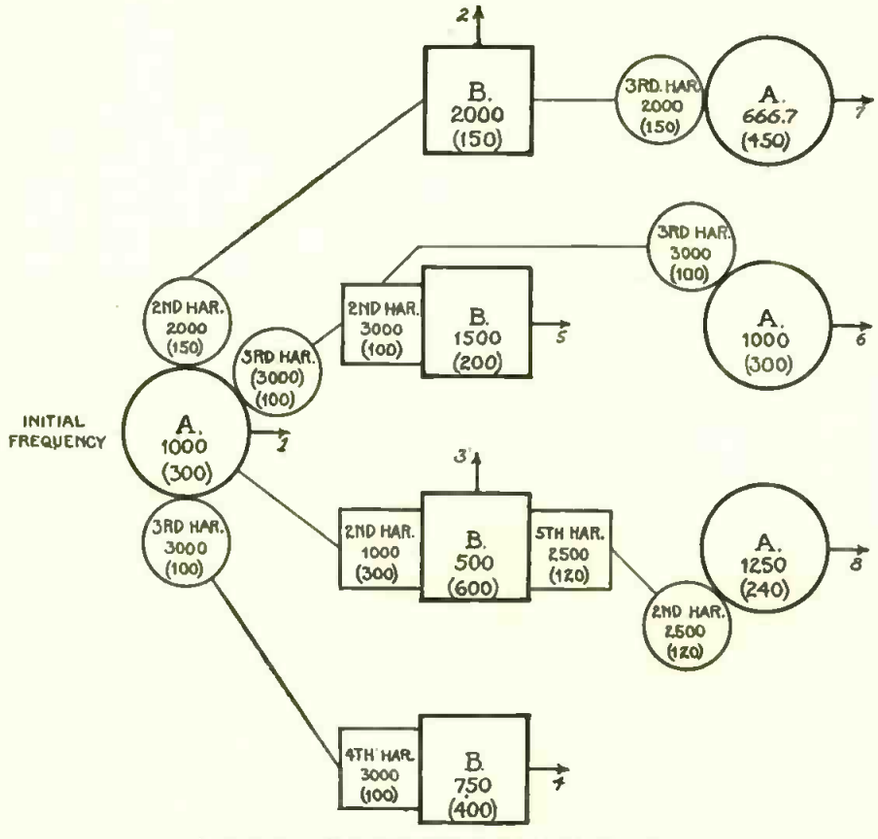
A check on the accuracy of adjustment of the generator is obtained by retuning the frequency meter and reading the setting.

An Approximate Calibration Should First be Obtained

Before undertaking the experiments described above an approximate calibration should be obtained for each generator, as the lack of such makes it difficult to locate harmonics.

These calibrations may best be given by curves plotted with frequencies (or wavelengths) against condenser settings, using one curve for each generator coil. Points for these curves may be obtained by tuning the generator to zero-beat with the known frequency of a transmitting station as tuned in on the receiving set, by employing harmonics between generators using the ideas sug-

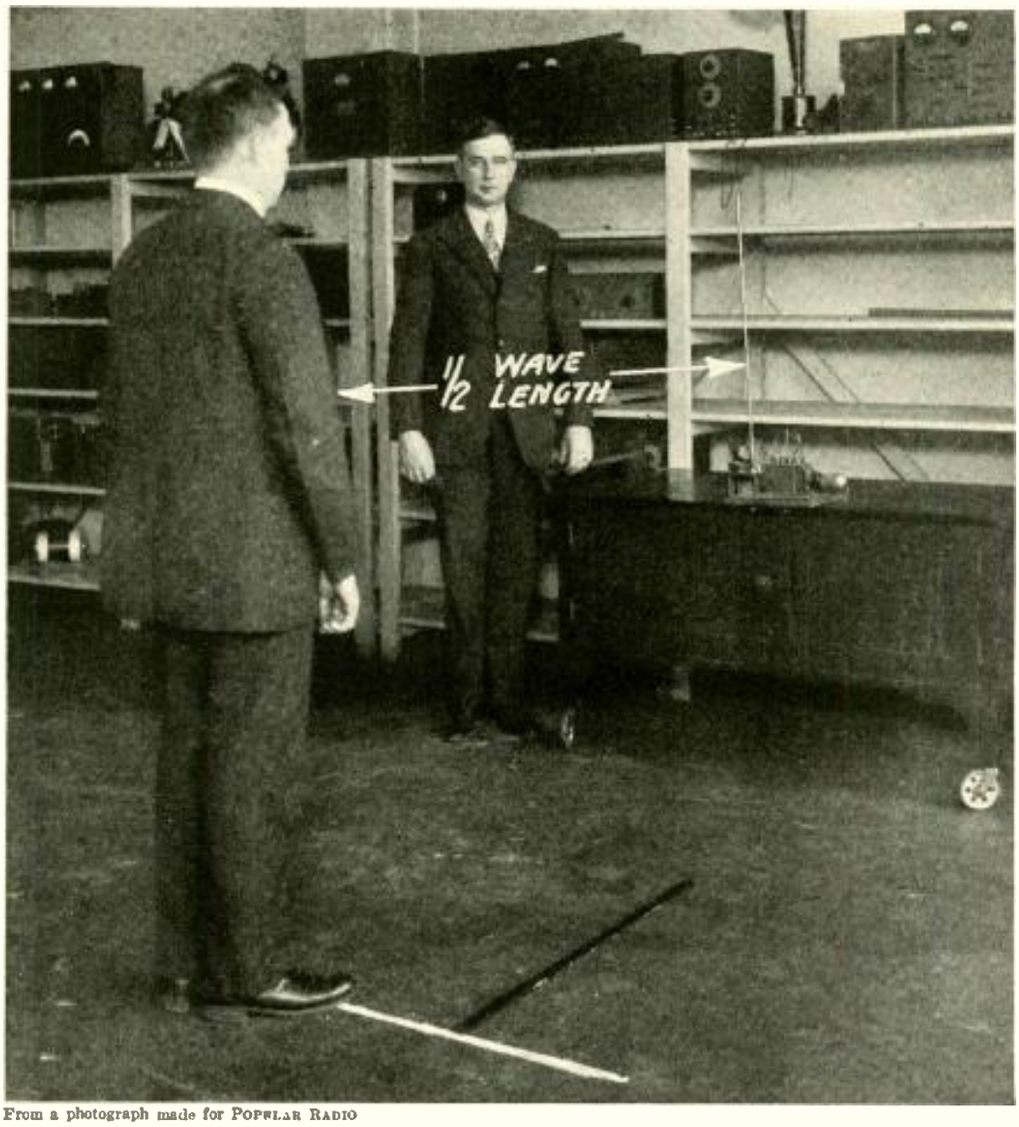
(*Continued on page 356*)



A SKELETON CHART OF HARMONICS

FIGURE 2: *A general idea of how harmonic heterodyning is used to produce new frequencies should be easily obtained from this chart.*

¶ HERE *is a real chance for the experimenter to cooperate with the Army scientists in solving one of the unexplained mysteries of radio.*



From a photograph made for POPULAR RADIO

HERE IS THE PROBLEM IN A NUTSHELL

What causes the increase of current in the antenna of a short-wave transmitter as the human body moves away from it, reading its maximum strength at one-half wavelength intervals?

Does the Human Body "Reflect" Radio Waves?

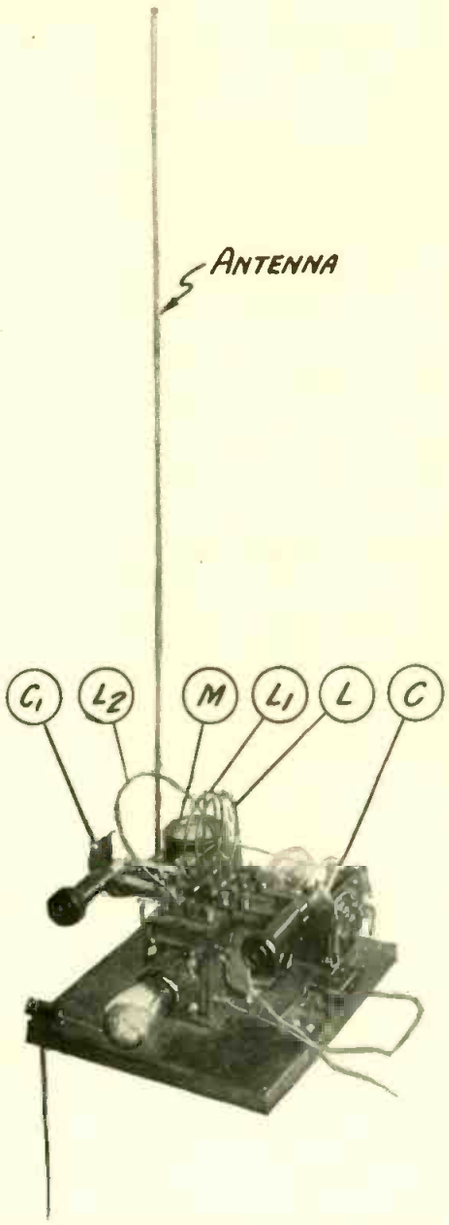
While working with short wavelengths, Major Mauborgne has observed a peculiar phenomenon that has not yet been fathomed. In this article he invites amateurs to conduct similar experiments and to report their observations to him at the Signal Corps Laboratory at Washington, D. C.

By MAJOR J. O. MAUBORGNE, U. S. A.

IN the practical operation of short wave apparatus by amateurs and others, various phenomena have been observed, from time to time, that show that operation in the region below one hundred meters, while enjoying certain advantages not obtainable with longer waves, meets with certain difficulties.

Some of these difficulties, for example, are the "shifting" and "fading" effects, and the so-called "skip distance" effect, which precludes reception within a given area of a transmitting station that employs certain waves.

Attempts to work below fifteen meters



THE SHORT-WAVE TRANSMITTER USED IN THE EXPERIMENTS

FIGURE 1: *The antenna is made of a telescopic brass rod which permits the adjustment of the antenna wavelength. L, L1 and L2 are inductances which are made of single turns of small copper tubing; M is the antenna ammeter; and C and C1 are variable tuning condensers.*

are found to involve still greater disadvantages on account of the apparently erratic behavior of these short waves, and because of the peculiarity of being reflected, refracted, or absorbed by almost anything which they may strike.

The shorter the wave, the more easily perceptible do these effects become.

Until many more experiments have been made to determine the sources of the erratic behavior of waves of this short length, proper corrective measures cannot be taken to put very short waves into daily practical use.

The author, while making experiments with a transmitter that operates between three and five meters, and using an antenna operating at its fundamental, has observed the curious phenomenon that the human body, or a suitable metallic plate, if steadily moved away from a transmitter such as is here described, will produce *an increase of current in the antenna*, as the body reaches points distant from the antenna equal to one-half the wavelength, one whole wavelength, or one and one-half times the wavelength.

The current change in the antenna as shown by the antenna ammeter might have been thought due to the effect of "body capacity," if the effect had been observed only when the body was rather close to the transmitter.

One might well argue that the approach of the body, particularly when we consider how short the wave is and therefore how easily influenced it is by small capacity changes, might have had the effect of changing the capacity of the antenna, either throwing the antenna circuit into or out of tune. However it is to be especially noted that particular care was taken first to put the transmitter proper into resonance with the antenna, with all persons removed at considerable distance from the set. This was accomplished by long control cords by which the coupling and wave length were changed by an assistant stationed about eleven feet from the set.

After the apparatus had been adjusted in this manner for maximum radiation, and a human body approached the transmitter at distances from eight meters to two and four-tenth meters away, it became evident that capacity effects at such distances were so slight as to be entirely negligible.

The only possible explanation of the remarkable increase in the antenna current over that existing in the set when tuned in the manner described, is that the extra current was due to reflection from the body back to the set.

This current in repeated tests of the particular apparatus used showed a nine percent increase in the antenna current when the body was at the distance of half a wavelength from the transmitter.

The particular apparatus used is shown in the accompanying illustrations.

The accompanying circuit diagram (Figure 2) is based upon the description given in a 1924 number of *L'Onde Electrique*, by Commandant Mesny, of Paris. It is highly recommended for work down to about two and a half meters, when using 201-a tubes in ordinary sockets.

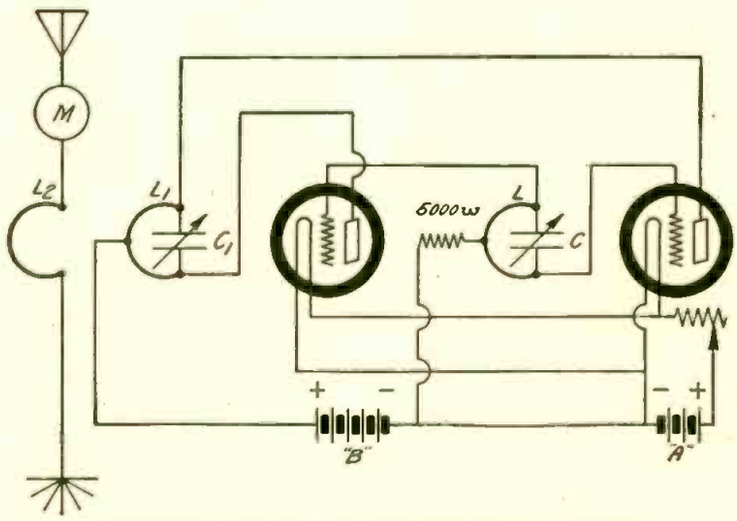
The inductances L and L_1 are similar. Each consists of a single turn, 3 in. in diameter, of small copper tubing. Each loop is tapped at the exact center, the grid coil tap connecting to the grid resistance of 5000 ohms. The other end of the grid resistance goes to the minus terminal of the filament. The center tap of the plate coil is tied to the positive pole of the "B" battery, the negative pole of which is connected to the negative pole of the "A" battery. The filaments of the two tubes are in parallel.

The "B" battery voltage for this experiment should be about 220 volts so as to give an antenna current of about 160 to 200 milliamperes, as shown by the meter "M" in the antenna circuit.

The antenna inductance, L_2, consists of a single turn 4½ inches in diameter of small copper tubing, inductively coupled to the plate inductance. The antenna meter should have a range of 0 to 250 milliamperes when using 201-a tubes.

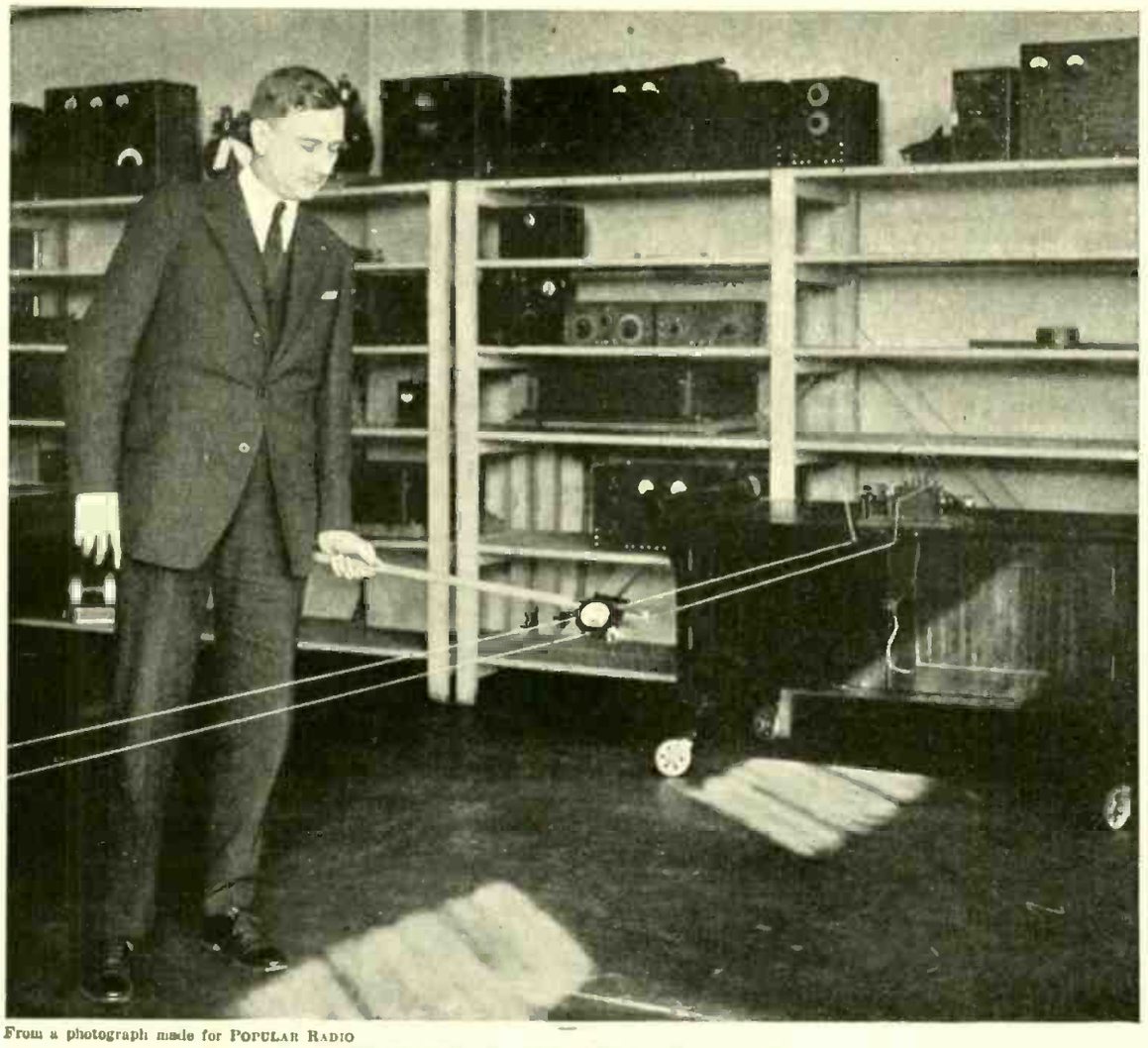
The antenna and counterpoise each consists of small telescopic brass rod, about two feet long when telescoped. This telescoping feature permits the adjustment of the antenna wavelength.

The particular condensers used across



A DIAGRAM OF THE TRANSMITTER WIRING

FIGURE 2: *The electrical connections for the various instruments in the short-wave transmitter shown in Figure 1; the lettering of the instruments is the same in both figures. This circuit will work down to 2½ meters with the ordinary 201-a tubes placed in standard sockets.*



From a photograph made for POPULAR RADIO

HOW THE WAVES WERE MEASURED

The method that was used to determine the wavelength, employed two parallel wires that were connected to the oscillator so that standing waves were generated in the antenna and counterpoise. This method of wavelength measurement is remarkably accurate for determining the wavelength of very short waves.

the grid and plate coils were General Radio Company's 2-plate vernier condensers.

The entire apparatus, including the batteries, was mounted upon a movable table, to permit use of the set in various parts of the room.

In order to tune the set to the antenna without the operator being near the apparatus, long cords were attached to the plate coil and to the antenna coil. One coil from each passed directly to the hand of the assistant, while another cord from each passed to him by way of a screweye, so that the coupling between the plate and the grid coil could be changed—thus tuning the set and, also, making possible the adjustment of the coupling between the antenna coil and the plate coil.

All this could be accomplished without requiring the assistant to move from his position, eleven or twelve feet away from the transmitter.

In these experiments the set was first roughly tuned to the antenna by the operator by hand. The coupling between the antenna coil and the plate coil was made loose from the beginning; and, by varying the condensers across the plate and grid coils, the set was adjusted to approximate resonance with the antenna.

The operator then took up a position at a telescope placed about thirty feet from the transmitter. This telescope was trained upon a small mirror so placed as to reflect the image of the antenna ammeter into the telescope. In this way any variation in the antenna current could easily be read with the telescope.

The assistant then manipulated the cords until the observer at the telescope noted that the set was in resonance with the antenna, when a reading of the antenna current was noted.

The assistant next left the control cords and took up a position near the transmitter, while the observer watched the changes in the antenna current as shown by the ammeter, as the assistant slowly backed away from the transmitter.

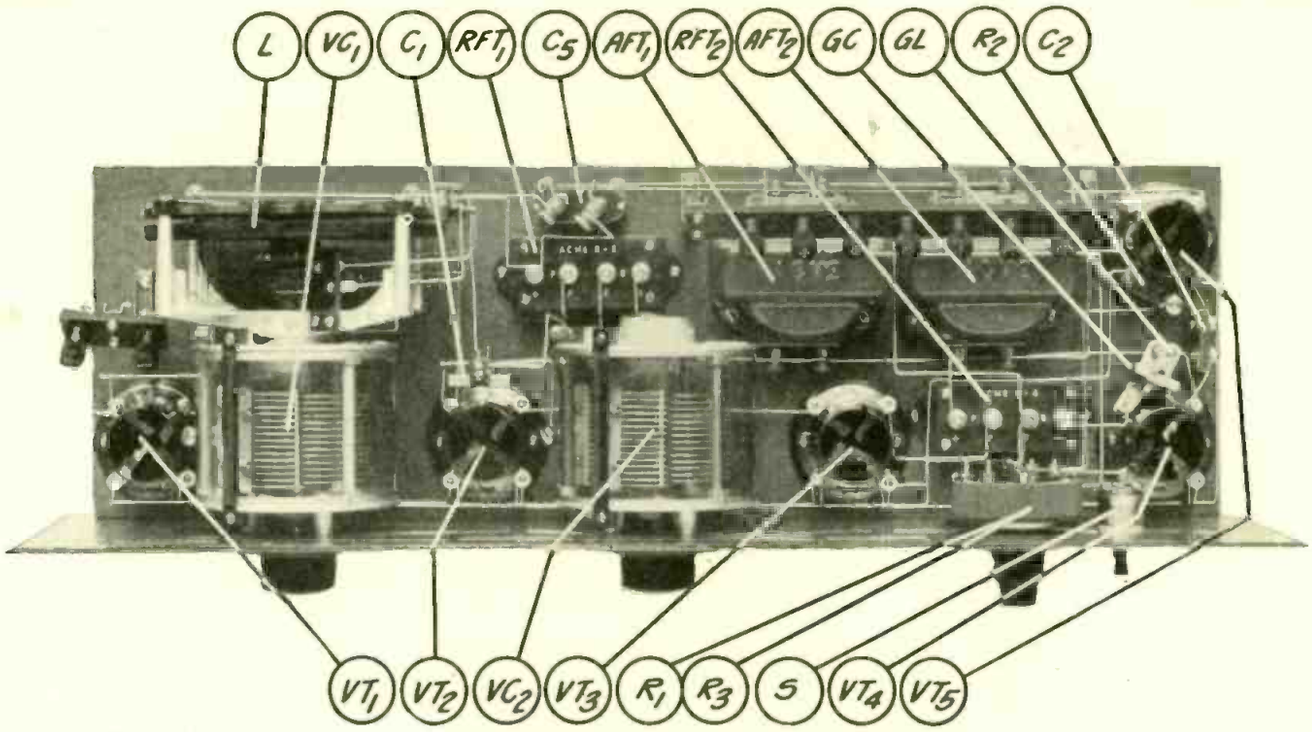
The results were checked many times. In each case the ammeter showed about nine percent increase over the normal current, when the assistant reached a position equal to one-half wavelength from the set, and further slight rises were noticed when positions one-wavelength, and one-and-one-half wavelength respectively were reached.

Between these points the antenna current fell off to normal.

While the assistant was standing at the half-wavelength point and a considerable increase in antenna current was noticed, another assistant was told to go and stand by the first assistant. The result was a further increase in antenna current as indicated by the ammeter.

The actual length of the emitted wave was measured both by a wavemeter and also by putting up a pair of wires on which standing waves were set up by coupling the set to the wires, the antenna and counterpoise being removed, but the distance between the antenna coil and the plate coil being kept constant. The operation of determining the length of the waves by the

(*Continued on page 360*)



The Acme 5-tube Reflex Receiver

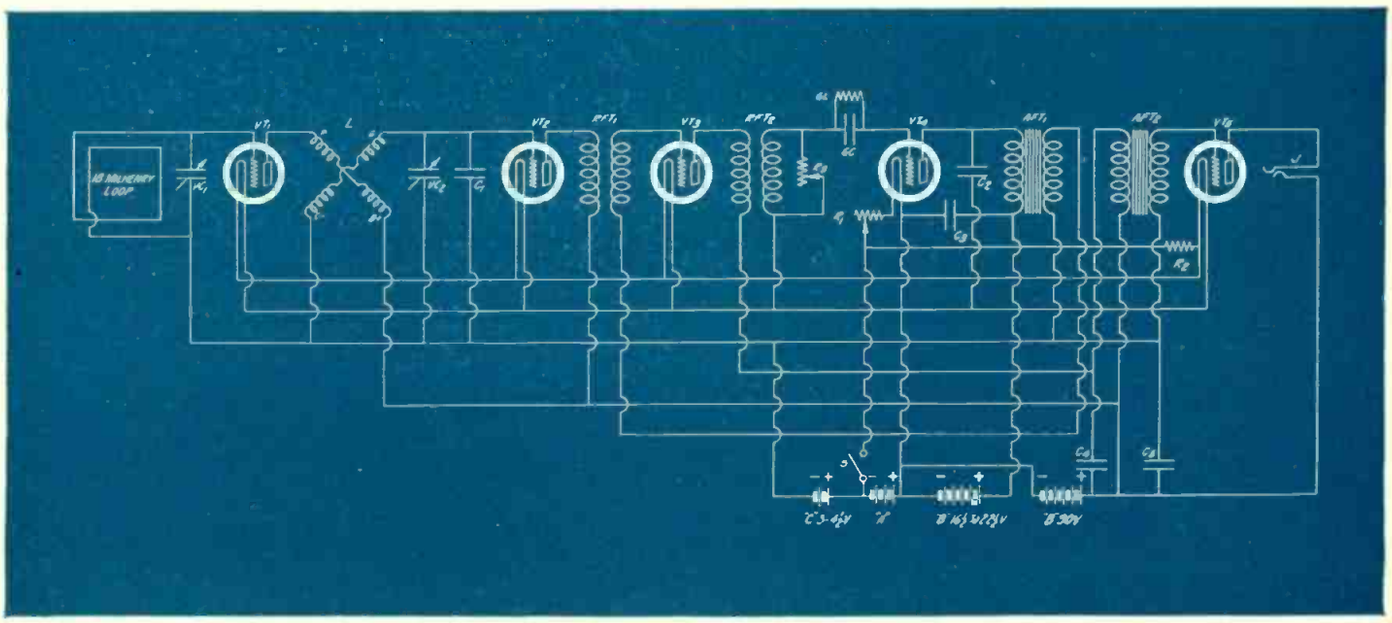
The Acmeflex S2, employs 3 stages of RF (the last one, a reflexed stage), a detector and a stage of audio. This circuit is very selective and the volume that is obtained is enormous.

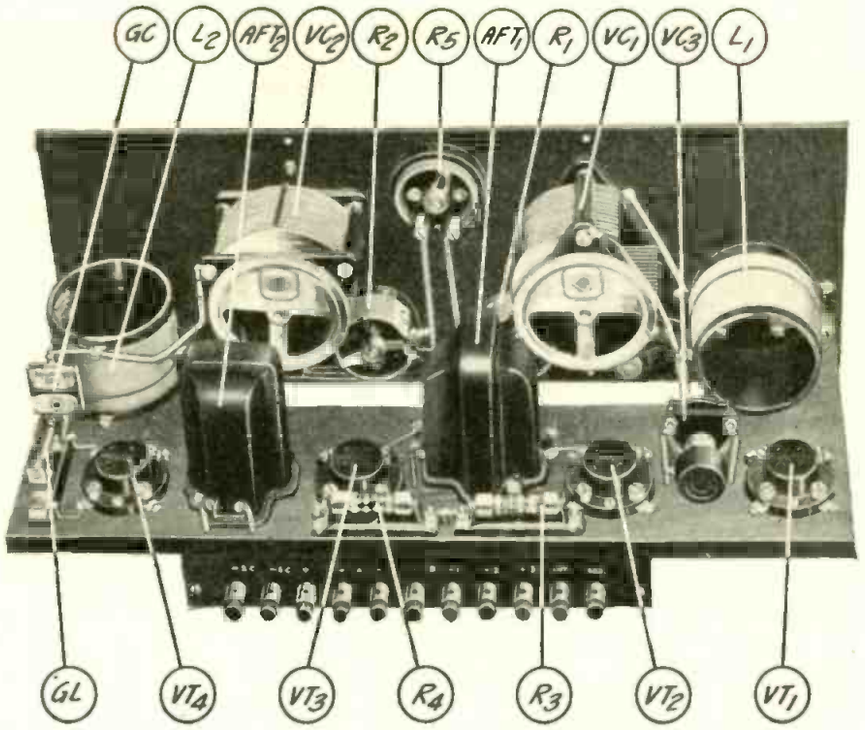
Popular Radio Circuits

INSTALLMENT NO. 1

THE PARTS THAT ARE USED IN THIS RECEIVER ARE—

L—Acme "D" Coil Unit (includes condenser VC1);
VC2—Acme variable condenser, .0005 mfd.;
RFT1—Acme radio-frequency amplifying transformer, type R3;
RFT2—Acme radio-frequency amplifying transformer, type R4;
AFT1 and AFT2—Acme audio transformers, type MA2;
VT1, VT2, VT3, VT4 and VT5—Naald sockets, type 400;
GL—Daven grid-leak, .5 to 2 meg.;
GC—Dubilier condenser with grid-leak clips, .00025 mfd.;
C1—Dubilier condenser, type 640, .0004 mfd.;
C2, C4—Dubilier condensers, .002 mfd.;
C3—Tobe condenser, 2 mfd.;
C5—Splitdorf by-pass condenser, 1 mfd.;
R1, R3—Acme potentiometer rheostats, 6 and 2,000 ohm resistances;
R2—Acme fixed resistance unit, 1 ohm;
S—Bradleyswitch;
J—binding-posts for the loudspeaker tips are furnished on the battery strip;
Loop—18 Milhenry Inductance. May be made by winding 92 ft. of loop wire (Litz), pancake style, on two crossed sticks, each 35 inches long. The separation of the wires should be exactly 9/16-in.;
Baseboard—7 by 23 inches, drilled for the instruments;
Panel—7 by 24 inches.



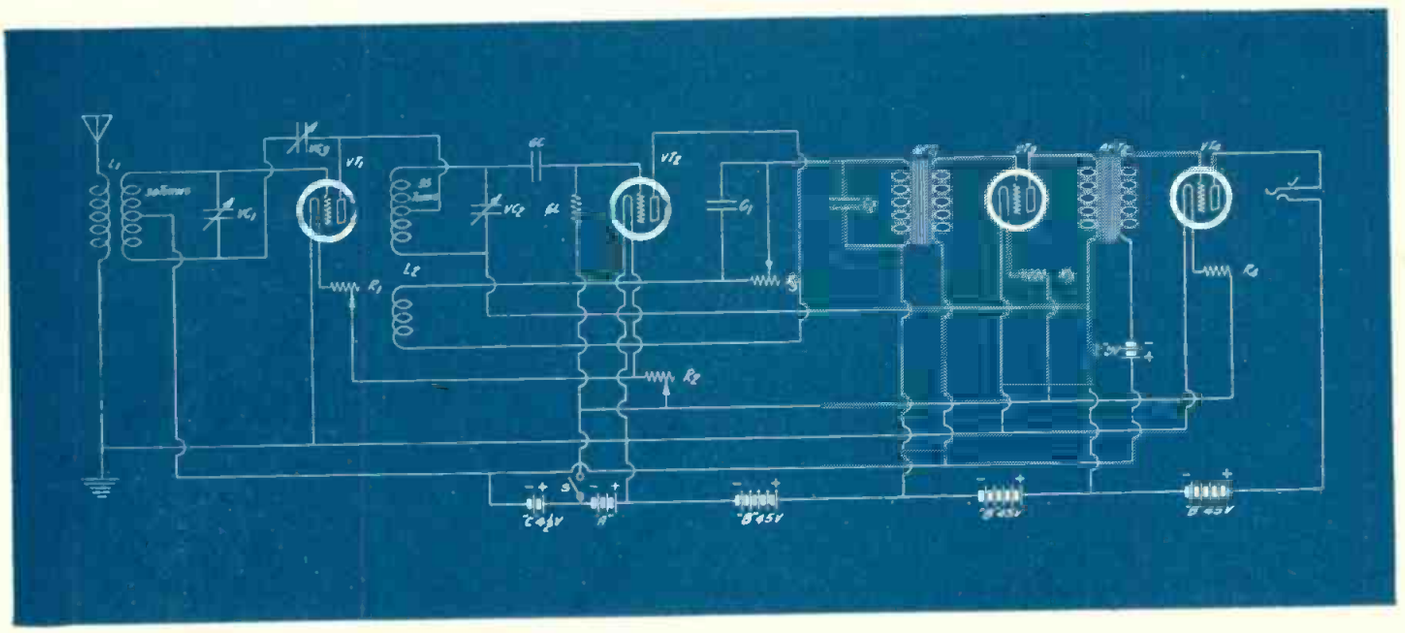


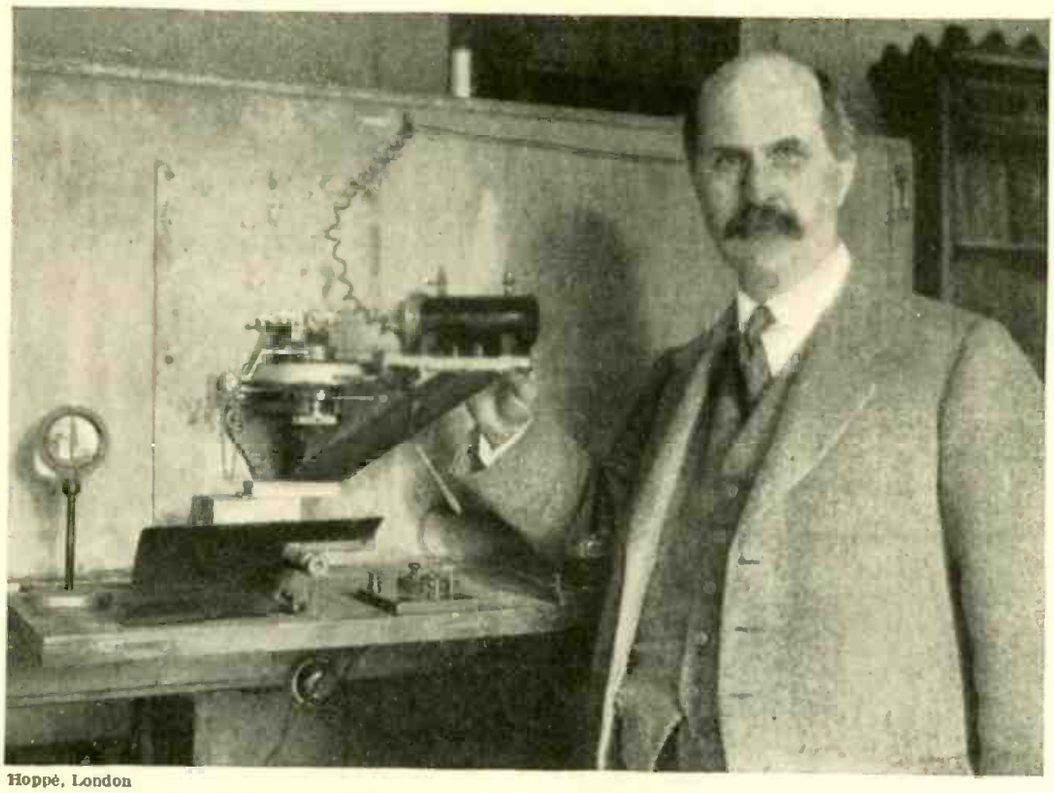
The "Universal" Receiver

This receiver consists of one stage of tuned-radio-frequency, a regenerative detector and two stages of audio-frequency amplification; the Rice method of neutralization is used. Particular note should be made of the use of low-ratio transformers in the audio stages for the best quality reproduction. The tubes that are used are of the UX-201-a type except for a UX-112 in tube socket VT4.

THE PARTS THAT ARE USED IN THIS RECEIVER ARE—

L1 and L2—General Radio coils, type 277-D, (secondaries of L1 and L2 tapped at 30 and 35 turns respectively);
VC1 and VC2—General Radio variable air condensers, .00035 mfd, type 247-H;
VC3—General Radio microcondenser, type 368;
GC—Electrad mica condenser, .00025 mfd.;
GL—Electrad grid-leak, 2 meg.;
C1—Electrad mica condenser, .5 mfd.;
C2—Electrad mica condenser, .0001 mfd.;
R1—General Radio rheostat, 30 ohms, type 301;
R2—General Radio rheostat, 10 ohms, type 301;
R3—Amperite, No. 1A, or ¼-ampere Brachstat;
R4—Amperite, No. 112, or ½-ampere Brachstat;
R5—Royalty variable resistor, 500 to 50,000 ohms;
VT1, VT2, VT3 and VT4—General Radio sockets, type 156 or 349 UX;
S—Yaxley filament switch;
J—Yaxley open-circuit jack;
AFT1 and AFT2—General Radio audio-frequency transformers, ratio 2-1, type 285;
Composition panel—7 by 18 inches;
Baseboard (used as sub-base)—7 by 17½ inches;
Sub-base brackets (2 required);
Composition binding-post strip, 1 inch by 1½ inches;
General Radio binding-posts, Type 138Z, (10 required);
Small brass brackets for supporting coils (2 required);
Brass bracket to support condenser VC3;
General Radio dials, type 310 (2 required).





Hoppé, London

ONE OF THE WORLD'S GREATEST AUTHORITIES ON THE ATOM

In the drama of radio the atom plays such a vital part that POPULAR RADIO *has turned to one of the world's foremost authorities for a series of short, popular articles on this subject that every radio fan should know about. Sir William Bragg of England is the Fullerton Professor of Chemistry at the Royal Institution and Director of the Davy-Faraday Research Laboratory.*

The ATOM

ARTICLE NO. 6

The Nature of Crystals: Metals

Scientists believe that tremendous power lies hidden in the minute particles of matter known as atoms. In radio, power from the thorium atom activates the filaments of our vacuum tubes; and now scientists are wrestling with the problem of how we can harness the immense energy in other atoms to do our work.

By SIR WILLIAM BRAGG, K.B.E., D.Sc., F.R.S., M.R.I.

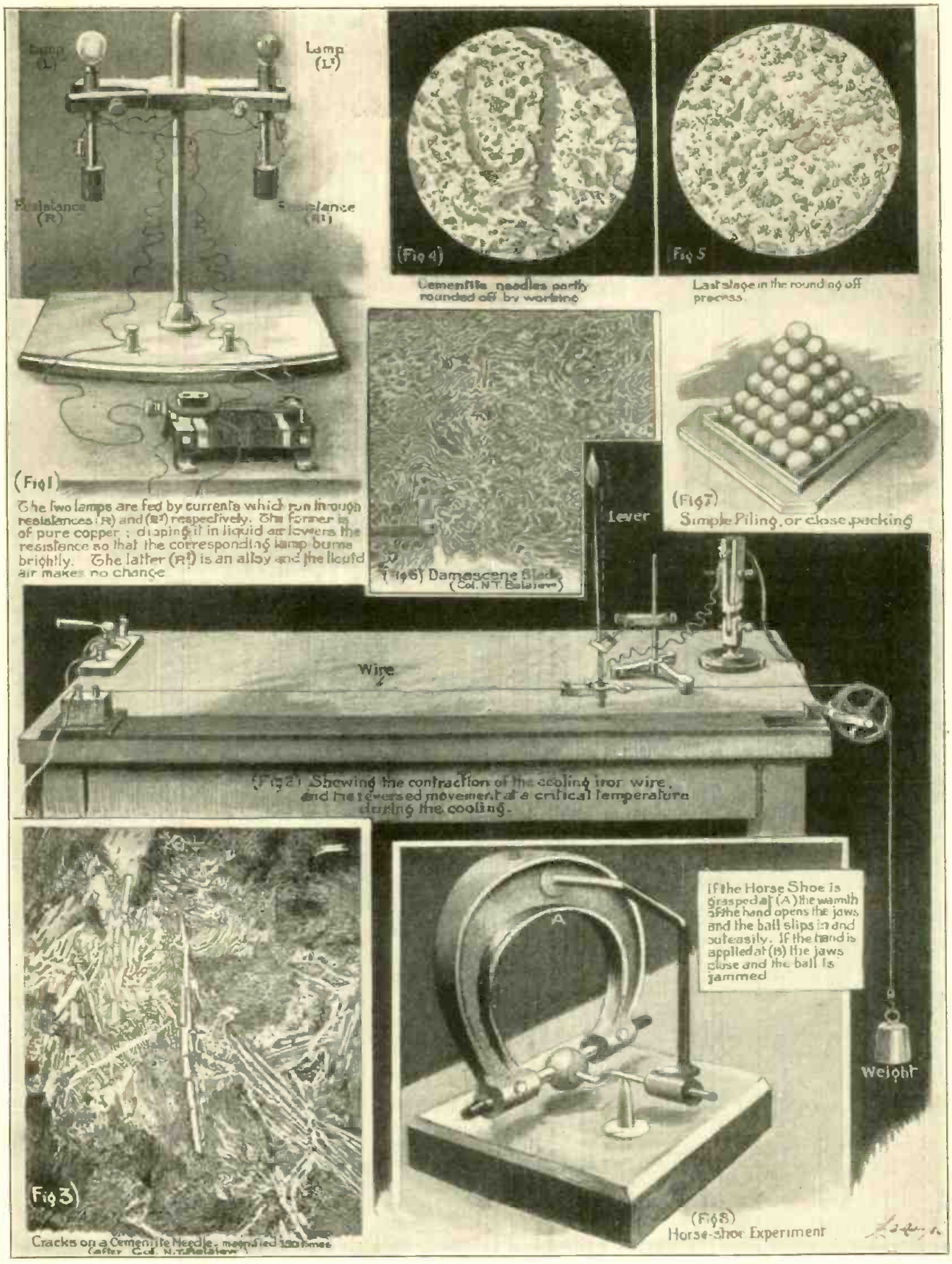
THE use of metals has been one of the principal factors in the development of human activities.

The beginning of the story is so far back in the ages that we can only make guesses as to how men first made metal tools and weapons. Perhaps copper was picked up in its native state and its weight suggested its effectiveness in a fight. Possibly it was afterwards discovered that copper could be smelted; and, again, there are various ways in which it might have been found that there was an alloy of copper and tin which was far harder and more serviceable than copper alone; and so the Age of Bronze set in and lasted many years.

Iron came later, of course. From that time to this there have been workers in metal, forming important members of their communities. We have but to think of the magnitude of the metal industries in this country alone to realize how great a part the metals play in the life of the world.

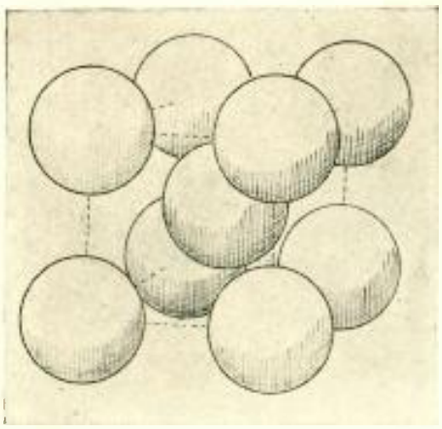
The properties of metals depend, in the first place, on the peculiar properties of their atoms, and, in the second, on the arrangement of the atoms in the solid material; in other words, on the crystallization. The microscope has been applied to metallurgy for many years now; and it has helped wonderfully in its development. Its chief revelation is the importance of the crystalline condition, including the various types of crystal which a metal contains, their nature, their magnitude, and their relative arrangement.

It is characteristic of the atoms of metals that they very readily part with one or more electrons, so that a piece of metal, to a first approximation, may be thought of as a collection of atoms, closely packed together, in form spherical or approximately so, and permeated by a crowd of electrons which are not attached strongly to any particular atom, but which can wander about among the atoms like people in the rooms of a building. In this way, we



EXPERIMENTS THAT SHOW THE FUNDAMENTAL NATURE OF METALS

In the illustrated articles which have already been published in POPULAR RADIO, *Sir William Bragg abridged the first four of his six lectures delivered at the Royal Institution of London under the general title, "Concerning the Nature of Things." The first five subjects were: "The Atoms of Which Things Are Made," "The Nature of Gases," "The Nature of Liquids" and "The Nature of Crystals: the Diamond," "The Nature of Crystals: Ice and Snow." The present article, illustrated like the others with diagrams representing the chief experiments performed during the lecture, deals with the nature of metals.*



THE ARRANGEMENT OF ATOMS IN A PIECE OF IRON AT ORDINARY TEMPERATURES

FIGURE 9: *The change that occurs in iron when heated to about 780 Centigrade (the atoms then packing more tightly as in Figure 10), is illustrated by the experiment shown in Figure 2 on the opposite page.*

have an explanation of the well-known fact that metals are conductors of electricity. An insulator, such as ebonite or quartz, is, from this point of view, a body in which there are no electrons free to move when the electric force is applied.

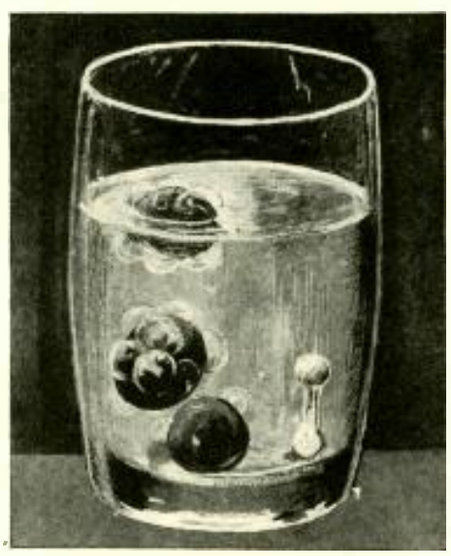
Each of the atoms in a metal, considered apart from its proper complement of electrons, is charged with positive electricity. It is not quite clear how they hold together. No doubt the electrons have a binding effect, being charged negatively; but the full explanation cannot be quite so simple as that. For we have to explain the great variety in the properties of the metals, their strength, their ductility, their melting points. If all of the metals were merely positive spherical atoms held together by electrons, we could not understand the great differences between them. It seems likely that the metal atoms, which are necessarily close neighbors to each other, are held together at points on their surfaces by local mutual attractions which outweigh the simple electric repulsions that would drive them apart.

The X-rays show that the atoms of aluminum, copper, silver, gold and some other metals are packed together like spheres in closest array. Each atom has in such case twelve immediate neighbors (Figure 10), as may be seen by counting the number of balls in contact with any one ball in a pile of balls.

Some metals have a different arrangement: one of the most important of these is iron. Each iron atom has only eight neighbors, which are arranged round about it as the corners of a cube are ranged round about the centre (Figure 9). Curiously enough, when iron is heated to about 780 degrees Centigrade, there is a remarkable change in its inner structure: the atoms pack themselves more tightly together in the manner of the four metals mentioned above (Figure 10).

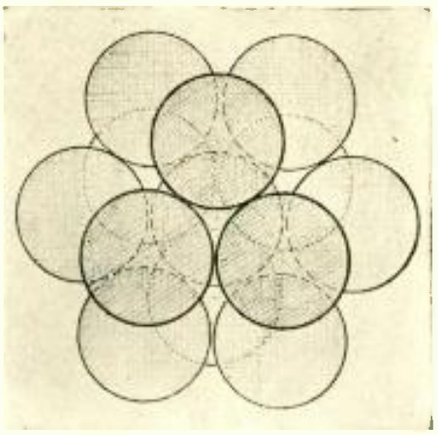
A very pretty experiment gives an obvious demonstration of the change. An iron wire is kept taut by a heavy weight in the manner shown in the figure (Figure 2). An electric current is made to flow along the wire, thus raising it to a bright red heat, at which temperature the iron is in the second of the two states described above. The actual stretching of the wire during the heating is shown, magnified, by a light pointer. When the current is turned off and the wire cools again, the pointer registers the contraction, which goes on uniformly until the critical temperature is reached, at which the change in the structure takes place. At that moment the atoms of the iron rearrange themselves, and take more room than they did before. The iron, in consequence, shows a sudden expansion, and the pointer hesitates, stops, and reverses for a time the movement which shows contraction.

Usually the crystals of a metal are in complete disarray. The metal is an aggregate of minute crystals pointing in all directions. When a metal is drawn or rolled or beaten, the crystals acquire greater regularity in their arrangement, related to the direction of the drawing or to the plane of the beaten sheet. In gold-leaf, silver-leaf, copper-leaf and aluminum-leaf, the X-rays show us the change that has been made by the beating. The crystals are of cubic pattern and consist of aggregates of cubes, like crystals of rocksalt. In the beaten leaf, the crystals are so arranged



THE BEHAVIOR OF A GLASS BEAD AND GRAPES IN SODA WATER

FIGURE 11: *The glass bead, if clean, collects no bubbles, and the soda water fastens on it, or "wets" it, so it sinks and remains at the bottom. But, if the bead is made greasy, it collects bubbles, which act like buoys and bring it up to the top. The bloom on the grapes prevents them from being wetted, so bubbles form and cause them to rise.*



ATOMS AS REVEALED BY X-RAYS

FIGURE 10: *The close-packed arrangement of atoms in gold, silver, copper, aluminum (and iron when heated)—each atom having 12 immediate neighbors.*

that one face is parallel to the plane of the leaf, or nearly so. When gold leaf is heated, the regularity disappears; and the crystals are arranged in a haphazard manner.

It is curious that gold leaf, which shows the familiar yellow color by reflected light and is green by transmitted light, becomes white, or nearly so, after heating.

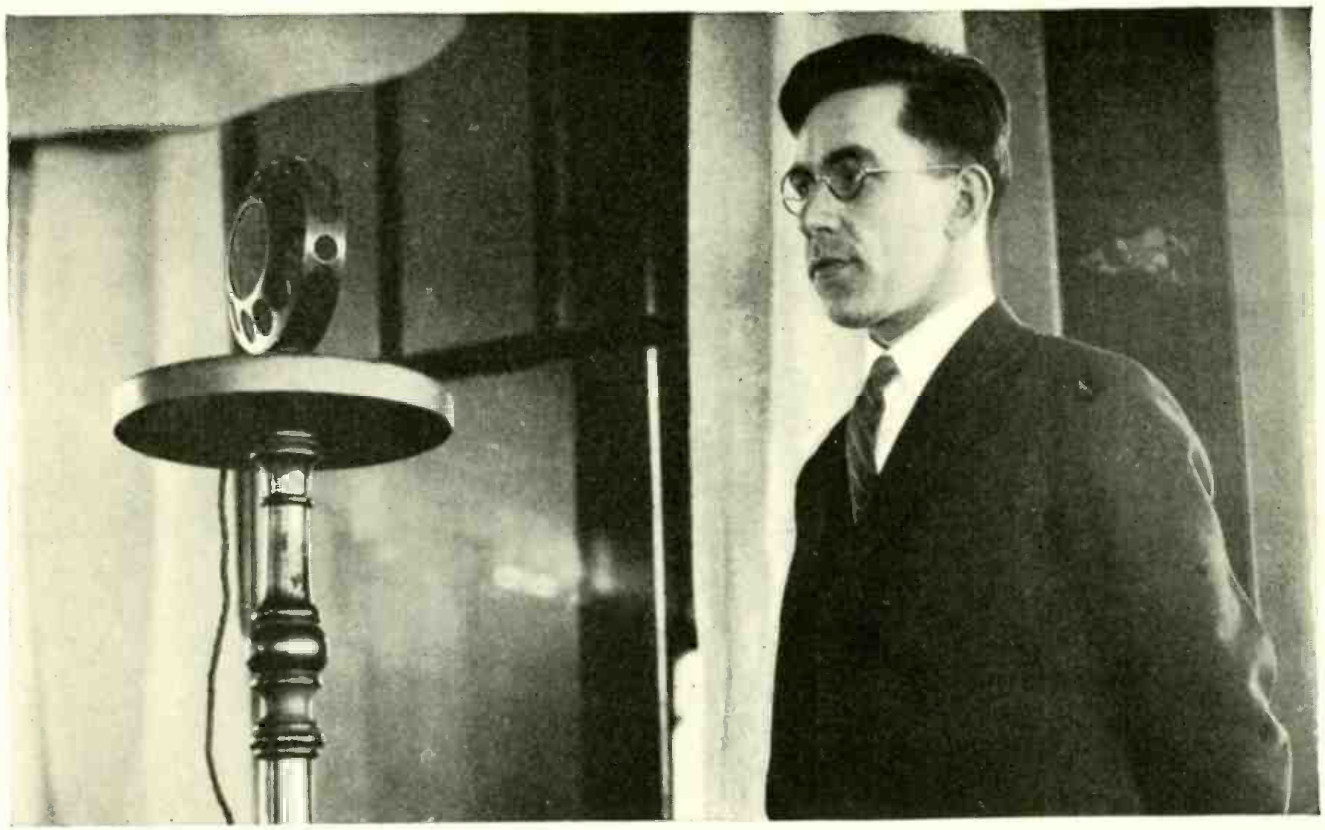
Faraday was very much interested in these color effects, though he could not find an explanation which satisfied him. Sir George Beilby has also investigated them, and has shown that under "cold working," whether drawing, rolling, or beating, the metal actually flows.

The X-ray experiments carry the investigation a stage further, and show that the flow which is due to cold working results in a rearrangement of the crystals; we may think of it as due to their re-forming in new aggregates under the influence of the forces.

When gold has been heated and becomes white, and is allowed to cool, retaining its white color and increased transparency, the pressure of a smooth agate pestle brings back the old characteristics and colors of the beaten leaf. No doubt, the regularity of arrangement is more or less restored. The arranging and disarranging, which are so easily demonstrable in the simple case of foil, are no doubt concerned intimately with the hardening by cold working and annealing by heat which are familiar to metal-workers.

The remarkable properties of alloys and their great variety are among the most interesting and important questions in metallurgy. To take a simple and ancient example, why should a small admixture of tin convert the soft and almost useless copper into hard and serviceable bronze? The X-ray will show that the copper crystal is merely a close-packed pile of spherical atoms;

(*Continued on page 358*)



Keystone View Co.

The First Minister Whose Income Is Entirely Dependent Upon His "Radio Parishioners"

The unique non-sectarian congregation of the Rev. Howard O. Hough of 'Way Down East in Portland, Maine, can boast of no pews, pulpits, pipe organs or other material equipment of any kind whatsoever—except broadcasting station WCSH. And that is only loaned to them for the allotted period on Sundays for religious services.

The Word of God—on 500 Watts

The novel experiment that is being made with the "First Radio Parish Church"

By L. T. PITMAN

"Canst thou send lightnings, that they may go and say unto us, Here we are?"
—Job, 38:35

IN the above words, quoted from the Bible, some of the more devout of churchmen have ingeniously read a prophecy of the coming of radio.

And now the first minister of the first regularly constituted "Radio Parish Church," as it is officially designated, may literally face the microphone on Sunday and announce to his thousands of broadcast listeners that constitute his parish, "Here we are."

This first Radio Parish Church, which is located in Portland, Maine, is unique in two particulars:

First: Its parishioners are all broadcast listeners who have no church edifice and whose place of worship is before their receiving sets.

Second: The minister is engaged solely in the work of the radio church, and has no outside interest, and his livelihood depends entirely upon subscriptions received from his unseen parishioners.

Religious organizations have for four years been using radio broadcasting for disseminating their teachings.* Many denominations are at present operating broadcasting stations, but none is as interesting or as unusual as the experiment of this radio parish.

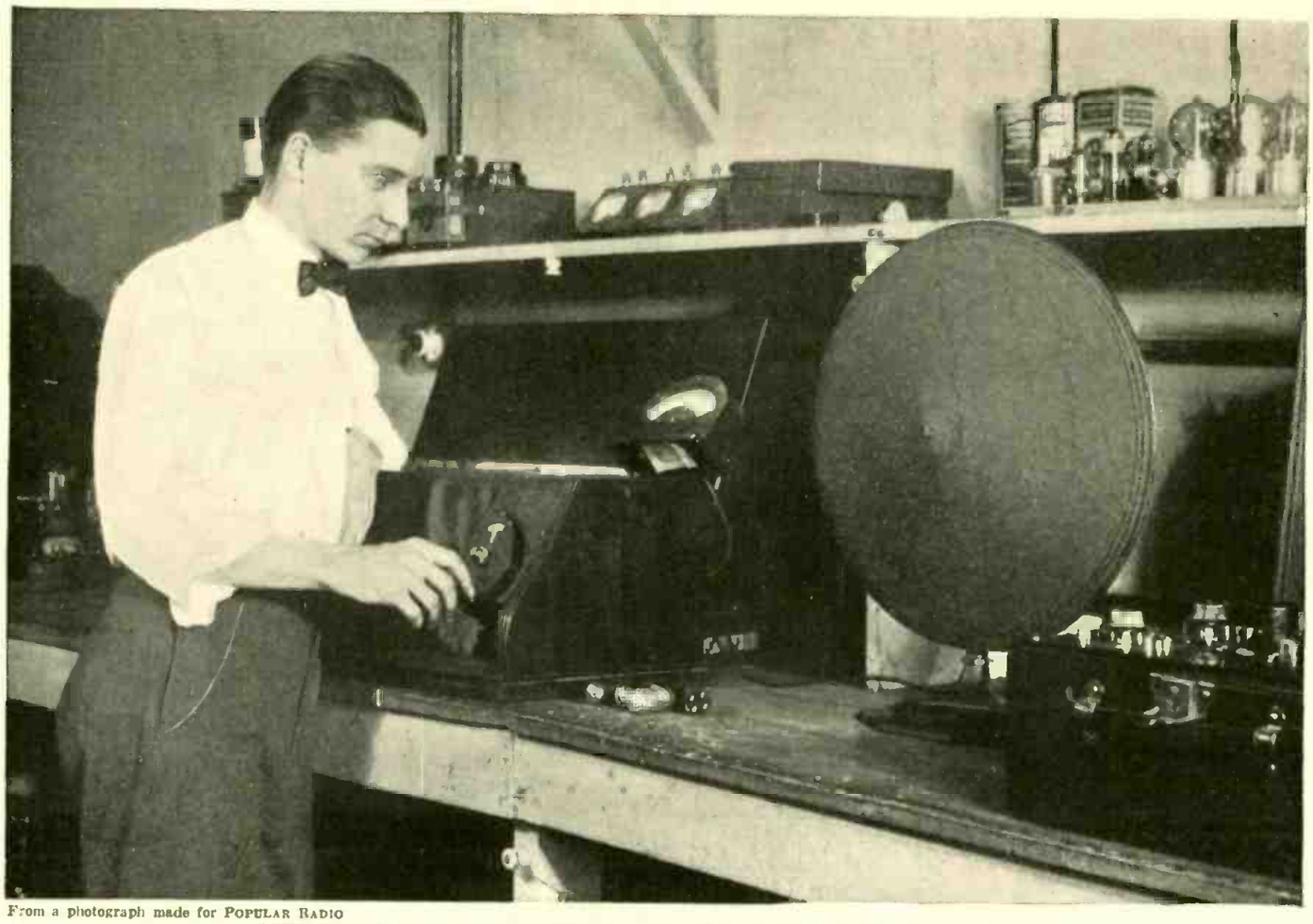
The Radio Parish Church uses the voice of station WCSH. Its pastor is the Rev. Howard O. Hough, who was installed as minister in due form. The number of its adherents is not known, but there are thousands who face, every day of worship, the microphone-pulpit.

*See "Religion's Raid on Radio," POPULAR RADIO, January, 1925.

True, during the past four or five years of broadcasting, there have been experiments somewhat similar to the one which station WCSH is attempting, but the Radio Parish Church is distinctive in that its pastor's time is devoted exclusively to broadcasting. He is, therefore, a minister with all of the duties and vicissitudes of any regular church, but with an unusual opportunity to administer the Word to those who have been forced absentees, or who would not listen.

The Radio Parish Church, as now constituted, is the conception of its pastor. With him have cooperated Henry P. Rines, owner, and William F. Foss, director, of station WCSH. The parish is a non-sectarian organization; it is planned to have preachers of prac-

(*Continued on page 361*)



From a photograph made for POPULAR RADIO

CHECKING UP ON THE "B" CURRENT CONSUMPTION OF THE SET

Before passing on the design of this improved receiver, the author and his associates tested it thoroughly in actual practice in the POPULAR RADIO LABORATORY *in New York City, in field tests at Atlantic City and in his own laboratory at Garden City, L. I.*

HOW TO BUILD THE IMPROVED

Browning-Drake Receiver

High efficiency that emphasizes fine tone quality is the outstanding characteristic of this new model, with its many improvements both in circuit and apparatus design.

By ARTHUR H. LYNCH

¶ *The list of parts given below 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 may be used with equally 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, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

COST OF PARTS: *Not more than $66.00*

HERE IS A LIST OF PARTS USED IN THE LABORATORY MODEL—

A and B—coil and variable condenser, respectively, of the National antenna tuning unit, type BD-1B;

C and D—coupling coils and variable condenser, respectively, of the National detector tuning unit, type BD-2B;

E—Jefferson "Concertone" sealed audio-frequency transformer;

F—Thordarson filter choke (this is the same type of choke that is used for "B" eliminator work);

G—Tobe paper filter condenser, 4 mfds.;

H1 and H2—Sangamo mica fixed condensers .002 and .006 mfd., as illustrated. (Dubilier, Aerovox or their equal may be used here or for U);

I—X-L variodenser, type N;

J1, J2 and J3—Lynch double resistance mountings;

K1 and K2—Tobe paper filter condensers, with a capacity of .1 microfarad each;

L1, L2 and M2—Lynch metallized resistors, .1 megohm;

M1—Lynch metallized resistor, .5 megohms;

N1, N2, N3, N4 and N5—Benjamin vibrationless sockets for UX tubes;

O—Lynch metallized resistor, 6 megohms;

P1 and P2—Lynch metallized resistors,

.025 megohms; and .09 megohms, respectively;
Q—Brach-stat, Code 2-B, with mounting;
R—Frost Gem-Jac, No. 954;
S—Carter battery switch;
T1 and T2—Tait brackets;
U—Sangamo mica fixed condenser, .0005 mfd. equipped with grid-leak clips;
V—Corbett sloping panel cabinet for a panel measuring 8 by 22 inches;
W—small brass brackets for mounting connection blocks (see Figure 9 for details);
X1—antenna connection block, (see Figure 9 for details);
X2—battery connection block, (see Figure 9 for details);
Y—decorated bakelite panel, 8 by 22 inches, (this panel was furnished by the Pausin Engineering Co.);
Z—hardwood baseboard, 9¼ by 21¾ inches furnished with the cabinet.
6 Eby binding-posts.

The National type B variable ratio Velvet Vernier dials are sold with the type BD-1B and BD-2B units mentioned above when specified by the purchaser—otherwise the standard National Velvet Vernier type A dials are supplied.

HERE is a receiver which combines all the advantages of a circuit that has long been recognized as standard with new ideas and improvements which have been made in receiver construction since the circuit was first developed.

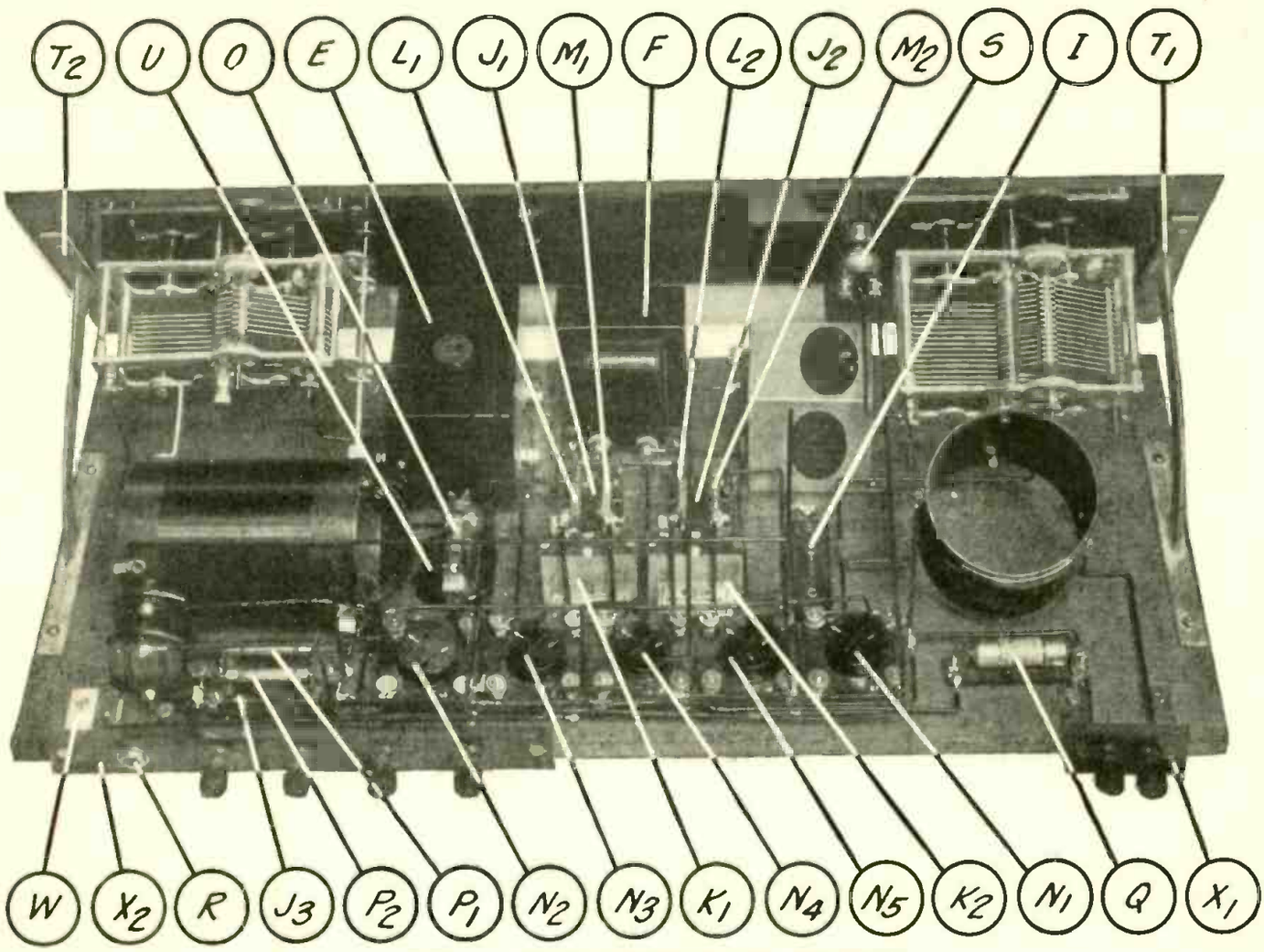
Extremely sharp tuning has been obtained by reducing the losses in the radio-frequency circuits to a minimum and remarkably low current consumption has been made possible without sacrificing volume range or quality. And, finally, the many minor features such as the elimination of hum in the loudspeaker when the set is used with the ordinary type of "B" eliminator and the extreme simplicity of the battery connections, help to make the new Browning-Drake receiver ideal for the home constructor who wants to build a good all round set with good quality, volume, range and selectivity.

Browning and Drake, as nearly every one interested in radio knows, became famous for their work in the design of radio-frequency devices having extremely low losses. A striking instance of the effectiveness of their work becomes immediately evident when it is considered that the radio-frequency resistance of the coils used in the present model receiver has been reduced by a rather ingenious method to 7 ohms.

The lowest resistance in coils of a similar nature, heretofore, has generally been in the neighborhood of 11 ohms. When coils of this character are used in conjunction with suitable variable condensers, the losses in the radio-frequency part of the receiver are negligible and the tuning is thus made extremely sharp.

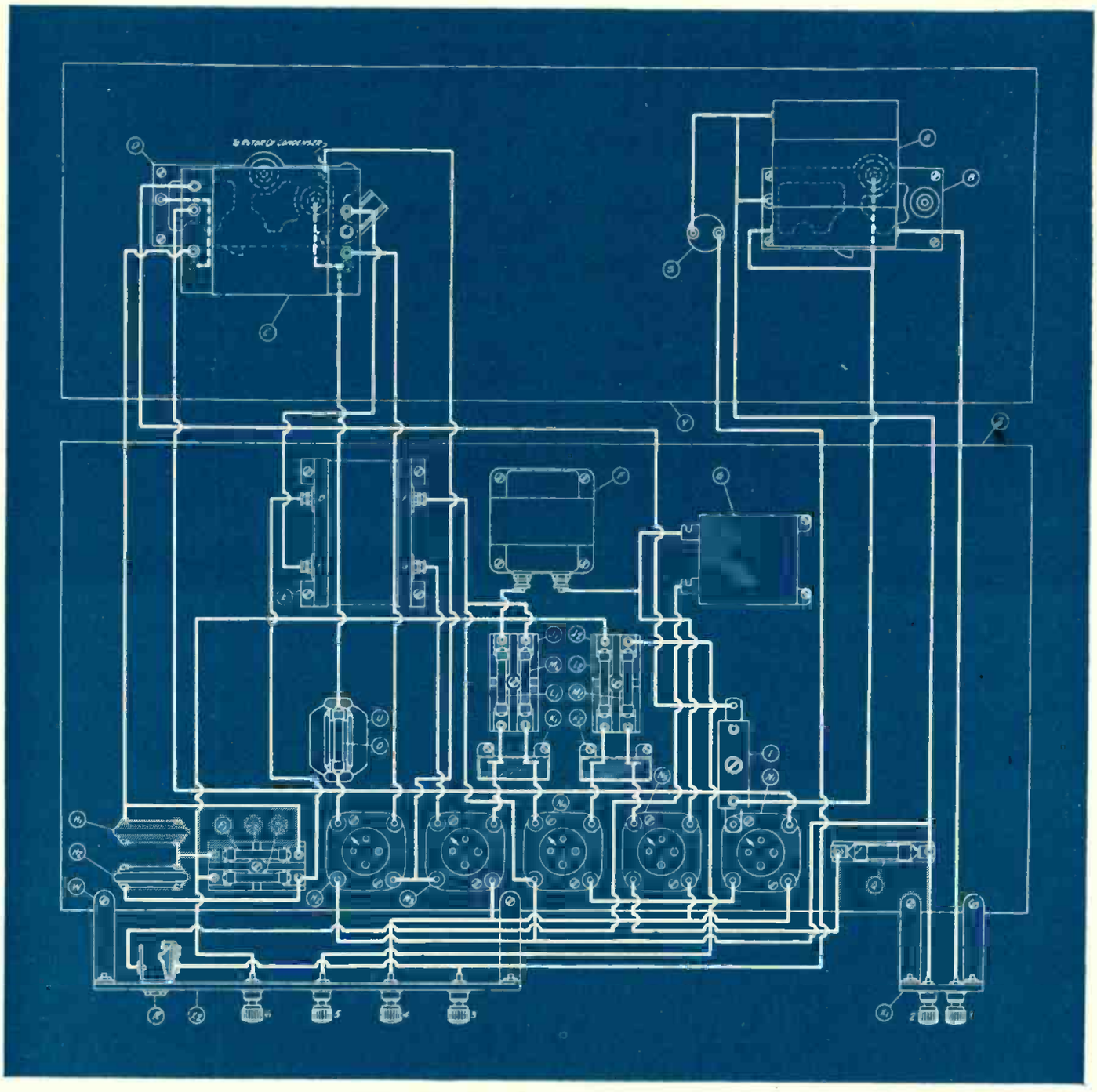
Without going into any long discussion of the advantages of the circuit, developed some years ago by Browning and Drake, it may be said, for those not already familiar with its arrangement, that it combines an antenna tuning device with a stage of tuned, neutralized-radio-frequency and a regenerative detector. Immediately following the detector, any system of audio amplification may be employed.

For a number of reasons (given later in more detail), the author has employed in the audio system one stage of transformer coupling, two stages of resistance coupling and a suitable output arrangement to permit the use of



A VIEW OF THE RECEIVER FROM THE REAR

FIGURE 1: *The general arrangement of practically all the instruments that are fastened to the panel or base. The exact locations for the instruments are shown in the working drawings on the following pages.*



THE PICTURE WIRING DIAGRAM

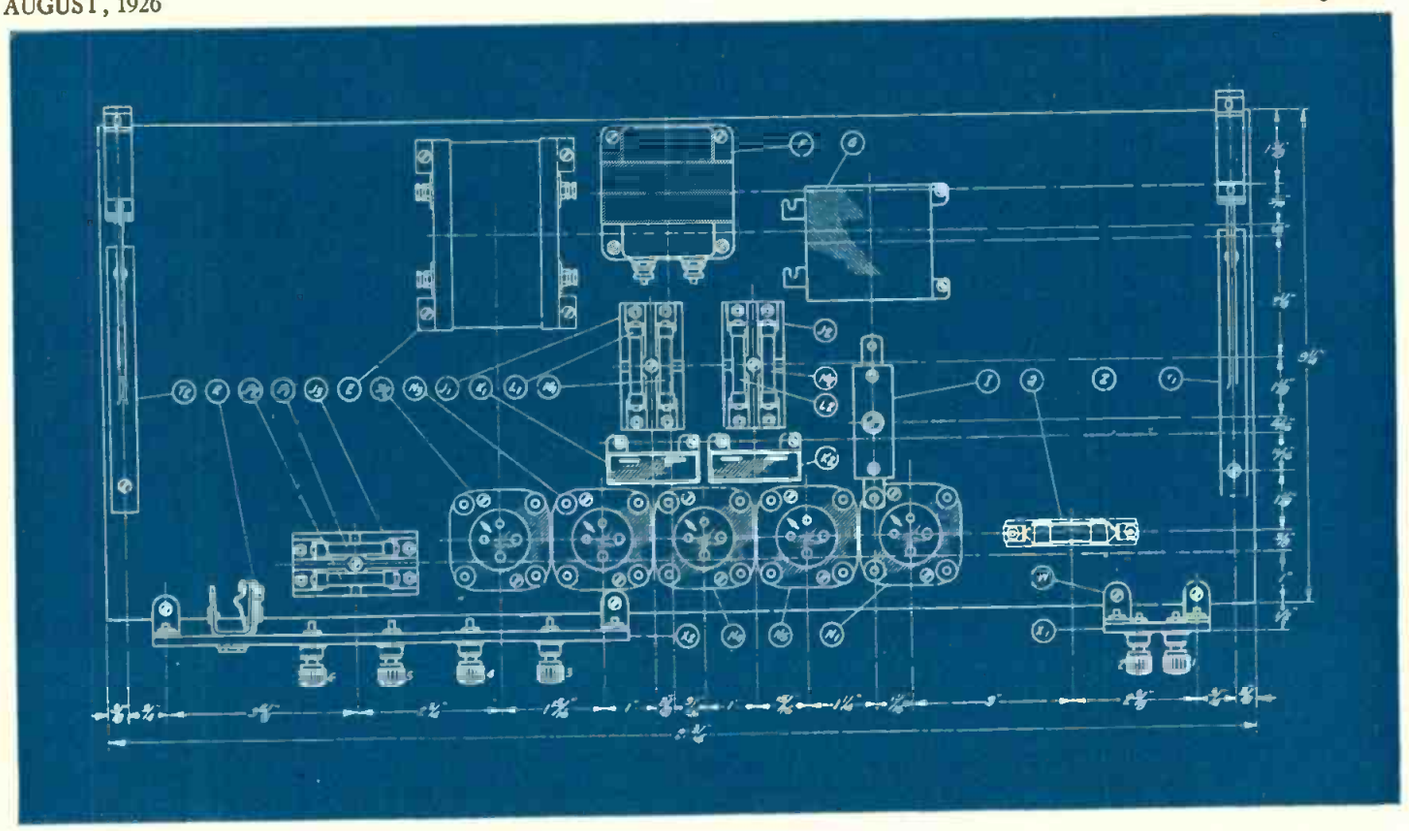
FIGURE 2: *The lower rectangle represents the base and the upper, the panel; both show the instruments in approximately their correct positions. The heavy white lines show the way to connect up the mounted instruments.*

the new UX-171 power tube and to keep the high voltage direct-current recommended for such a tube out of the loudspeaker windings. The new Ceco power tube has also been found satisfactory.

In the design of this receiver, one of the principal considerations, was the reduction to an irreducible minimum of the amount of current drained from both the "A" and "B" batteries and, at the same time, the provision of satisfactory volume for loudspeaker operation.

The plan in its original form called for the use of two 199 tubes in series, two high-mu tubes and one power output tube. At the suggestion of Mr. Laurence M. Cockaday, the two high-mu tubes were replaced by two more 199 tubes having their filaments in series so that the entire current consumption in the filament circuit is not more than .62 of an ampere. The results obtained were quite a surprise to the writer; and all who have heard the receiver in operation marvel, first at its volume, and then at its exquisite tone quality with the small tubes. This reduction in filament current consumption means that the receiver will perform over long periods without recharging the storage battery even though the battery itself may be of small capacity.

Another result of this change has been a decided reduction in the plate current so that the "B" batteries will last much longer. The greatest drain on the "B" batteries takes place in the output tube or power tube. However, the drain on the "B" batteries caused by the operation of all five tubes is sufficiently low to permit the use of standard sized "B" batteries, which under ordinary operating conditions of from three to four hours a day, will not wear out for at least a year. This greatly reduces the annoyance of constant changes.



THE WORKING DRAWING FOR CONSTRUCTION

FIGURE 3: *The exact positions of all the instruments mounted on the base are shown in this layout; center to center dimensions are used. This drawing should be referred to constantly in building the set.*

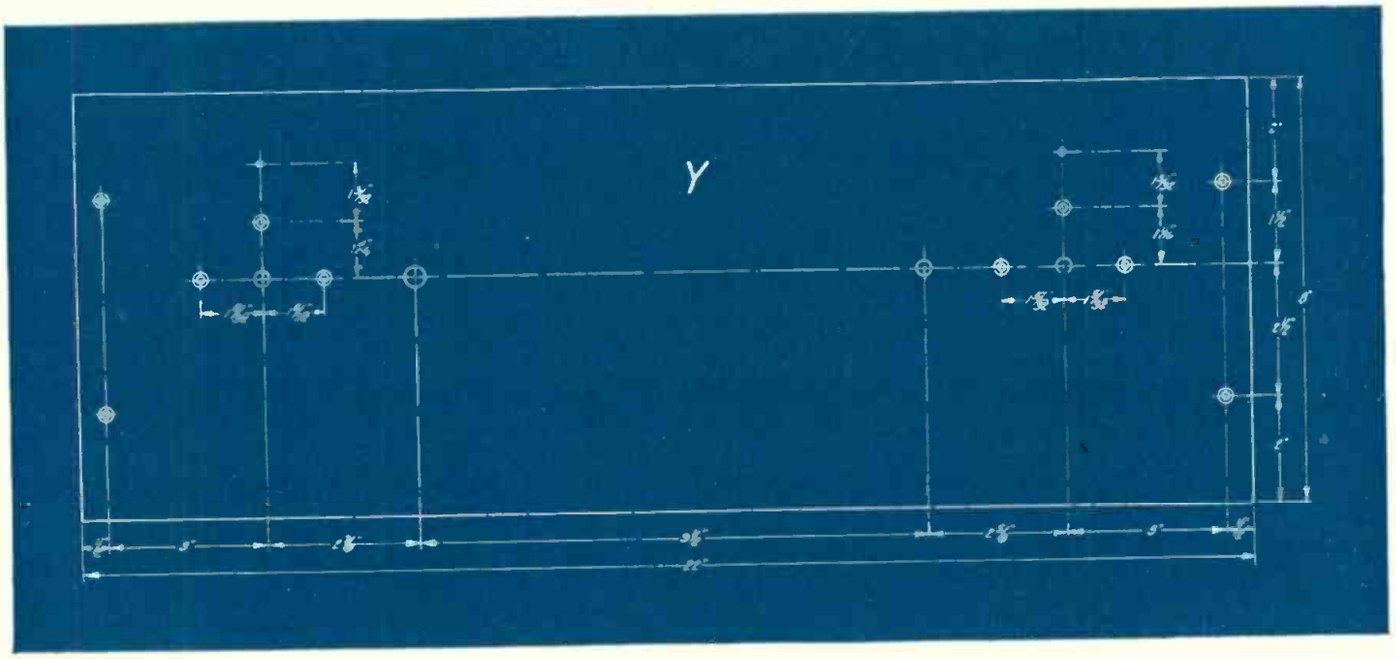
Operation from the Light Socket

Before considering the design of the audio-frequency circuit, it may be well to point out two or three common difficulties which have been eliminated in this receiver. The first question generally asked by the student of circuits when he sees this receiver is:

"Why did you use a transformer in the first stage of the audio amplifier?"

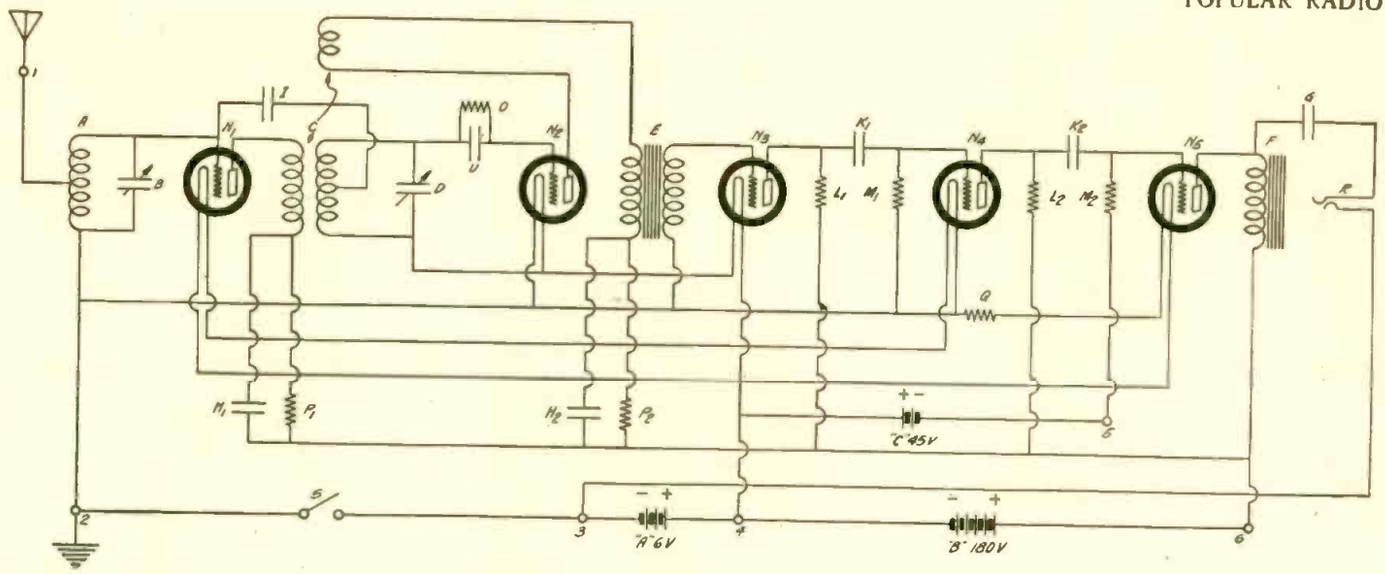
There are several answers to this question; the most important one, however, is that where three stages of resistance coupling of the ordinary type are used in a receiver, it has been found that a very undesirable hum is heard in the loudspeaker when one of the ordinary type of battery eliminators is employed. This hum may, of course be overcome by the proper selection of condenser and resistance values in the resistance-coupled amplifier but the simplest solution is found in making the first stage of the amplifier transformer-coupled.

Another reason for the use of the transformer is that, because of its step-up



WHERE TO DRILL THE PANEL

FIGURE 4: *The exact positions for the holes that must be drilled in order to mount the panel itself and also to mount the instruments on the panel. The holes outlined with the double circles should be countersunk.*

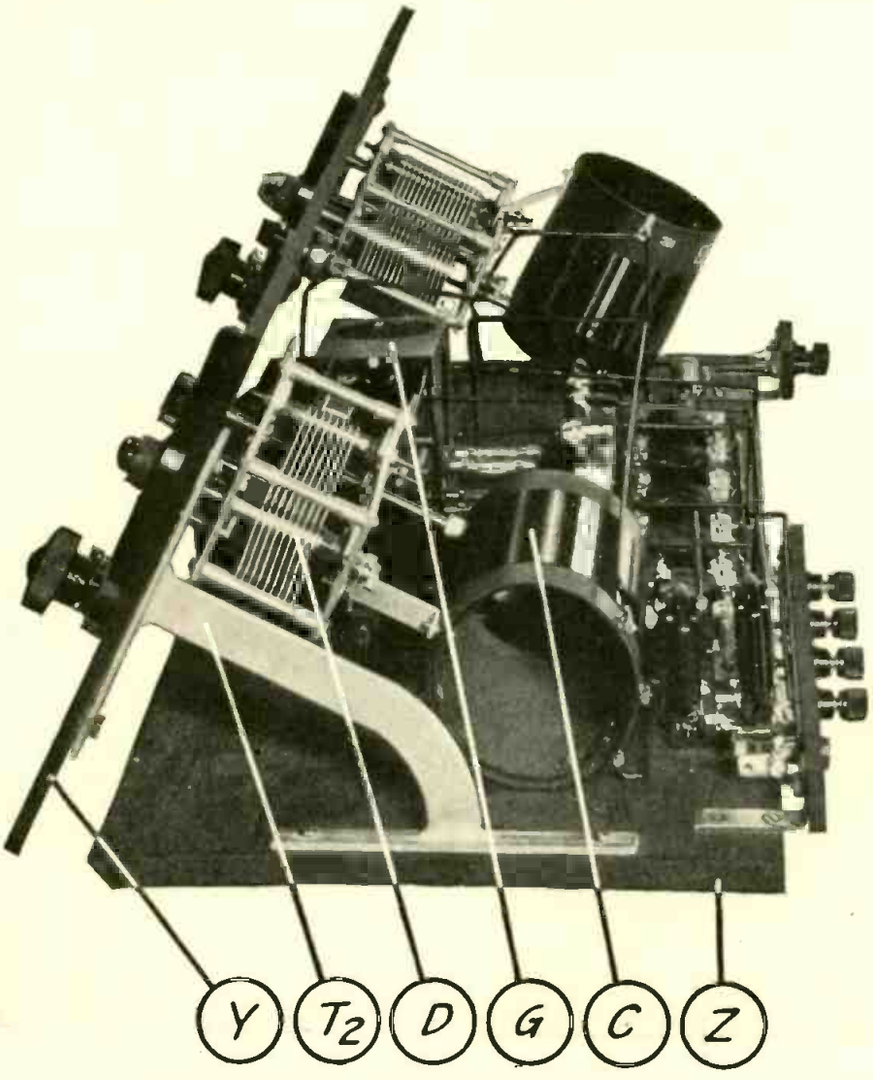


THE CIRCUIT DIAGRAM FOR THE RECEIVER

FIGURE 5: *The complete hook-up at a glance. All the symbols for the instruments bear designating letters which are used in the list of parts, the text and the illustrations.*

ratio, the amplification obtained by the first 199 tube is greater than it would be if resistance or impedance coupling were employed.

It should be borne in mind, however, that the transformer used should, by all means, be a good one. There are at present on the market a number of transformers that may well be put in this class and that will give good results.



THE RECEIVER AS SEEN FROM THE RIGHT

FIGURE 6: *This end view of the receiver gives a general idea of how the tuning units and the adjacent apparatus are mounted.*

This receiver has been tried with a number of regular battery eliminators without producing a hum, although when the same eliminators were used with receivers employing three stages of the ordinary type of resistance coupling, the hum was very disagreeable. No change has been made from the ordinary values used in recognized resistance coupling other than the changes indicated in the values of the grid-leaks and these changes have been made to obtain the proper grid-bias for the 199 tubes.

Therefore, we find that in the present combination we have plenty of volume without distortion at a very moderate consumption of current in both the "A" and "B" circuits. The current used in the "C" circuit is, of course, negligible.

A Unique Feature for Cutting Down "Parasytic" Coupling Effects

Serious consideration has been given in the design of this receiver, to the problem of making it as simple in operation and set-up as is consistent with good design.

It is a well-recognized fact that the ordinary receiver that has five or six wires running to the batteries is subject to a certain amount of pick-up from local stations because of these wires. Then, too, another fault is introduced, known as coupling, in the circuits which are made by these wires.

In order to reduce the number of wires outside the receiver to a minimum, and also to cut down the possibility of parasytic coupling effects, two fixed resistor elements have been employed to reduce the normal plate voltage to the proper value for use with the radio-frequency tube and the detector tube.

To offset the bad effects such an arrangement would ordinarily set up in the radio-frequency circuits, these re-

sistors have been shunted by suitable fixed bypass condensers. The direct current from the "B" battery thus flows through the resistance to the plate of the desired tube at the proper voltage and the radio-frequency current (or the voice current as the case may be) passes through the bypass condenser.

A table of resistance values for two "B" battery voltages is appended and it will be seen at once that variation of the plate voltage may be brought about by merely changing the value of the resistor used in either the detector or radio-frequency plate circuits. It will be noted that the value of these resistors is quite low in comparison with familiar types.

How to Construct the Set

After all of the instruments and materials for building the set have been procured, the panel (shown in Figures 1, 2 and 4) should be prepared.

First of all, cut the panel to the correct size, 8 by 22 inches. Then, square up the edges smoothly with a file.

The centers for boring the holes, which are used in mounting the instruments, should then be laid out on the panel, as shown in Figure 4. A convenient method is to lay out all center holes on a piece of paper the same size as the panel and then to fasten the piece of paper on the panel and to mark the centers directly on it by punching through the paper with a sharp pointed instrument.

If all of the holes are started first with a small drill, one-sixteenth of an inch in diameter or less, they may be more nearly centered.

The holes that are outlined with a double circle, in the diagram, should be countersunk so that the flat-head machine screws that are used for fastening the instruments may be flush with the panel. All the rest of the holes are straight, drill holes. Sizes for the diameters of these holes have not been given; but the builder may easily find what size holes are necessary by measuring the diameter of the screws and shafts of the instruments that must go through them.

When the panel is drilled, the builder may give it a dull finish by rubbing the face of the panel lengthwise with fine sandpaper until it is smooth. This process then should be repeated, except that light machine oil should be applied during the second rubbing.

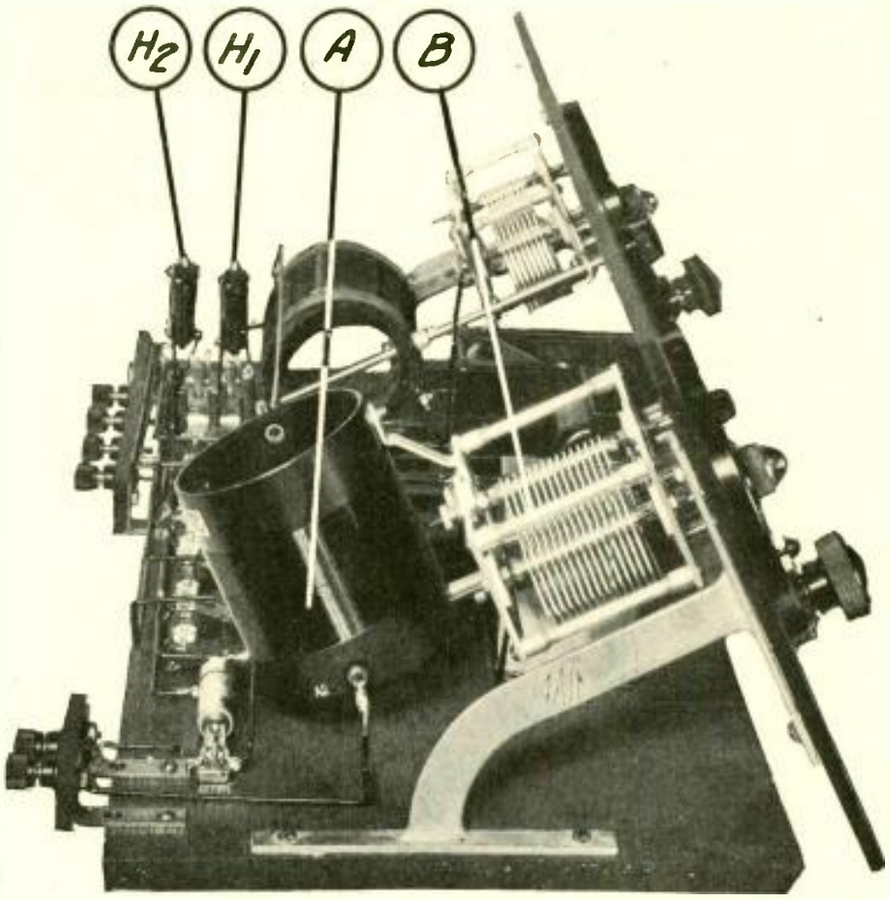
Finally rub the panel dry with a piece of cheesecloth. A permanent dull finish will be the result. Or, the panel may be left with its original shiny-black finish, if care has been exercised not to scratch it during the drilling.

If a "tailor-made" drilled and engraved panel is bought this work will be unnecessary, as the drilling and finishing have already been done by the manufacturer of the panel.

After the panel has been prepared the experimenter is ready to mount the instruments upon it.

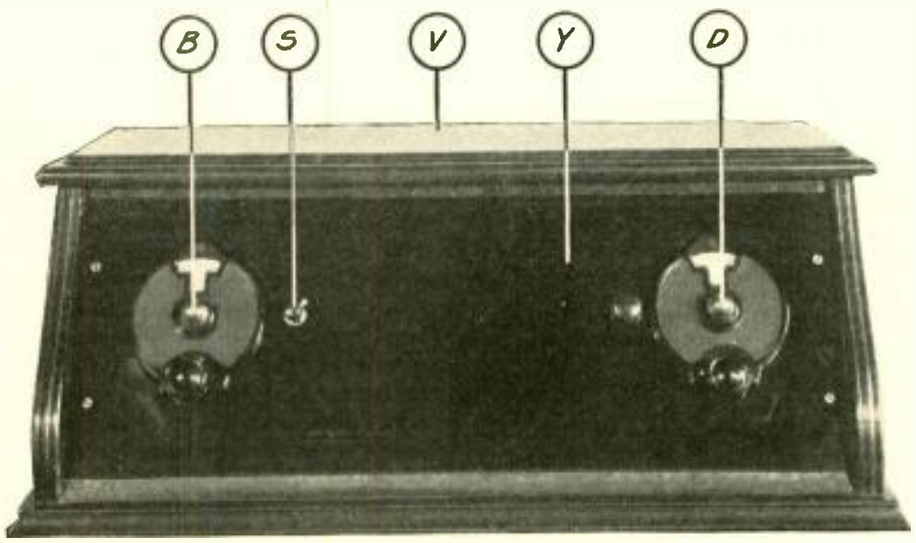
First of all, mount the tuning unit AB. To do this properly the coil A, which is attached to the condenser, B, must be taken off and the supports reversed so that the coil A sticks out in an opposite direction, as shown in Figures 1, 2, 6 and 7. The coil, A, is fastened to the condenser, B, by means of two screws. When this has been done, the unit may be fastened directly to the main panel Y by means of three screws.

Next, attach the dial to the tuning unit, AB, taking care that the small pin in the top of the dial engages



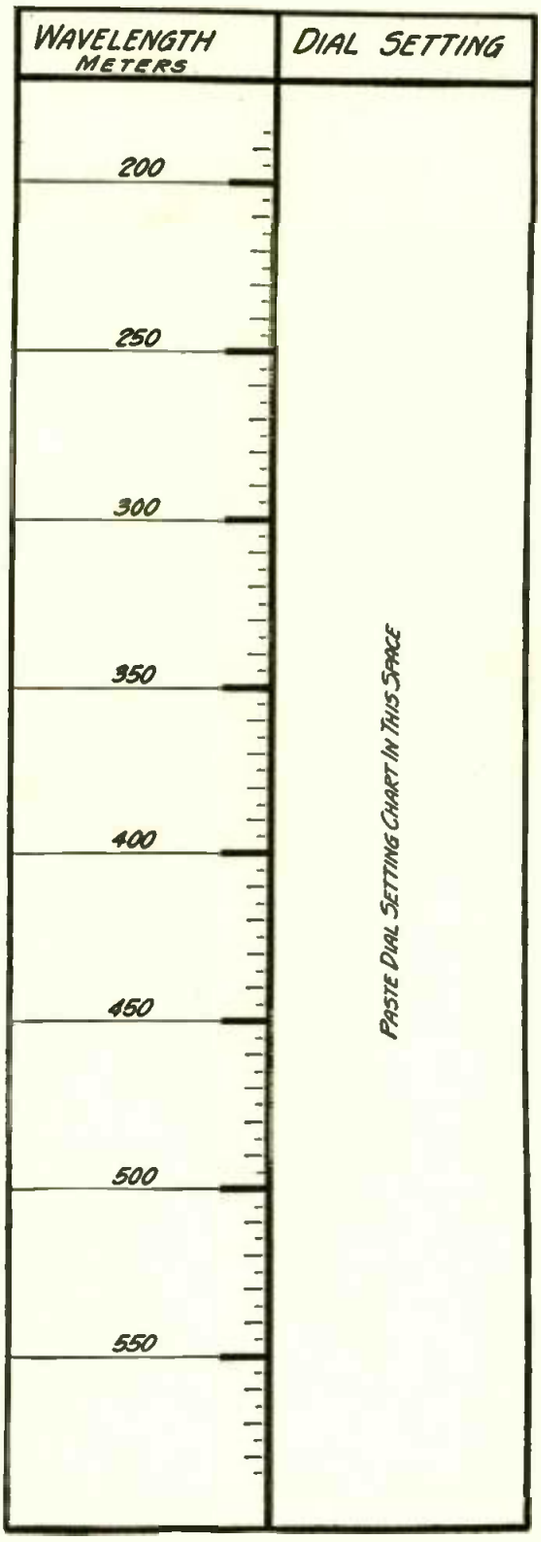
A LEFT-HAND VIEW OF THE SET

FIGURE 7: *The way in which the antenna tuning coil has been inverted on its condenser and the manner in which the panel is fastened to the base with heavy angle brackets are both shown here.*



THE FRONT OF THE RECEIVER

FIGURE 8: *The knobs and dials are marked with letters corresponding to the instruments to which they are attached. The small number of tuning controls show how operation has been simplified.*



A Tuning Chart to Adjust to Your Own Set

INSTRUCTIONS FOR USE: *Cut out the chart at the left and paste it on a piece of thin, stiff, white, bristol paper. Then cut out the small chart at the right. It should be pasted in position on the blank space on the right-hand side of the main chart underneath the heading "Dial Setting." To get it in exactly the right position tune in a station of around 350 to 450 meters and find out what setting it comes in on on your dial. For instance, a station on 405 meters would come in somewhere near 113, 114 or 115 on your dial according to the variation of the condenser in the set. If it comes in at 114 (say), paste the dial setting part of the chart in place so that 405 meters on the wavelength scale is exactly opposite 114, on the dial setting scale. Then all the other stations will tune in approximately as indicated by the completed chart.*

through the hole drilled directly above the center line for the shaft. This pin is used to keep the dial from turning.

Then prepare the second tuning control, CD, for mounting on the main panel, Y. The coil unit C that forms a part of this tuning unit should also be reversed so that the small inside coil will face to the right instead of to the left when looking from the rear of the set. Attach this tuning unit to the panel Y by means of three screws with the volume-control shaft and the condenser shaft protruding through the panel.

Attach the tuning dial to this instrument and also the small volume-control dial. The volume-control dial simply screws on to the threaded shaft. Then mount on the panel Y the small battery switch S. This is mounted next to the tuning dial of the tuning unit AB, as shown in Figures 1 and 8.

This completes the mounting of the instruments directly on the panel Y, and you are now ready to mount the instruments that go on the baseboard Z that is supplied with the cabinet V. (Reference to Figure 3 will make it easy to mount the instruments in their proper positions).

Begin by mounting the five vacuum-tube sockets, N1, N2, N3, N4 and N5, care being taken to place them with the arrows pointing in the proper direction, as shown in Figure 3.

Fasten to the baseboard, Z, the transformer, E, by means of four wood screws, as shown in Figure 3. It should be attached with the grid and filament terminals turned to the right-hand side, as viewed from the back of the set.

Mount the choke coil, F, by means of four screws, as also shown in Figure 3.

Now the condenser G may be mounted with the two terminals in the position shown in Figure 3. This should also be fastened by means of four small wood screws.

The next job will be to mount the two double resistor units J1 and J2, as shown in Figure 3. These are mounted by means of one screw to each mounting. The third double resistor mounting, J3, should be placed in position, as shown in Figure 3, and attached to the baseboard with a single screw.

Then, the two condensers K1 and K2 should be attached to the baseboard, Z, with the terminals placed as shown. These should be fastened down to the baseboard by means of two screws to each instrument. The mounting for the automatic-filament control, Q, may then be placed as shown and fastened to the baseboard with a single screw.

The two binding-post connection blocks X1 and X2 should be prepared as described in Figure 9. When the binding-posts and the jack, R, have been fastened in their correct places, attach the small brackets, W, to the proper holes at the extreme end of each block. The two blocks may then be fastened to the baseboard by means of two flat-head wood screws to each brass bracket.

This completes the work on the base-

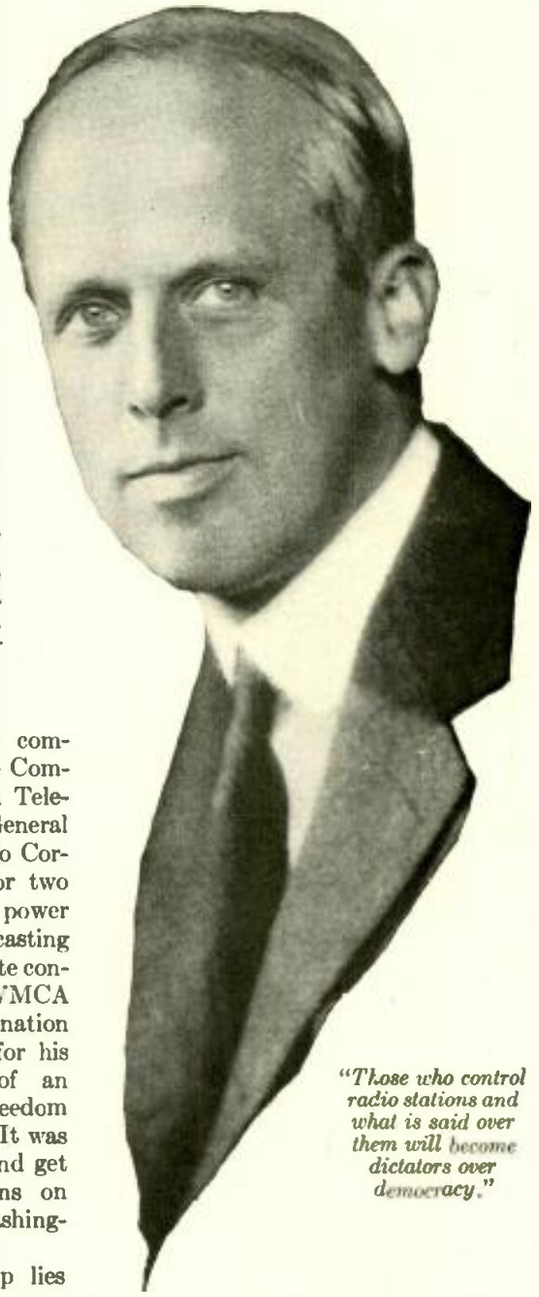
(*Continued on page 364*)

¶ The eternal struggle for "freedom of speech" is now entering upon a new phase—a struggle for the "freedom of the air," as expressed in the control of broadcasting stations.

Is there a radio CENSORSHIP?

Dr. Norman Thomas, *who classifies himself as a liberal and who is classified by some as a radical, answers*

"YES"



"Those who control radio stations and what is said over them will become dictators over democracy."

When Station WEAF recently withdrew its invitation to Dr. Thomas, who is the executive director of the League for Industrial Democracy, to broadcast an address on "Education and Peace," it started a rumpus that was only augmented when stations WHAP, WMCA and WNYC also declined him a hearing on the ground that the talk touched upon controversial subjects. "Censorship!" charged Dr. Thomas, who added; "There seems to have grown up a curious and undemocratic notion in the broadcasting world that high public officials are sacrosanct, that what they say is not controversial, but that to answer it is." Here are Dr. Thomas' opinions on the subject—written especially for POPULAR RADIO.

RADIO broadcasting is today so controlled and censored that with rare exceptions only one side—and that the conservative—of public questions, political, social and economic, is presented to listeners.

There is a growing accumulation of specific evidence on this point. Speakers have been cut off in the middle of speeches, invitations to speakers have been cancelled, opportunity to speak has been denied, organizations and individuals whose views have been misrepresented have been refused all opportunity to answer the charges against them.

In the space at my disposal I cannot even list this specific evidence; I can, however, appeal to you to recall how often you have heard public officials, spokesmen for great interests, patriots of the National Security League brand, and how seldom their opponents.

There are two great sources of censorship:

(1) *The way in which licenses are granted.*

I do not believe that Herbert Hoover desires to be dictator over the air. It is, however, a matter of fact that labor and liberal organizations have found it impossible to get new licenses or purchase old ones and that the owners of existing stations are extraordinarily careful to avoid any criticism of the policies of the Cabinet officer and his associates in the Administration to whom they must look for licenses.

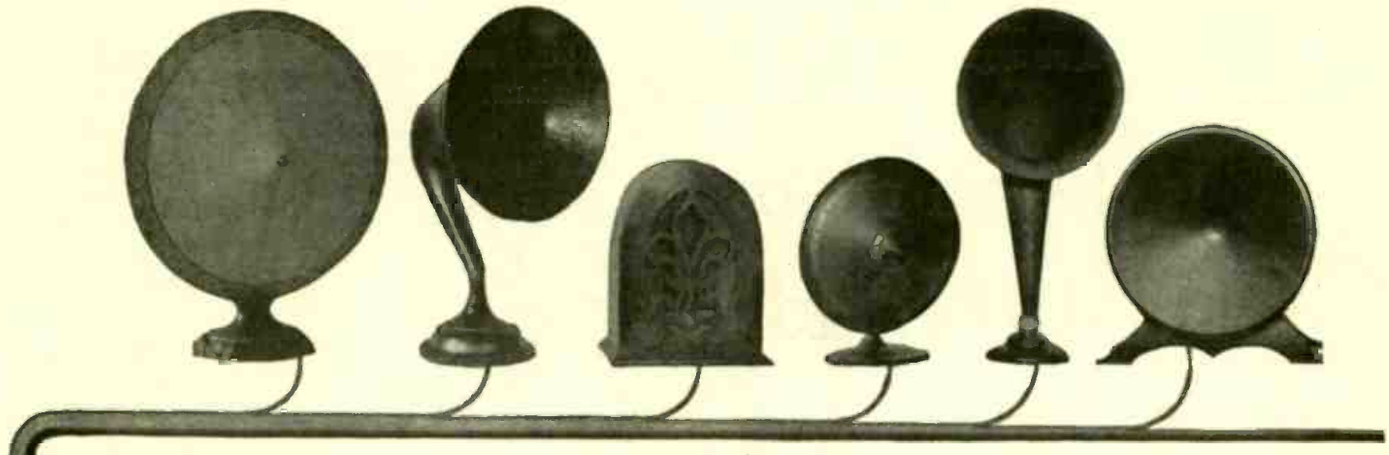
(2) *The power that is inherent in the so-called "radio trust."*

This trust, according to the complaint filed by the Federal Trade Commission, comprises the American Telephone and Telegraph Co., the General Electric, Westinghouse, the Radio Corporation of America, and one or two others. It exercises control by its power over patents necessary for broadcasting and over wires necessary for remote control. Donald Flamm of station WMCA admitted my case in the explanation he gave to the *New York Times* for his station's sudden withdrawal of an invitation to me to speak on "Freedom of the Air." Said Mr. Flamm: "It was better not to do anything rash and get into trouble with other stations on whom we depended or with Washington."

Behind this specific censorship lies the general failure of station managers, government officials, and the public itself to realize that radio must be a public utility. Only a limited number of radio stations are possible. Those who control them and what is said over them will become dictators over democracy. A radio company cannot have an "editorial policy" to which all speeches must conform unless such a station is carefully balanced by another with a different editorial policy. A radio station cannot use the poor pretext of refusing to accept controversial matter—a speech on a social problem which is in no sense controversial is dead—as a reason for barring some speakers while accepting others. In general radio stations must accept speeches on their merit without discrimination because of their point of view.

The bill drawn up by Senator Dill goes a long way in the right direction. It declares radio a public utility, has provisions against monopoly and discrimination and sets up a non-political commission to grant licenses and in general regulate this broadcasting business which already has acquired such significance in our democracy. A non-partisan commission giving all its time to radio will be exempt from the fear that it may use its power to punish stations for expressing controversial opinions.

There is no other way out. If you want freedom of the air back Senator Dill's admirable bill.



HOW TO PICK OUT A LOUDSPEAKER

What is the best speaker to use with your transformer-coupled amplifier? Or with your impedance-coupled amplifier? This article tells you how to determine the particular type and quality of speaker—cone, horn or cabinet—that will prove most efficient *with the set that you use*.

By LAURENCE M. COCKADAY

THE BEST WAY TO SELECT YOUR SPEAKER

The set with which it is to be used should be placed on the testing table; and connected with each of the loudspeakers in turn by means of the plug - in arrangement shown above. In this way the apparatus that gives the best results IN ACTUAL OPERATION *may be chosen.*

THE quality of radio entertainment depends, more than on any other single factor, upon the loudspeaker that you pick out to use with your set.

Yet when the average man walks into a radio store to buy his first loudspeaker he is at a loss when he is called upon to decide what kind he should select from the horn speakers, cabinet speakers, cone speakers, loudspeakers of all shapes and sizes that are spread out before him in a bewildering array.

Just which type should he buy? Would his set work better with a horn or a cabinet speaker? Would his wife tolerate a barrel-like cone or a goose-neck horn? Or, after all, does it make any difference which one he takes home?

And in the end he may pick one at random—and one that is just as likely to give him wretched as enjoyable reception.

But the experienced radio fan takes certain definite points into consideration when he picks out his loudspeaker. To determine which one best suits his needs he asks himself the following questions:

What type of audio-frequency amplifier does my set use and what is its relative quality?

What is the approximate size of the room in which I intend to place my loudspeaker?

What is the relative amount of power that will be supplied to the loudspeaker by the last tube of my set?

Once these three points are settled in the prospective purchaser's mind, it is really a simple problem to choose the proper speaker to use with his receiver.

Audio-frequency amplifiers may be roughly classified under three heads:

A—transformer-coupled amplifiers;
B—impedance-coupled amplifiers;
C—resistance-coupled amplifiers.

Transformer-coupled amplifiers may be again divided into those of a high quality and those of a cheaper grade.

If your set is equipped with a high-quality transformer-coupled amplifier that will amplify all frequencies evenly and give even and faithful amplification, the use of a really good loudspeaker is fully justified. It will give its best results with one of the larger and more expensive cone-type loudspeakers. A cheaper speaker will not take advantage of the fine tone quality of which the amplifier is capable.

On the other hand, if the set employs a cheap form of transformer-coupled amplifier, the cone-type of loudspeaker will not be found to be as satisfactory, even if the most expensive grades are used. Much better results will be obtained from some of the horn or cabinet loudspeakers used with this type of amplifier.

Impedance-coupled amplifiers usually give the best quality reproduction when they are used in conjunction with a cone loudspeaker or one of the high-grade horn or cabinet type. It is never advisable to use one of the cheaper horn or cabinet loudspeakers with this type of amplifier because these speakers do not reproduce the low tones, and the good quality of reproduction that the amplifier gives may be entirely lost.

If your set is equipped with a resistance-coupled amplifier, it is worth while to employ one of the more expensive cone loudspeakers because this amplifier will give clear and faithful reproduction of broadcast programs.

In general, therefore, it is best to use a cone loudspeaker with all receivers that have power amplifiers that operate with a minimum amount of distortion.

On a mediocre amplifier, for medium volume, the horn or cabinet type loudspeakers are usually most suitable.

Two considerations—the size of the room in which the loudspeaker is to be used and the amount of power that is supplied to it—should be carefully weighed when you decide just how large a loudspeaker to buy.

If the room is fairly large, it is obvious that a bigger loudspeaker should be used than if the space which the sound must fill is small. Again, if the set supplies only a limited amount of power to the loudspeaker, it would be foolish to use one of the large cones which may be operated satisfactorily only by a powerful set.

A small loudspeaker should be used in a small room or with a small set, and only a large loudspeaker will give satisfactory results with a powerful amplifier. Common sense can be the only guide in the matter of these two considerations.

Finally, it is most important that actual tests should be made, using the loudspeaker on the set with which it is to be used.

Ask the clerk in the store to demonstrate a number of loudspeakers, and, if possible, to demonstrate them *with the set that you have decided to buy.*

Then make a careful comparison of the quality and volume that each loudspeaker gives on that receiver.

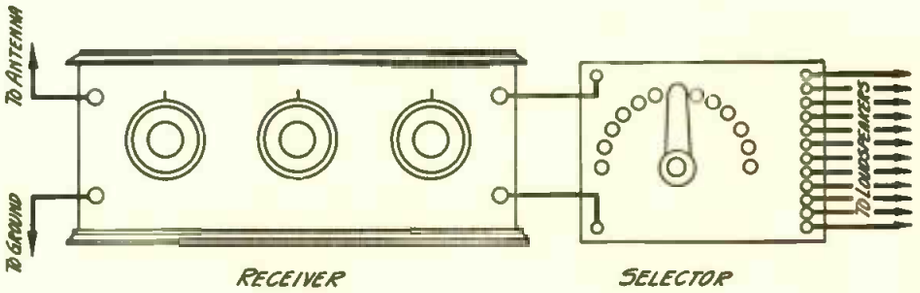
This is especially important in the case of the sets that employ the cheaper grade of transformer-coupled amplifiers, for it is only by actual test that it is possible to tell just which one of the horn or cabinet speakers will provide the proper characteristics to make it possible for the set to give the best possible performance.

There is no single factor that is more important in a radio installation than the choice of the proper loudspeaker to go with the type of set that is being used. You would never use a Ford motor with a Packard car nor could Chevrolet wheels be used on a Pierce Arrow; they would not fit or perform the proper duty although they may be entirely satisfactory when used with the type of car that they are manufactured for. In the same way, the various types of loudspeakers and various kinds of sets must fit each other electrically and acoustically if the best possible results are to be obtained.

Some inexpensive loudspeakers give really satisfying results when they are used with an inexpensive set; the results depend upon how the characteristics of the amplifying system combine with the characteristics of the loudspeaker itself.

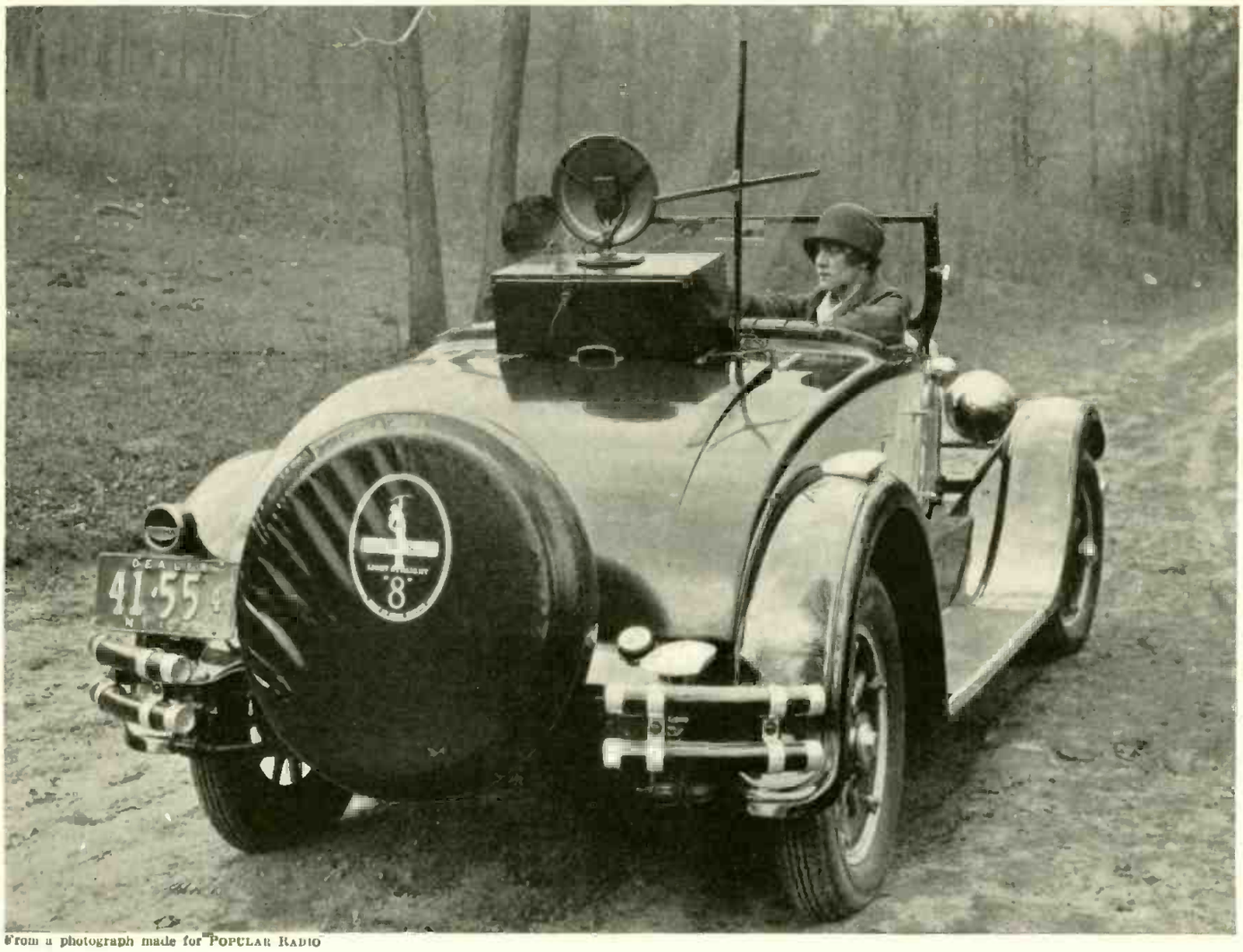
Remember that the best and most efficient cone-type loudspeaker may sound tinny and may give much distorted reception if the amplifier with which it is used does not amplify the signals excellently.

By keeping these few simple admonitions in mind and by making an actual test of various loudspeaker units with his set, even the novice should be able to choose a loudspeaker that will fit both his receiving set—and his pocketbook.



THE HOOK UP FOR THE LOUDSPEAKER SELECTOR

How the receiver should be connected to the selector so that a number of loudspeakers may be tested by actual comparison.



From a photograph made for POPULAR RADIO

A REAL "CROSS-COUNTRY" TEST OF THE SET

One of the hardest tests to which a receiver may be put is to subject it to the vibrations and jolts of a motor trip over country roads. This portable set was thus transported for hundreds of miles—with successful results that demonstrated its durable and serviceable qualities.

HOW TO GET THE MOST OUT OF YOUR

"Town and Country" Receiver

Data on the antenna, batteries, transformers and on the interchangeable coils that make it possible for this receiver to cover the wide wavelength range between 50 and 1500 meters, and that will help every owner to get the best possible results.

By S. GORDON TAYLOR

IF any reader who has built the new portable receiver that was described in the July issue of this magazine has any doubts concerning the practical, serviceable qualities of this set for ordinary vacation-time use the following report of the tests that have just been made with it will be informative and illuminating.

As this "Town and Country" set was designed by the POPULAR RADIO LABORATORY for out-door use during the summer season, the receiver was submitted to what is at once the most severe and at the same time the most common test to which portable sets are subjected—when it is placed in a motor car and exposed to the jolts and jars of ordinary road driving.

For the purpose of this test the original laboratory model that was shown in the July issue was employed.

The receiver was "installed" by placing it on the rear seat of a closed car with the open equipment carrying case (the loudspeaker was left in the case) lying on the car floor. The loop was propped up flat against the side of the car at one end of the rear seat.

Under these conditions the car travelled a total of over 1,000 miles, within a radius of 150 miles of New York City, and during this entire time, not even a tube was damaged although the seven tubes were left at all times in their sockets and the receiver was in operation both when the car was in motion and during stops.

Under these conditions good recep-

tion was obtained from stations up to 50 miles away.

During a short mid-afternoon stop, at a point 150 miles from New York City, several of the city stations were brought in with good loudspeaker volume and Schenectady, 300 miles distant, was tuned in with good loudspeaker audibility.

This represents excellent daylight reception for any receiver working under favorable conditions; in the present case it is all the more remarkable in view of the fact that the entire receiver and loop were inclosed within the all-steel body of the car.

During one of the tests, under more favorable conditions, over 40 stations were tuned in during a single evening. These stations included some as far away as Mexico City, Canada and California. This test was made with the receiver located in the author's home in New York City, where he employed only the loop antenna; in every case each station was held until its call letters were announced. This consumed a great deal of time, but guesswork was entirely eliminated and the resultant log of stations that were heard is authentic.

The Best Antenna and Ground

A study of the wiring circuit of the first detector, VT1, of the "Town and Country" receiver will show that the coil socket, A, and the loop jacks are connected in parallel to provide the input to the detector tube. When the loop is plugged into the three jacks the loop winding completes the detector circuit and signals may be received. Or if an outdoor antenna is used, the coil A is plugged into its socket and the antenna and ground are connected to terminals A1 and A2 of the coil socket.

Both the loop and coil A should not be plugged in at the same time.

If the receiver is permanently installed in the home during the winter months, either the loop or the outdoor antenna may be used at will.

Any type of outdoor antenna may be used with the receiver. If the antenna is extremely long it may be advisable to connect a small, fixed condenser of about .00015 mfd. capacity between the antenna and the receiver in order to sharpen up the tuning of the first tuning condenser, C1, although this same end may be obtained largely, by turning the rotor of coil A almost at right angles to the stator winding.

Extreme sharpness in the tuning of the condenser C1 is not essential, however, and will really provide little cause for worry because the sharp tuning qualities of the oscillator condenser, C2, will provide ample selectivity to prevent interference between stations.

There is little more to be said about the antenna except that, when a loop is used, the three wires that run from the loop to the receiver should be kept slightly separated; otherwise the capacity between these wires will be in shunt to the capacity of the condenser C1 and this will make it impossible to tune in the low-wave broadcasting stations. A separation of ½-inch or more between these wires is therefore recommended.

The Right Tubes to Use

The UX-199 type of tubes are used in all sockets except the last, where a UX-120 dry-cell power tube is used.

If the prospective builder happens to have on hand six of the old type UV-199 tubes (UV-199 or C-299) these may be used. In such a case it will be necessary to use suitable sockets, of course, as these tubes will not fit in the new universal type.

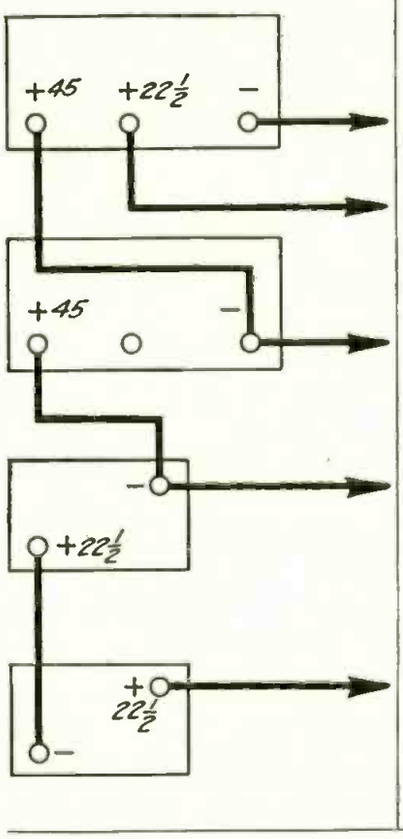
The UV-201-a type of tubes cannot be used in this receiver without extensive changes in the circuit.

How to Get the Maximum Results from the Batteries

By the use of six "A" batteries connected in series-multiple, as shown in the battery hook-up diagram in the July, 1926, issue, this life will be almost exactly the same as that of the four "B" batteries. This means that nine of the ten "A" and "B" batteries in this receiver will become exhausted at the same time and it is probably best, therefore, to replace all ten at that time rather than to continue to use the tenth with nine new batteries.

If the receiver is to be permanently installed at home during the winter months larger "B" batteries will be somewhat more economical. Referring to Figure 13, in the July issue, two large-size batteries would be used in place of the two shown in the lower right-hand corner and the single, intermediate-size battery would replace the two "baby" batteries that are shown to the left of these two.

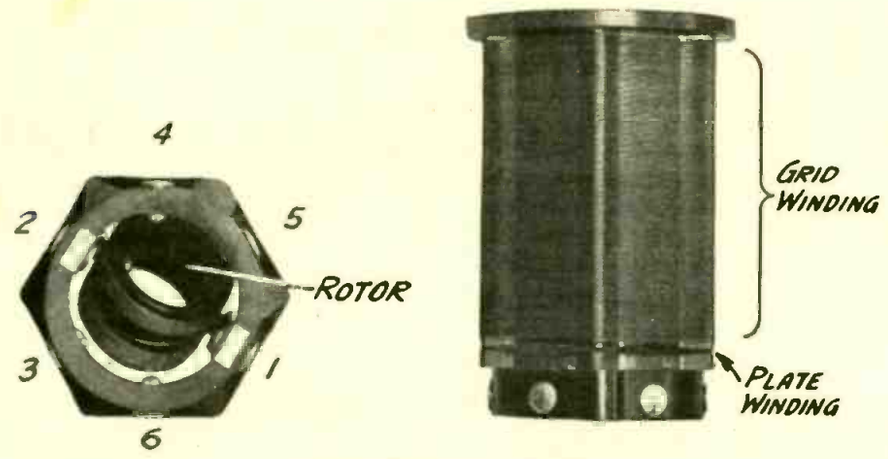
DATA ON PLATE CURRENT CONSUMPTION



BATTERIES	PART OF CIRCUIT	NO. OF TUBES	PLATE CURRENT CONSUMPTION MILLIAMPERES
	B−		
	TWO DETECTORS AND OSCILLATOR	3	1.5
	LONG WAVE AMPLIFIER	2	2.5
	1ST AUDIO AMPLIFIER	1	1.0
	POWER AMPLIFIER	1	4.0

THE DISTRIBUTION OF THE BATTERY DRAIN

FIGURE 1: *Half of the first large battery supplies the plate current for three tubes and it is also in the circuit of all the other tubes. The current drain is therefore 9 milliamperes on this section of the battery. The second half of this battery and all of the second battery are drawn on by only 4 tubes, a total of 7.5 milliamperes. The drain on the two small batteries is only 4 milliamperes as they supply the power tube only. It is this low current drain on the last two batteries that permits the use of the smaller size batteries in this part of the circuit.*



THE "PLUG-IN" COILS

FIGURE 2: *Two views of the No. 111A coil, one of the highly efficient coils used in this receiver. Forms for these coils may be purchased by those who prefer to "roll their own." Instructions for winding are given in the text.*

The connections for this combination of batteries are shown in Figure 3. It will provide over 400 hours of service before replacement becomes necessary.

The dry-cell "A" batteries that are recommended are those made expressly for radio work. Their size is the same as the ordinary 1½-volt door-bell batteries, but they are so constructed that they will give a great deal longer service with a radio receiver than will the ordinary type.

If desired, a 6-volt storage battery may be used in place of the dry-cell "A" battery. The rheostat that is used to control the filament current in this receiver is of sufficiently high resistance to control either a 4½-volt supply, as when dry cells are used; or a 6-volt supply, as when a storage battery is used. It need only be connected to the receiver in place of the dry cells.

The life of the "C" batteries is more than a year, regardless of the amount of use to which the receiver is subjected. This applies to the 22½-volt "C" battery in the battery case, as well as to the 4½-volt battery which is installed in the receiver cabinet.

The voltmeter on the panel may be used to test the voltage of all batteries except the "C" batteries. In the normal operation of the receiver the total "B" battery voltage may be seen by pressing the small button just above the dial of the voltmeter.

The exact "A" battery voltage is of little interest. All the operator wants to know is the voltage drop across the filament of the tubes and this is continuously shown on the upper scale of the voltmeter (except when the button is pressed to obtain the "B" battery voltage reading). When the "A" battery voltage has dropped to a point where the voltmeter registers less than three volts, even with the rheostat turned all the way to the right, it is time to lay in a new set of "A" batteries.

The voltage of the individual "B" batteries may readily be tested. Disconnect the "red" wire from the 135-volt binding-post of the battery, or of the binding-post strip in the equipment carrying case, and touch it to the 90-volt terminal of the battery, at the same time pressing the button on the voltmeter.

The resultant reading will be the voltage of the first two "B" batteries (originally 90 volts). Repeat this process, touching the red wire to the 45- and 22½-volt terminals to obtain the voltage of these portions of the battery. When the voltage has dropped to 34 volts for a 45-volt block it is time to replace the block.

The only precaution that is necessary to observe in making this test is to make sure that the red battery lead that is used in making the test is disconnected at the battery end rather than at the receiver end. *Also, do not attempt to check the "A" or "C" batteries by touching the red wire to their terminals.*

The Long-wave Transformers

When constructing the new "Town and Country" portable receiver, it is of the utmost importance that the long-wave transformers IFT1, IFT2 and IFT3 be matched for use with 199 tubes because those matched for the 201-a type tubes will not give maximum results when used with 199 tubes. If the type of tubes for which the transformers are matched is not plainly marked on the container, the transformers are matched for 201-a tubes and will not be suitable for this receiver.*

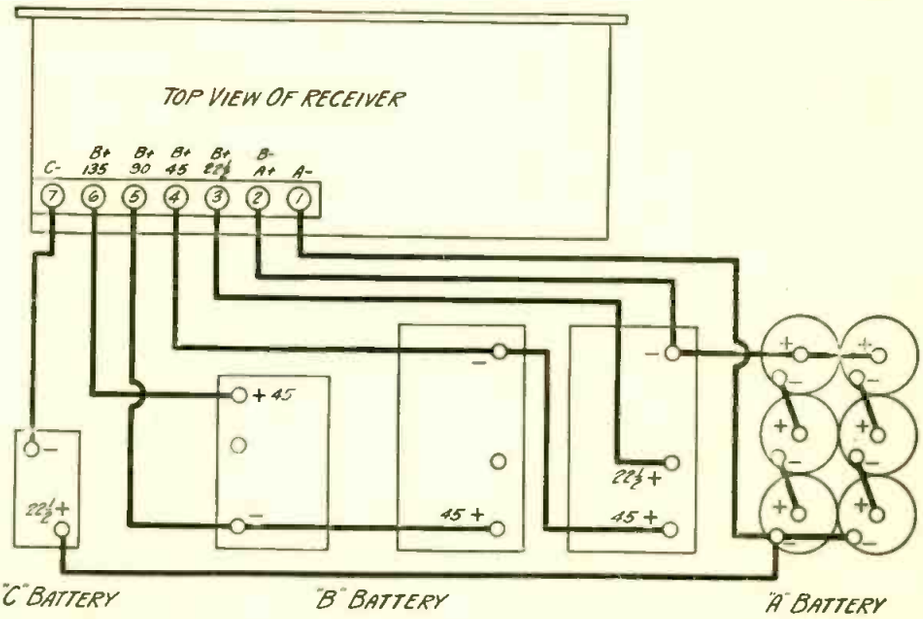
Long and Short-wave Range of the Set

One point which was not brought out in the July, 1926, issue of POPULAR RADIO is the great wavelength range of the new "Town and Country" receiver.

The use of the plug-in coil sockets, A and B (shown in the descriptive article in the July issue), permits the use of Silver-Marshall coils of varying sizes, with the result that a wavelength range of from 50 up to 1,500 meters may be obtained. This range covers the regular broadcasting waveband, 200 to 550 meters; the short-wave broadcasting, 60 to 100 meters; the amateur wavebands, 75 to 85 meters and 150 to 200 meters; and the various foreign amateur,

(*Continued on page 374*)

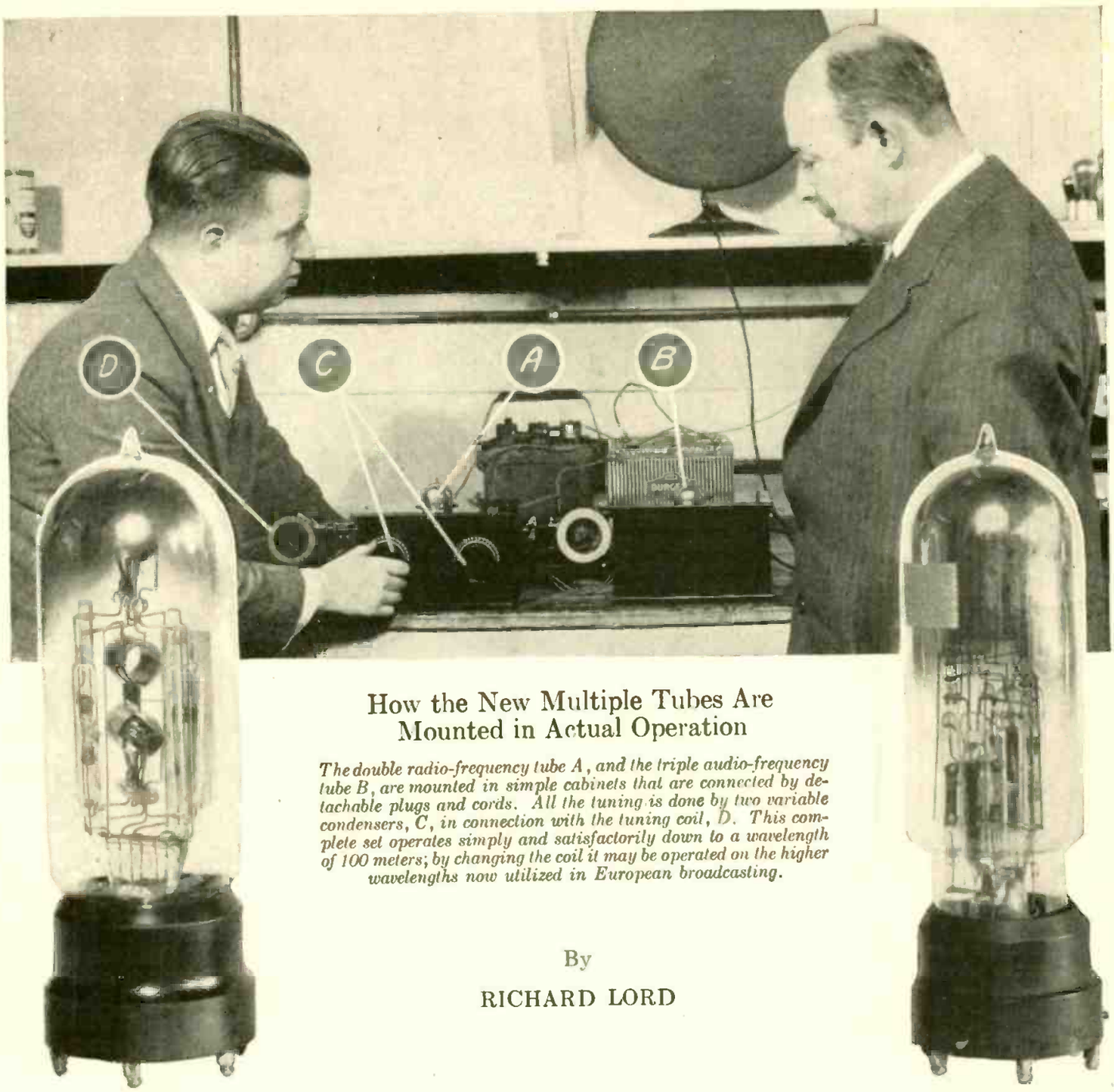
*The manufacturer of the transformers has had the 199 type in production for a considerable length of time and if your local dealer does not have them in stock he can obtain them readily.



THE BATTERY CONNECTIONS FOR HOME USE

FIGURE 3: *When the receiver is installed in the home, larger "B" batteries may be used and may be connected direct to the binding-posts in the receiver. The batteries suggested are the Burgess No. 3508 for the small 45-volt block and the Burgess No. 2308, or Eveready No. 772, for the two larger batteries.*

THREE VACUUM TUBES IN ONE



How the New Multiple Tubes Are Mounted in Actual Operation

The double radio-frequency tube A, and the triple audio-frequency tube B, are mounted in simple cabinets that are connected by detachable plugs and cords. All the tuning is done by two variable condensers, C, in connection with the tuning coil, D. This complete set operates simply and satisfactorily down to a wavelength of 100 meters; by changing the coil it may be operated on the higher wavelengths now utilized in European broadcasting.

By

RICHARD LORD

MULTIPLE tubes have for a long time been the talk and conjecture of radio experimenters and fans. And now the well-known German radio scientist, Dr. Sigmund Loewe, announces that such a tube, combining two or three stages of resistance-coupled amplification, has actually been developed.

Dr. Loewe has developed the tube for two different purposes: one for radio-frequency amplification (as shown in the tube on the left) and the other tube for audio-frequency amplification (as shown in the tube on the right.)

In the radio-frequency tube the inter-capacity of the tube itself has been so reduced that the resistance-coupling is efficient even down as far as 100 meters. The tube shown on the left contains the resistances and capacities for the first and second stage of radio-frequency amplification.

The new tube is made so that it fits into a simple tuner with two variable condensers and a set of honeycomb coils for tuning the input circuit, as shown in the illustration at the top of this page. The radio-frequency unit, therefore, comprises a small cabinet and one tube that does the work of two.

The second tube consists of a rather complicated arrangement for the vacuum-tube detector and two stages of resistance-coupled audio-frequency amplification, all built within the tube itself. This tube is mounted in a similar simple cabinet with the proper connections for telephones and batteries.

Both tubes function at a 4-volt filament potential with 150 volts on the plates with suitable "C" batteries.

Sets that employ this new device are now in common usage in Germany and it is to be expected that this or a similar unit will be soon in use in America.

Although these new multiple tubes are somewhat complicated in their internal arrangement of elements, they simplify, by a great deal, the wiring and construction of the set that they are used with. In fact, the tubes themselves contain the major portions of the instruments and the wiring of the whole set.

WHEN YOU

Lay Out Your Set

Neglect of small details—such as the proper planning of panel and wiring—have ruined many an otherwise efficient home-made receiver. Here are some simple facts that every fan should know before he begins to lay out his set.

By WILLIAM F. CROSBY

JUST because a set is home-made is no reason why it should not have a professional look. And there should be no necessity for the usual excuse: "Oh, it's just a home-made outfit, you know."

In present day practice, beauty and utility go hand in hand; and the radio receiving set which is correct architecturally will probably be much easier to wire and operate.

The old idea of liberally sprinkling the panel with knobs and dials is rapidly passing. Engineers are cutting down on the number of controls; and the few that are left are arranged as neatly as possible while at the same time they are placed in the way that is best adapted to the operator's needs.

There are many radio fans who prefer to build their own sets; but there are comparatively few of them who give a thought to looks. Often the panel has too many knobs, dials and vernier controls scattered wherever they happen to land, with the result that the completed set appears rather botchy. It is just as easy to work out a balanced design; and the chances are that if this is done the set can be handled more easily when it is completed.

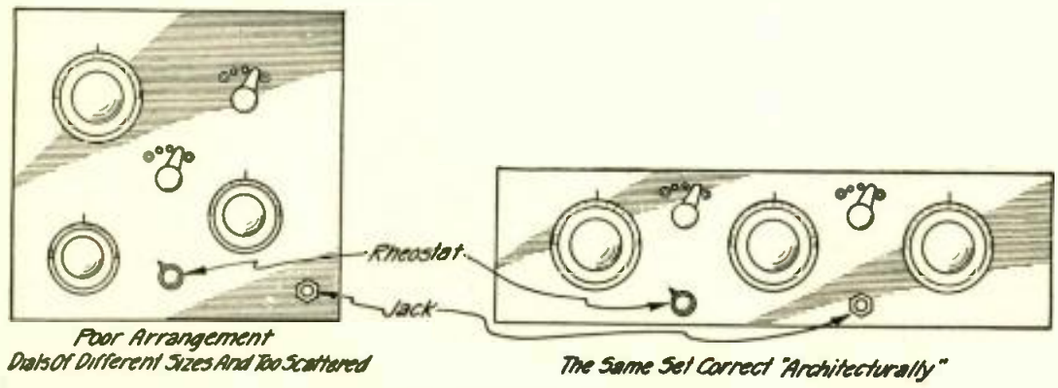
After you have decided on some particular circuit to build the best thing to do is to make a trip of observation among the radio stores to see what good designs actually look like. A careful study of the advertising pages of radio magazines will often convey a wealth of worth-while information on the subject.

Find out how many tuning controls you are going to have and also how many smaller knobs such as rheostats and potentiometers. If there are three dials for tuning and two smaller ones, work out the set in such a way that the three large dials come in a straight line across the center of the panel with the two smaller knobs below or between the larger dials. (see Figure 2)

A good way to begin is to place the panel on the table and make up your mind to spend an hour or two shifting the various parts back and forth on it until you have a combination that is going to look well from the front and at the same time make wiring convenient. Bear in mind that short connection wires are always desirable.

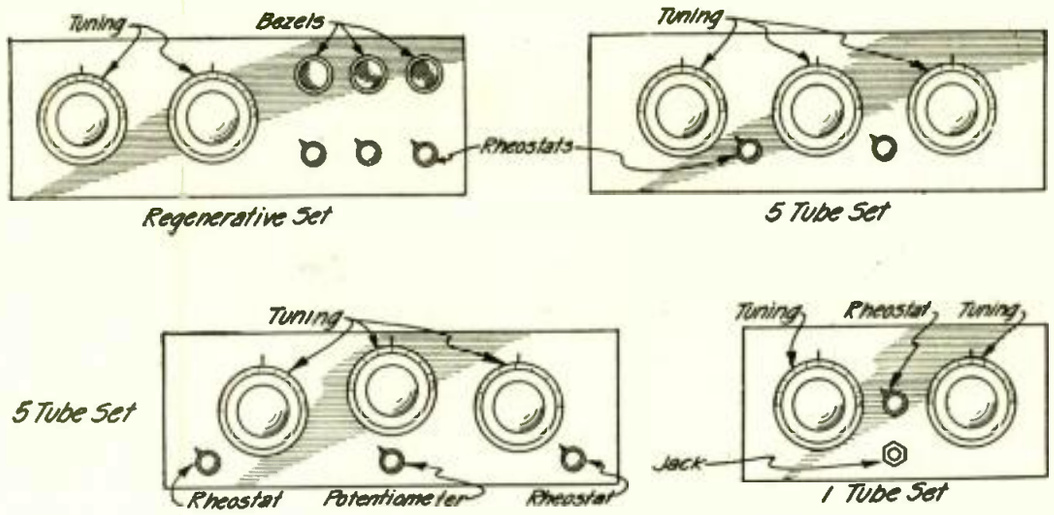
It is customary to work from the back of the panel but in doing this care should be taken not to scratch the glossy finish of the other side.

In all commercially built sets the antenna and ground connections are made from the right-hand side as the builder faces the back of the panel. The circuit starts on the right-hand side and works across to the output side at the left. Therefore, as you shift the parts around



A POOR PANEL LAYOUT—AND A GOOD ONE

FIGURE 1: *The scrambled arrangement of receiver design that is shown at the left not only looks poorly but it would work poorly as well. At the right the same instruments are laid out in a more pleasing and efficient arrangement.*



FOUR STANDARD PANEL LAYOUTS

FIGURE 2: *The panel layout at the top left is an arrangement for a regenerative receiver that employs three tubes; the two large dials control the tuning and the regeneration; the small dials are the three rheostat knobs. At the top right is a standard panel for a five-tube neutrodyne circuit. The lower left panel is for a receiver that employs two stages of tuned-radio-frequency with a potentiometer control; and the small panel layout at the right is for a one-tube regenerative set.*

on the panel bear this fact in mind.

When you are sure that you have everything exactly right take a piece of paper and pencil and make a rough sketch of the panel with the parts approximately in place. This will serve as a memorandum and will aid in the next step.

You will need, for the actual panel work, a sharp-pointed punch, a small rule and a try-square.

The first job, of course, is to locate the centers of the main tuning controls. These are usually half way between the top and the bottom of the panel and you should measure off this distance carefully.

Then, with the try-square and punch, mark off a horizontal line on the panel.

Now place your condensers or coupler so that the shafts come on this line. If there are three of them, space them evenly.

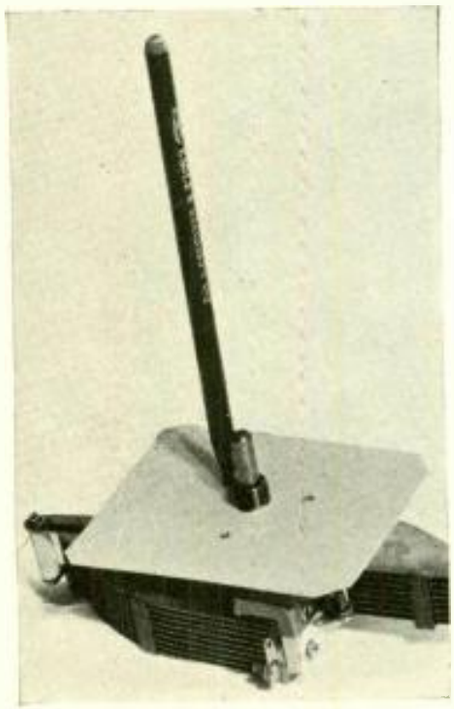
When you are sure that you have these instruments far enough apart so that they will clear each other yet not so far that there will be waste space, mark off roughly the shaft centers.

Then remove the instrument and with your try-square and punch mark off a vertical line on the back of the panel so that it crosses the horizontal line. At the intersection make a good deep punch mark which will later serve as a center for your drill.

If you are going to mount a variable condenser at this point, the chances are that the instrument will come equipped with a paper template for drilling the holes. This template may then be laid on the panel in such a way that the center of the shaft hole comes directly over the "spot" just made on the panel. It should be held securely in place and the screw holes "spotted" wherever they come on the panel. (Figure 5)

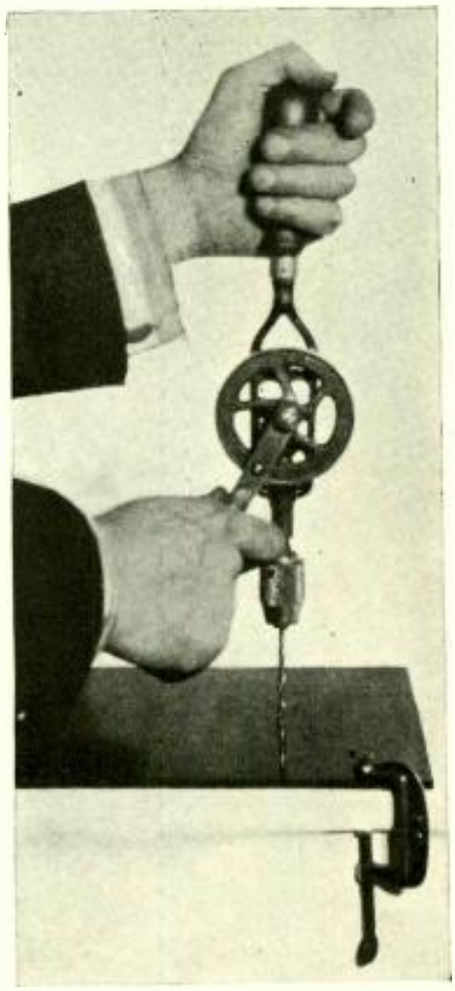
If a template is not supplied with the instrument you are to use, you must make one. This is easily done by cutting a hole, with the exact diameter of the shaft, in a piece of paper. This is slipped over the shaft of the instrument and by sliding a pencil around over the surface you will find that the point will drop through the paper into the screw holes through the frame (Figure 3). Of course, the paper should not be moved until all the holes are carefully located.

Once this is done you will find that you have a good template to work from. It should be handled in the manner al-



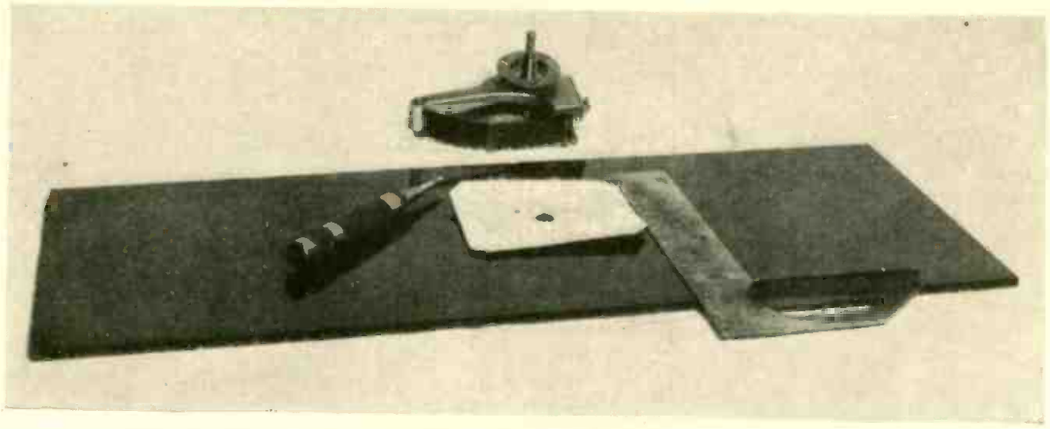
HOW TO MAKE A TEMPLATE

FIGURE 3: *A small piece of stiff paper laid over the condenser bearing may be spotted with a pencil to find the exact location for the holes that are to be drilled in the panel.*



WHEN YOU DRILL YOUR PANEL

FIGURE 4: *When the holes for mounting the instruments are drilled in the panel, be sure that the panel is held fast to the bench and that the drill is held in an exactly upright position, as shown above.*



HOW TO LAY OUT THE HOLES FOR MOUNTING A CONDENSER

FIGURE 5: *First, be sure that the template is centered at the exact position you want to mount the instruments. Then, make sure that the template is aligned evenly with the length of the panel, with the use of a square.*

ready outlined (see Figure 5 for details).

Suppose, now, that you have located all the holes for the tuning instruments and checking up shows that everything is symmetrical so far. You should determine which holes are to be countersunk from the other side and draw a ring around them with a soft pencil.

The next step, of course, is to choose locations for the rheostats and the potentiometer if such an instrument is used. These are usually placed on the panel in a position lower than the tuning dials. They may be laid off in exactly the same way as the tuning instruments by making the paper template and again marking the panel with the try-square and punch.

The positions of the jacks should be determined next and the holes laid out and center-punched.

Remember to mark off holes about the edge of the panel for the screws which hold it to the cabinet and do not begin drilling until after you are certain that every hole is properly centered. Two or three little clamp screws will come in handy at this point for holding the panel on the edge of the work bench while the holes are drilled (Figure 4).

When all the holes are drilled turn the panel over and countersink those screw holes which come behind dials.

The next thing to do is to screw the baseboard in place. This done, the tuning instruments are attached to the panel, the rheostats put in place and the sockets and transformers are located on the baseboard. In placing the sockets be sure that sufficient room is left so that the tubes may be placed in them.

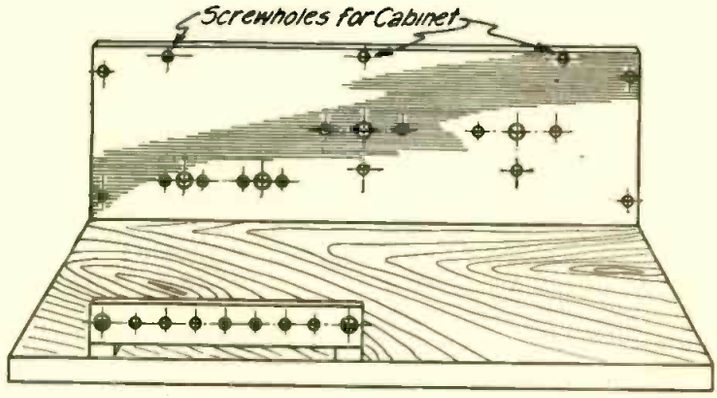
A composition strip may be arranged across the back of the baseboard for carrying all the binding posts for batteries, aerial and ground. In some home-made sets the jacks for the loudspeaker or headphones are also put on the back of the set. This arrangement is to be recommended as it keeps all wires away from the front of the panel of the set.

When everything is in place and you are sure that you have a set which is "architecturally correct," then proceed with the wiring.

Work out the position of each wire so that it will be as short as possible. Try to keep the wiring low down in the set. Nothing looks more amateurish in a set than a maze of untidy wiring. In a great many commercially built sets not a single wire is visible when the lid is lifted. Try to follow out a neat plan in designing the wiring for your own set.

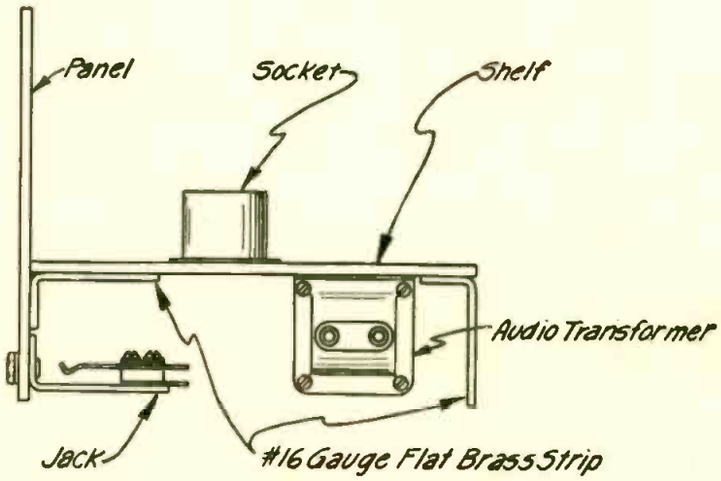
Some fans wire a set roughly at first and do not install the permanent bus-bar wiring until after every necessary change has been made and the set is working correctly.

In order to avoid mistakes only one wire at a time is put in place. One of the temporary wires is removed and the new bus-bar bent to shape and substituted. This method is a good one, where the builder is not sure of his work.



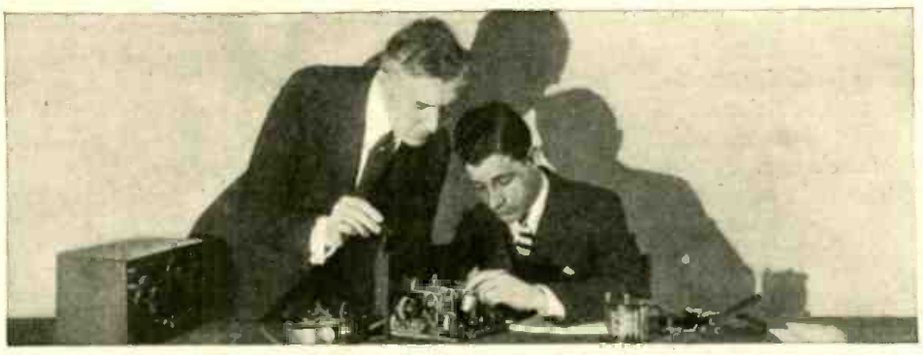
HOW THE FRAMEWORK LOOKS

FIGURE 6: *The front panel and a connection-block strip attached to a wooden baseboard.*



ANOTHER TYPE OF CONSTRUCTION

FIGURE 7: *A bakelite sub-base is used here so that the instruments may be fastened underneath and wired up. This arrangement makes possible a very neat looking set when the top door in the cabinet is opened.*



WITH THE EXPERIMENTERS

CONDUCTED BY LAURENCE M. COCKADAY

Trouble Shooting in the Cockaday Eight-tube Superheterodyne

PART III

IF ALL of the suggestions that were given in Parts I and II, in the June and July issues, have been tried and the operation of the receiver is still unsatisfactory there is probably some fundamental defect in one of the parts that the experimenter can not find. As considerable apparatus that is not owned by the average experimenter is necessary to measure the electrical characteristics of the various parts a reliable repairman who has the necessary equipment should then be consulted.

Many inquiries have been received in regard to circuit modifications in the receiver and methods of overcoming some of the difficulties that were enumerated in Parts I and II.

Before going ahead with a discussion of these changes the attention of the reader should be called to the fact that any parts that have given poor results in the original receiver are apt to prove just as unsatisfactory in the modified one. This is naturally true only of the parts that are used in the reconstructed receiver.

The wavelength range, "B" battery consumption, amplifier frequency range and the presence of unnecessary repeat points may all be improved by making the suggested changes. These changes will have no effect, however, unless the IF and AF transformers, condensers, resistances and tubes are satisfactory.

The modified receiver is shown in Figure 2. All the parts that were used in the original receiver may be identified by referring to Figure 2, Part II.

The additional parts that are necessary in order to complete the suggested changes are as follows:

C1 and C8—Condensers, fixed, .00025 mfd. shunted by 2 megohm leaks;
C3 and C4—Condensers, fixed, .002 mfd.;
C5—Condenser, semi-variable, Griddenser type G-10;
C6 and C7—Condensers, fixed .1 to 1 mfd.;
C2—Condenser, fixed, .001 mfd.;
R1—Amperite type 112 or similar filament control cartridge;
One tube socket (rigid type).

The coil, Z, may be made by winding four turns of number 18—24 DCC or DSC wire on a 2-inch tube. The coil should then be removed and tied with thread or fastened with collodion to make it self-supporting.

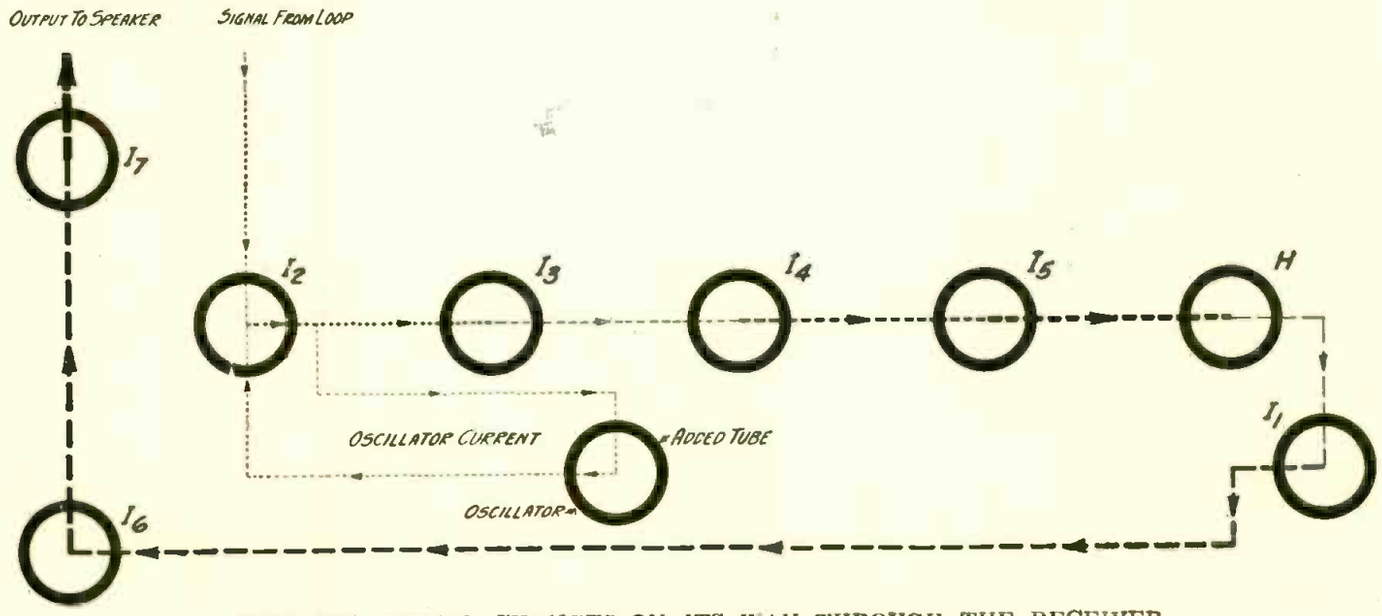
It should be mounted just over the Autodyne coupler. The two bus bar leads to it will provide sufficient support for the coil.

To make a fundamental frequency oscillator coil out of the Autodyne coupler, all but 72 turns should be removed from the secondary (the large section) and all but 38 from the tickler coil. To lower the total capacity in the oscillator circuit to .0005 mfd. (in order to restrict the frequency ratio and thus minimize repeat points) a fixed .001 mfd. condenser should be connected in series with the .001 mfd. variable one.

The fixed condenser should be one of the better mica types, guaranteed within ten per cent, or less if possible. Any variation in this capacity will alter the frequency range of the oscillator circuit.

This condenser is shown in Figure 2 at C2. It is mounted vertically to shorten the leads.

Note that the .006 mfd. fixed condensers and the clips have been re-



HOW THE SIGNAL CHANGES ON ITS WAY THROUGH THE RECEIVER

FIGURE 1: *Starting with the signal from the loop, the currents travel through tube, I2. The oscillator tube combines its current with the original current and the combined current is passed on and amplified through tubes I3, I4 and I5. From there it is passed through H, the detector, and I1, I6 and I7, to be greatly amplified at an audio frequency. An increase in the length of the dashes indicates a decrease in the frequency of the signal while an increase in thickness represents an increase in the amplitude of the signal at that particular frequency.*

moved from the Daven mountings. This is not essential but it slightly improves the looks of the receiver.

The picture, wiring diagram (Figure 2) does not show the exact location of the parts. The parts are slightly spaced so that the numerous leads may be shown in horizontal projection. The intermediate - frequency transformers should actually be mounted as close as possible to the rear of the base-board. The three leads shown by the binding-post strip should be nearly over each other and spaced ½-inch or more.

The difficulties that are involved in getting good results from the receiver will be considered in the order in which they appeared in the preceding parts, that is, by following the signal through from the input to the output.

Trouble from the shunt reflexing, which may occur if the transformer is slightly defective, may be minimized either by elminating the reflex principle or by using series reflexing. For several reasons it was decided to make the former change.

The main wavelength limiting factor, the radio-frequency transformer, should be removed.

This permits the receiver to cover quite a broad wavelength band. By using a small loop and overloading the oscillator tube, so as to secure considerable energy at harmonic frequencies, the receiver may be made to operate as low as 30 or 40 meters.

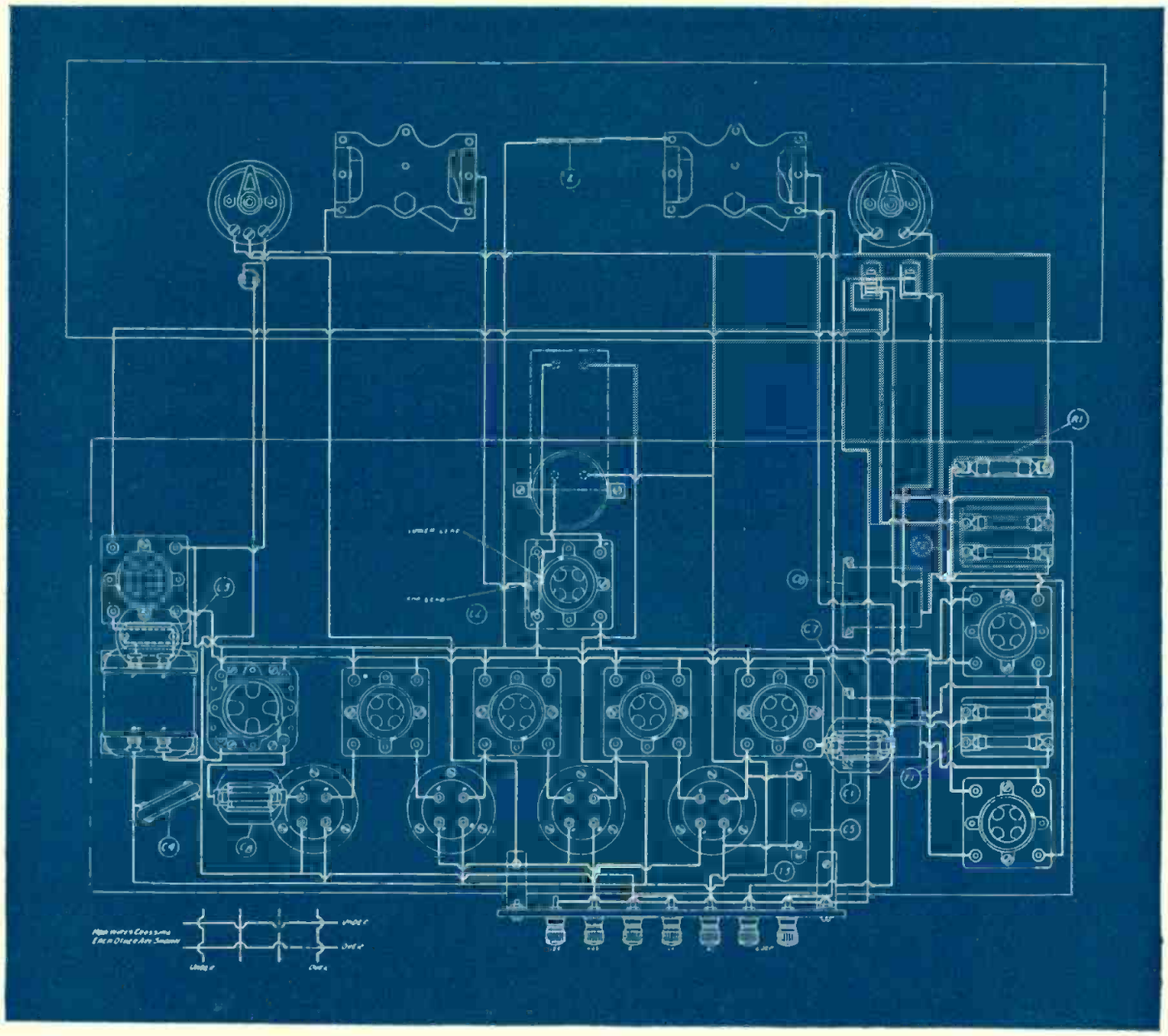
The loop tuning circuit is then connected directly to the input circuit of the first detector. No method for balancing out the regeneration due to the interelectrode capacity of the detector tube is used as numerous readers wish to use regeneration.

The same type of intermediate amplifier is employed and the second detector corresponds to the original one.

The first audio-frequency stage should be moved to the right-hand end of the baseboard, as shown, as it seems more advisable to carry the output of this tube to the other end of the board than the output of the second detector. The whole arrangement could be simplified if it were not for the location of the jacks and the binding-post strip. Changing these two would deface both the front of the panel and the back of the cabinet.

The amplifier is a straight, two-stage, resistance-coupled one. Two changes are made from the former arrangement. An Amperite is used to control the fila-

(*Continued on page 368*)



THE PICTURE WIRING DIAGRAM OF THE CIRCUIT REVISION

FIGURE 2: *The upper rectangle represents the panel with the various instruments mounted upon it; the lower rectangle represents the baseboard with the instruments that are mounted there. The wires should be run exactly as shown by the heavy white lines in this illustration.*

IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

Radio on the Norge Flight

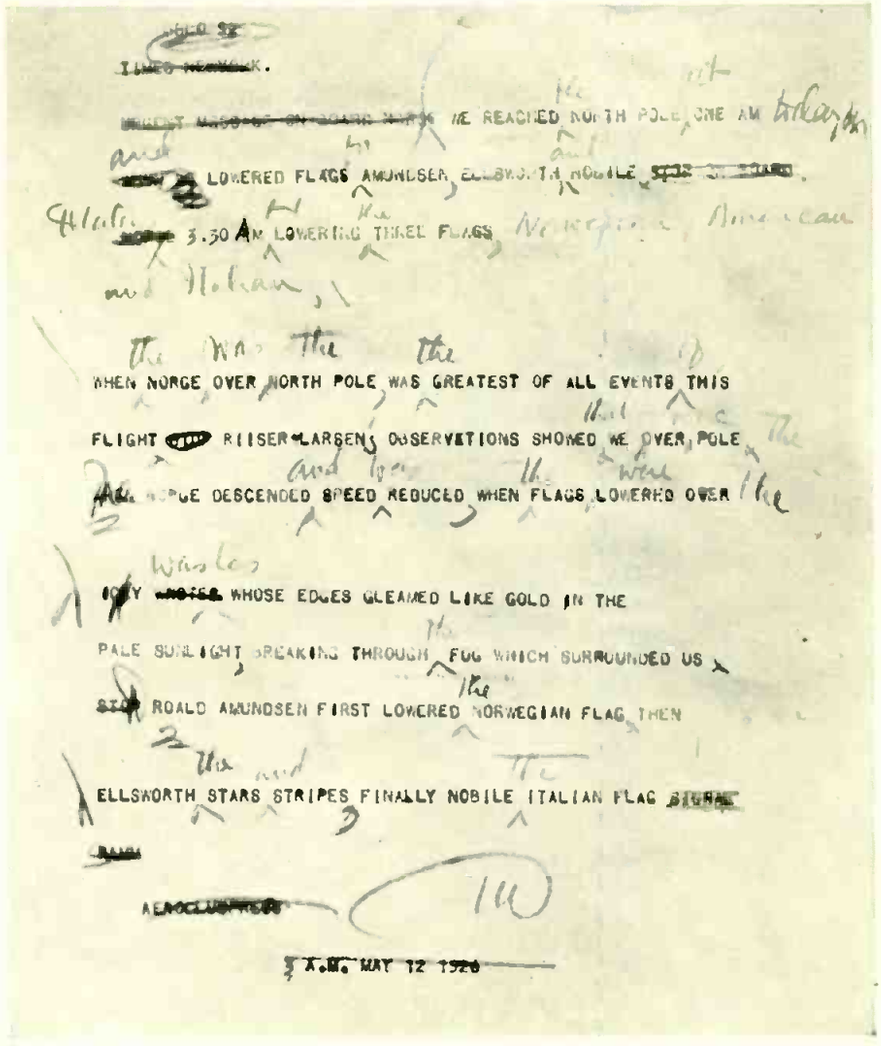
UNDOUBTEDLY one of the most spectacular among all the achievements of radio was the reporting of the arrival of the Amundsen airship, the *Norge*, over the North Pole at 8.00 P.M., Eastern Daylight Saving Time, Tuesday, May 11, 1926. The message came from the key of the Norge to the special radio station at the airship base at Kings Bay, Spitzbergen; thence it went to Oslo, the capital of Norway, whence the great Norwegian radio telegraph station at Stavanger forwarded it directly to the addressee, the New York *Times*, in New York City. Commander Byrd had flown over the pole only a few days earlier in his Fokker airplane, the *Josephine Ford*, but he had sent no radio messages.

This *Norge* message, transmitted by the hand of the airship's radio officer, Captain Birger Gottwaldt, was the first message of any kind sent directly from the top of the earth.

Until the *Norge* passed the pole on her way from Spitzbergen to Alaska her radio was able to keep in virtually continual touch with her base. After passing the pole something went wrong, not with the *Norge*'s equipment but with the ether. For nearly three days the world waited in suspense to learn the fate of the adventurous explorers. Not until the airship had almost landed did any of the hundreds of listeners at northern stations pick up the slightest whisper of the ship's transmissions. This failure of the signals to come through on the Alaska side of the pole as perfectly as they did on the Spitzbergen side is the most interesting radio fact of the expedition. As yet, Captain Gottwaldt has not returned from Alaska nor have details of his own observations been published as this note is written, many days in advance of its appearance.

It is possible to think of several reasons why radio transmission may have fallen off on the American side of the pole. For one thing, the *Norge* was then on the same side as the north magnetic pole of the earth. This would probably make little difference in itself, but it is probable that the lines of magnetic force which cluster close to this pole tend to control the downward movement through the earth's atmosphere of clouds of electrons arriving from the sun. It is these electrons which are supposed to have much to do with the production of the Northern Lights or Aurora Borealis. Very little is known about these supposed electron streams; not even that they surely exist. But if they do exist, they are probably not arranged uniformly on both sides of the pole. Possibly they, or some of their effects, are responsible for the difficulty which American and Siberian stations had in hearing the *Norge* as well as for the similar difficulty which the *Norge* appears to have had in hearing stations in the inhabited regions.

Another disturbing factor in all arctic radio in the summer is, of course, the continual sunlight. This is the time of "midnight sun." The sun is above the horizon during the entire twenty-four hours. In the winter, conversely, the sun is continually below the horizon. The pole suffers continual night. The reasons lie, as everyone knows, in the tilting of the earth's axis, so that the yearly progress of our globe around its orbit tilts the northern pole alternately toward the sun and away from it. The continual sunlight of summer probably



Courtesy New York *Times*

THE FIRST RADIO MESSAGE FROM THE NORTH POLE

This photograph, especially supplied by the New York "Times" for publication in POPULAR RADIO, *shows the original message from the north pole, exactly as it came to the desk of the editor of the "Times." The pencil changes indicate how the original message was edited for publication in the newspaper*

Underwood & Underwood

HOW THE DIRECTIONAL ANTENNAS WERE ATTACHED

This snapshot of the "Norge" was made over Pulham, England, while the airship was on her way to Spitzbergen to begin the flight over the pole. The white lines drawn around the ship indicate the approximate positions of the two double loops which constituted the direction-finding system. These loops were connected to the single receiver, installed in the main cabin. The antenna used for transmission and for ordinary reception was a trailing wire let down from this cabin.

has important effects on the ionization of the air, and consequently on radio wave propagation. All these matters we will be able to guess about more definitely when the radio log of the *Norge* is published in full, as everyone hopes it soon will be. Conditions in the arctic are so altogether unlike radio conditions in more usual parts of the earth that any information about them might prove extremely useful for radio theories.

The radio equipment of the *Norge* was built especially for her by the Marconi Company, of London, and was certainly the best ever used in polar work—probably the best ever installed on an airship for any region. There were two transmitting tubes, their circuit being coupled directly to the antenna. The antenna was a trailing wire approximately 300 feet long, let down through a hole in the cabin. An antenna tuning inductance was provided and, together with the trailing wire itself, permitted tuning to any wavelength between approximately 550 meters and approximately 1500 meters. According to reports so far received a wavelength of approximately 1400 meters was used in most of the communications from the ship. To absorb the minimum of space as well as to permit easy adjustment when the fingers were nearly frozen, the transmitter was not encased, the instruments being mounted on an open board. Power was supplied by a 500-watt, 2500-volt dynamo, driven by an air propeller outside the cabin. The rated antenna power was approximately 200 watts.

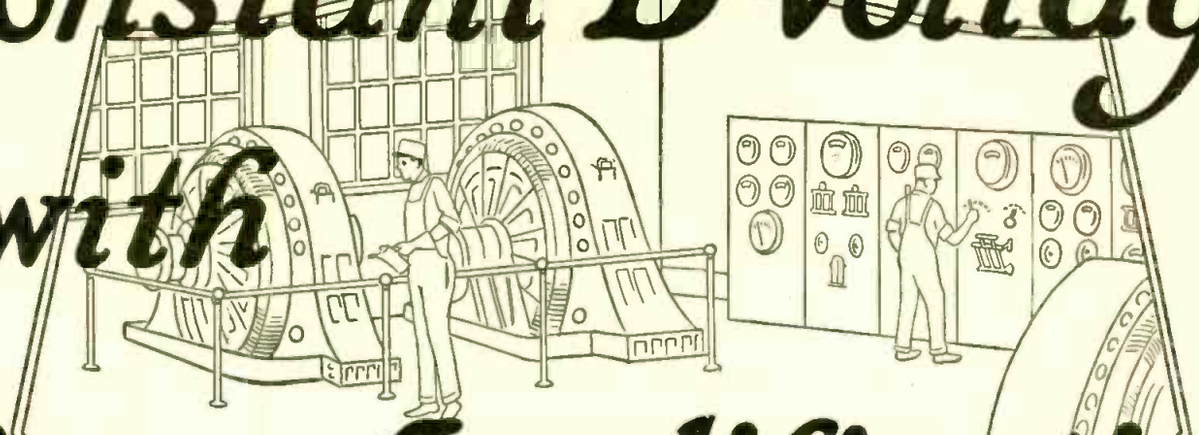
The receiver was built on the principle of plug-in coils as tuning inductances. Enough such coils were provided to cover the entire wavelength range from 300 to 25,000 meters. Reception of telephony, C. W. telegraphy or spark signals was equally possible. Arranged to be plugged in to this same receiver was the special radio direction finder, the antenna system of which consisted of two double loops of wire, each passing entirely around the body of the ship. Each loop was set at an angle of 45 degrees to the axis of the ship, so that the two loops stood at right angles to each other at all times. The two wires of each loop were placed approxmiately nine inches from each other and were tied down to the fabric of the ship with linen tape and airplane dope. It was expected that this system would enable the *Norge* to find her position by radio at all times, even should the usual methods of arctic navigation fail. It appears that the system did not work quite so well as expected, suffering from the same troubles as other radio communications.

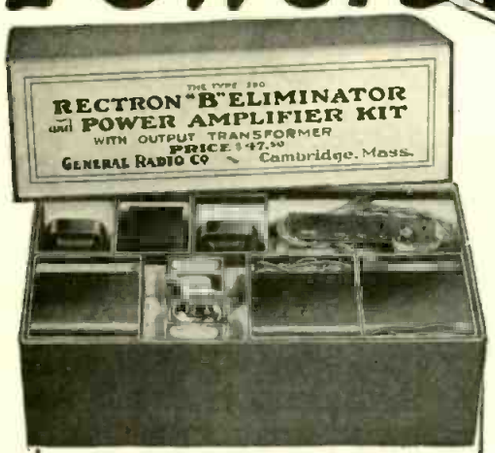
The scientific results of the expedition are apparently not great, nor were they expected to be. Short of the possible discovery of land, there was little that could be done in a mere flight over the icy wastes. What was hoped for, and was accomplished, is proof that it can be done. The only important difficulties were the trouble with radio communication after the pole was passed and the unexpected accident that lumps of ice froze on the propellers, were thrown off and punctured the envelope of the ship. Both these difficulties can presumably be remedied another time. We may be sure that the flights of the *Norge* and of the *Josephine Ford* are merely the first of many.

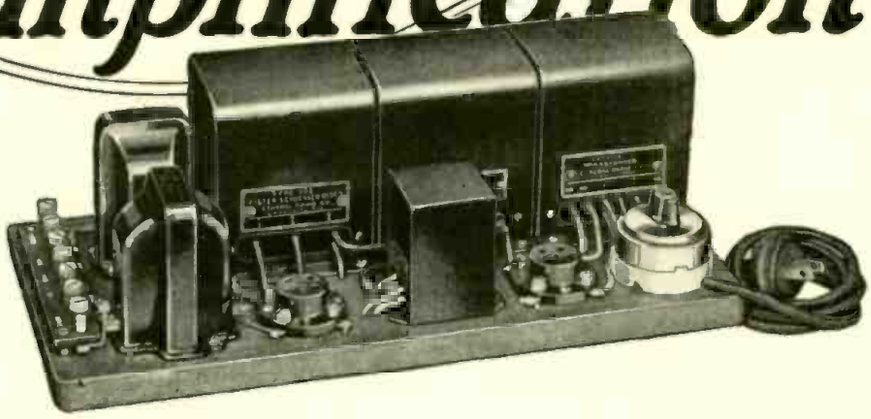
What is even more important is the possibility of maintaining a permanent party of observers near the pole, even during the arctic night. This would be of the greatest value to science. In radio theory, for example, we need exact and continual information about the supposed streams of solar electrons coming downward to the earth in polar regions. The weather experts need daily facts about what storms are brewing in the arctic and about where they are centered. The experts on ocean currents need more detailed information about the depth of the polar ocean and the contour of its bottom. All these facts can be obtained only if someone can stay in the arctic continually, munitioned and relieved by airships or airplanes. This summer's work indicates a probability that this can be accomplished. There now seems little chance that the arctic contains any large continent, but small islands may be found, suitable for permanent bases. Indeed, a base could probably be maintained on the ice itself, if no land at all is discovered. Should any such project be at-

(*Continued on page 376*)

Constant "B" Voltage with Power Amplification







A properly built "B" eliminator operated from the lighting circuit noticeably improves the consistent quality of reception. It provides a constant, silent flow of current that makes it as dependable as the power station itself.

Worry whether the "B" batteries are run down and their continual replacement is forever abolished by the use of reliable "B" voltage supply unit. Once installed and adjusted it is ready for years of constant service.

A Power Amplifier in conjunction with the "B" eliminator permits the use of a high power tube in the last audio stage. This overcomes the tendency toward tube overloading and removes the most common cause of distortion in loud speaker operation.

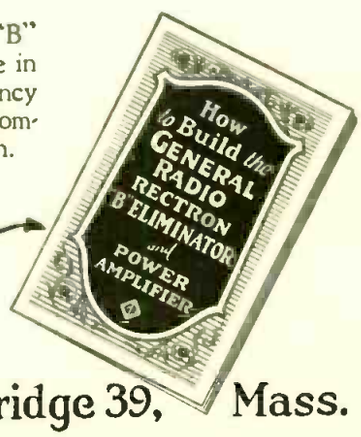
For a dependable "B" eliminator—power amplifier unit which will enable your loudspeaker to deliver greater volume with a tone quality that is amazing, buy a General Radio Rectron "B" eliminator—Power Amplifier kit and carefully follow the few simple instructions for assembling the unit.

Price of Kit, including all parts and drilled baseboard,

$47.50

Get this Booklet

Ask your dealer or write today for our pamphlet "How to Build a Rectron 'B' eliminator and Power Amplifier."



GENERAL RADIO CO. Cambridge 39, Mass.

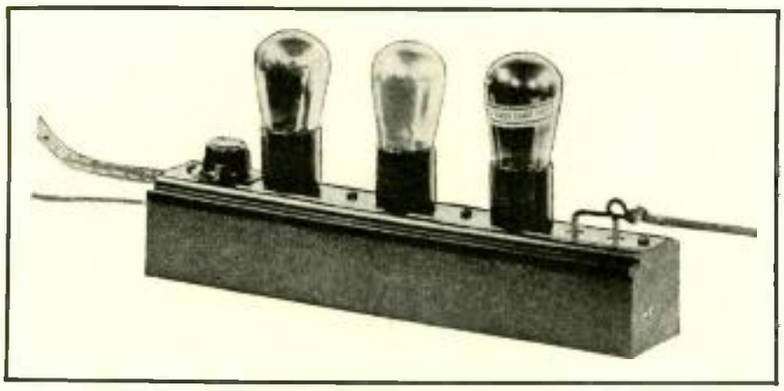
GENERAL RADIO
INSTRUMENTS

Behind the Panels of Better Built Sets

Revolutionary Method of Amplification Sets New Standard of Reproduction

PICTURE *your* ideal of a perfect audio amplifier—you would insist first on quality, the bass with its original volume and resonance and the delicate overtones clear and distinct, separating the f's and v's, and making applause the actual clapping of hands and not just a roar. You want this fidelity to the original from the faint high notes of a distant singer to the roundness of crescendo of a nearby symphony orchestra. Plenty of amplification, you would include, so that you do not have to hold your ear to the speaker to hear, but can sit back and feel the original actually at hand. Picture all this as a fact, fill in for background, ease of installation, freedom from deterioration, economical operation, and the important item of reasonable cost, and you commence to get a picture of the Na-Ald Truphonic Amplifier.

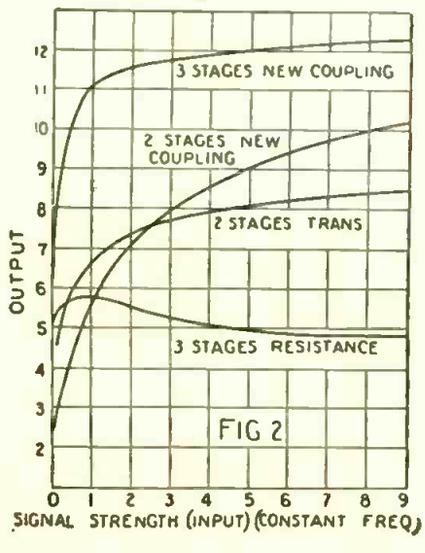
Engineers thought this stride impossible. Transformers did not fill the bill. Increase in their size and cost was an improvement, approached the goal, but still much was to be desired in both quality and volume. Resistance coupling could not do it. Lack of volume distortion under heavy load, and deterioration were among the factors which led engineers to look for something better. Impedance systems were tried. Many such systems possessed many of the disadvantages of resistance, and were much more expensive. Double impedances, one for the grid and another for the plate circuit, were used with fair satisfaction, though almost prohibitive in cost when large enough to provide real quality. Various combinations used usually combined the disadvantages of their components.



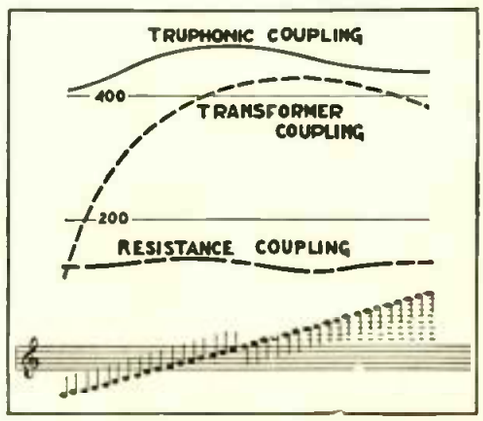
Complete Na-Ald Truphonic Amplifier may be used with any type of set. List Price.....$20.00

It remained for Mr. H. P. Donle, the noted scientist, to solve the problem by the creation of the Truphonic system. By a stroke of rare genius, he conceived a completely balanced system, with each component coordinated to operate at maximum efficiency, the whole having a capacity for precise, undistorted amplification which is as revolutionary as the principle by which it is attained. The Truphonic system is a fitting climax to the work of Mr. Donle, often called "The Steinmetz of Radio," whose patents cover the principle of the new R. C. A. supersensitive detector tube, the common mesh or basket weave coil, the Raytheon tube, and one of the earliest vacuum tube sockets.

You must really hear the Truphonic Amplifier to appreciate it. Notice the perfect fullness attained by the absolute fidelity of every detail. Heretofore, the amplifier has been the weak link in the radio chain. Wellnigh perfect broadcasts are stepped up through perfect tubes, while new power tubes have recently been developed to supply undistorted power for the operation of the new and almost perfect speakers. Engineers have been groping for a coupling device which would approach the quality of other parts. Some complacent ones have been satisfied, others have been fairly content to use the best available, but it remained for Mr. Donle, inspired by the importance of the problem, to solve it, once and for all, by the inven-



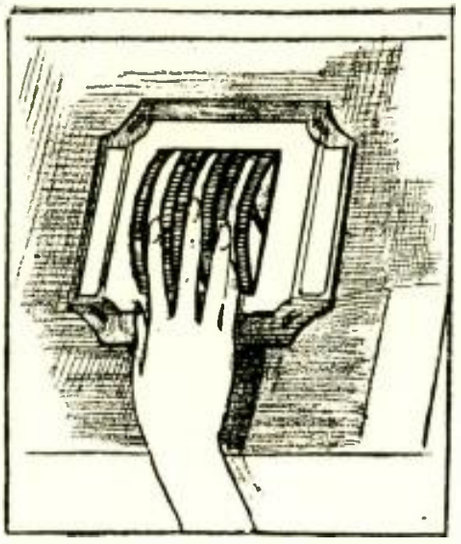
The curves indicate the remarkable superiority of Truphonic Amplification. On the left, the input output curve at constant frequency shows the overwhelming superiority of Truphonics. The curve on the right indicates the excellent frequency characteristic at constant load. Such curves indicate the performance. To really appreciate how much the curves mean, you must hear the system in actual operation.



tion of Truphonic Amplification.

It seems incredible that the tiny Truphonic coupler 2½ x 1½ x 1½ inches can perfectly reproduce such power. Engineers marvel at the design which raises the efficiency to so high a level that at output far beyond the capacity of ordinary apparatus, no signs of overloading appear.

With standard UX201A or equivalent tubes, a new standard is established. Even broadcasting stations you have ruled out as poor, and speakers condemned as impossible, will give results you never dreamed of. But for the real thrill, for reproduction so startling in tone, in volume, in real re-creation of the original, give the Truphonic a chance to show its full power. Use a 171 or equivalent power tube in the last stage, with maximum rated voltage. Get, never mind how, an absolutely top-notch speaker with plenty of power capacity, look over the program and tune in your favorite broadcast



and—well, you will agree with us, it's hopeless to attempt description. At a single step, audio amplification has moved so far ahead that years of painstaking investigation will be required to pass it. For the first time, you can invest in a new radio, or modernize your old one, feeling that years will pass before it can be improved upon. Radio users no longer need tolerate mediocrity.

Truphonic Amplification will of course be a part of the most modern of the high grade sets. Avoid later regrets by having a comparative test of a set with Truphonic Amplification against any set without this wonderful amplifier you consider purchasing.

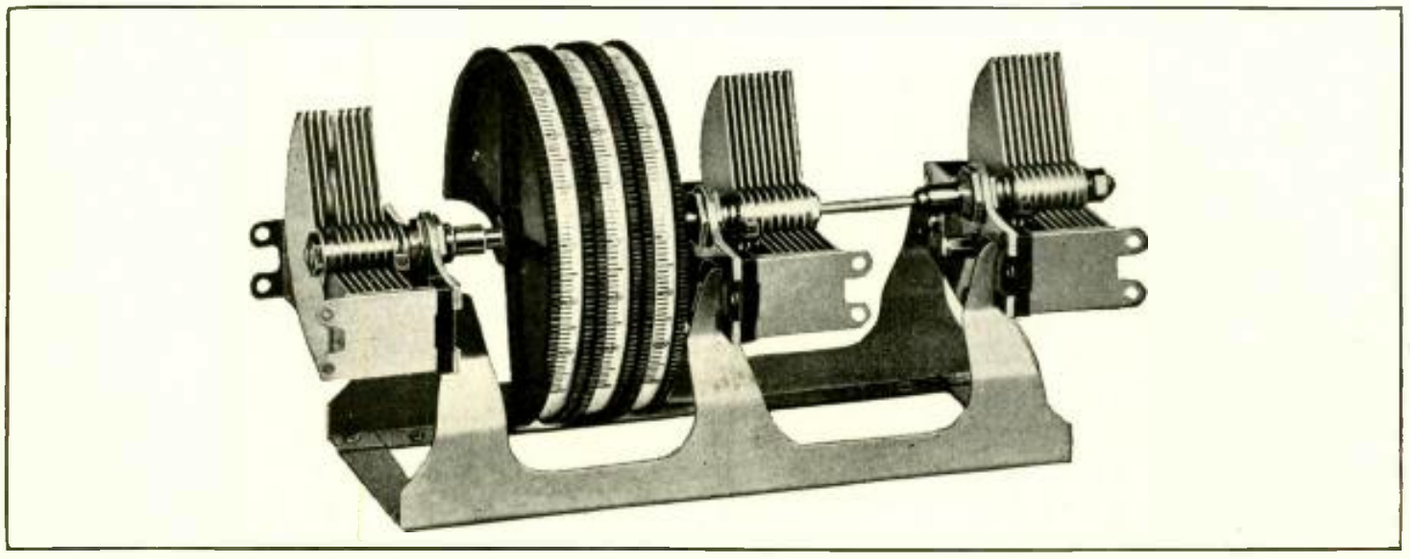
The amplifier will also be sold as a complete unit equipped either to build into a set or to attach to a set already complete. For the latter, just put in the tubes, connect the batteries, loud speaker, and a single lead to the set and you will get music such as you never even dreamed of. The independent unit may be incorporated in a new set, or attached with surprising ease to your present set. Just picture yourself, sitting at home, with your present set listening to the New York Philharmonic Orchestra playing in the same room with you—not at you! Picture *your* ideal of a perfect audio amplifier, and you will commence to get a picture of the Na-Ald Truphonic Amplifier.

Localized Tuning Control
Another Revolutionary Alden Development

ADMITTEDLY the most insistent demand of the purchaser or constructor of a set is for tonal quality. A close second, and one which has engrossed the attention of radio engineers to an equal extent, is the demand for single control. The first demand is definitely answered by Na-Ald Truphonic. For the second, an equally satisfactory solution is provided in an equally radical way by the Na-Ald Localized Control tuning unit, another startling improvement brought out by the Alden Manufacturing Company.

By bringing the tuning controls together beneath the fingertips of one hand, all the advantages of single control are attained with none of the limitations which single control imposes, when carried out in the usual form.

All three condensers can be



This amazingly simple tuning device accomplishes all the good of single control, without losing the flexibility of separate controls. There is a drum for each condenser, and each drum moves freely separately, or in unison with the others. Called the "Na-Ald Localized Control Unit," it merits wide popularity among set builders.

moved at once, when shifting from one station to the next, with all the ease of single control. Without even shifting the fingers, each condenser is brought to the point of maximum volume. No necessity for separate adjusting knobs, which make tuning a matter of several widely separated controls on so many nominally single control sets. Nor is it necessary to use broadly tuned, inefficient circuits to compensate for inevitable discrepancies between even the most accurately adjusted tuning units. All the difficulty and extra expense of specially matched units, extra adjustments, additional equipment, increased servicing necessary, and the inferior operation inherent in single control is done away with, without sacrificing any of the advantages. And the whole localized control unit is available at a price but slightly above the cost of the individual condensers and plain dials.

The unit is particularly flexible, and lends itself most readily to a wide variety of sets. Almost any desired type of coil may be used. The coils may be shielded, if desired, and these shielded coils may be adjacent to the condenser, without requiring the undue depth of set which is necessary for a single control shielded set with the condensers in line at right angles to the panel. The unit is of unusually handsome appearance, and lends itself to a variety of cabinet designs. Because there is no metal near the front panel, this panel may be of wood, metal or Bakelite. Scales in any desired calibration may be used. Calibration in meters or kilocycles, as well as the regular 0-100 can be used.

For the amateur and semi-professional set builder, the localized control unit opens wonderful possibilities. The almost insurmountable problem of single control is simply and easily solved. The unit is most flexible, and lends itself readily to all the popular circuits, including beside all the tuned radio frequency receivers, sets such as the Browning - Drake, Hammarlund - Roberts, Aristocrat, LC-26, or T. I. C. The chassis is provided for three condensers. One condenser and controller may be omitted, or the controller may be used for either the tickler coil or tuning inductance so universal in two condenser sets.

Go to your neighborhood store and ask to see the Localized Unit. Note, please, how beautifully it is made. The three master dials are each masterpieces of the Bakelite moulders' craft. They must be made to operate without rubbing in such close proximity. And note how smoothly they turn, how beautifully they respond to your easiest touch. This flawless operation called for machining to a hair's breadth and moulding that nine out of ten Bakelite moulders would not attempt. Years of experience as the largest moulders of Bakelite for radio parts, made this an easy job for Alden engineers and Alden skilled workmen.

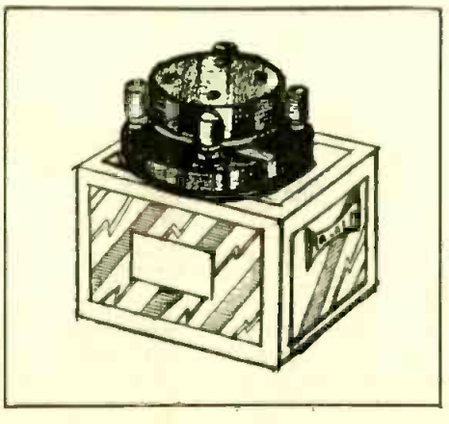
The corrected frequency condensers are models of modern practice made with the very best materials and, provided with self-aligning cone bearings, they represent all that is desirable and necessary in variable condenser engineering. And the unit is compact. It is nine and one-half inches long and three inches wide. The dials measure four and one-quarter inches in diameter and have corrugated peripheries. Provision is also made for the easy insertion of graduated strips similar to those included with instrument.

Outline the advantages of Localized Control for yourself. There you have (1) convenient manipulation, (2) compactness, (3) low price compared with separate purchase of elements, (4) more practical and better appearing receiver, (5) easy mounting compared with that of three separate condensers on the panel.

Na-Ald Sockets

THE Na-Ald Truphonic Amplifier and the Na-Ald Localized Control Unit are so startling, so outstanding, that they tend to overshadow all other items. However, the engineers of the Alden Manufacturing Company have not for an instant slackened their attention to sockets, and the same high order of engineering which has contributed so much to establishing Na-Ald as "World's Largest Makers of Sockets and Dials" has developed a new universal socket which is in a class by itself.

Recent developments have emphasized the importance of proper cushioning. High ratio, low loss amplification, has increased the tendency toward microphonic effects. At the same time, this same high ratio amplification magnifies all extraneous noises exactly the same in proportion as signals, making quiet essential. Finally, the demand for reproduction unmarred by noises from within the set has made the use of properly cushioned sockets more necessary than ever. Almost every conceivable method of cushioning has been tried at one time and another. Most were makeshifts, though some were quite effective. However, it remained for the engineers of the Alden Manufacturing Company, with their long and varied experience in the design of all types of sockets, to make a really scientific study of the situation, and by a long and careful series of experiments to determine on a support which should provide absolutely the best cushioning for actual service.



Examine one of the new Na-Ald 481XS universal cushion sockets. Note how "live" are the springs, rolled of a special phosphor bronze for this particular purpose. You can see the tube apparently start in motion from the slightest vibration, though what actually happens is that the tube stands almost still, while the socket moves under it, the vibration being absorbed by the springs. In particular you will be interested in the fact that the tube has a very considerable freedom of motion up and down as well as sidewise. Since a large proportion of the shocks are vertical, and since on account of the method of supporting the grid, the tube is quite sensitive to this type of vibration, this socket has been especially designed to cushion this, as well as for the horizontal cushioning, which is the only cushioning of most types of so-called shock absorbing sockets.

Of course the slogan "It's the Contact that Counts" was kept in mind. Springs held in tension by the Bakelite of the socket press firmly against the prongs of the tube for quiet positive contact. Just the feeling when you insert and remove the tube assures you

Na-Ald De Luxe Socket

that the contact is right, far more clearly than pages of description. The same strip of special phosphor bronze which contacts with the tube terminal extends to the binding post, and terminates in a soldering tab which may be run through the panel for sub-panel wiring. No eyelets to loosen and become noisy, no rubber to dry and harden, no soldered contacts to loosen under vibration.

The sockets are of course, moulded of Alden Processed, Genuine Bakelite, famous for its mechanical and electrical properties. Na-Ald production and inspection methods assure that every socket is perfect in every respect before it leaves the factory. And the large scale methods make possible the very low price of fifty cents each.

Na-Ald No. 400 DeLuxe—The Standard Socket for Heavy Duty

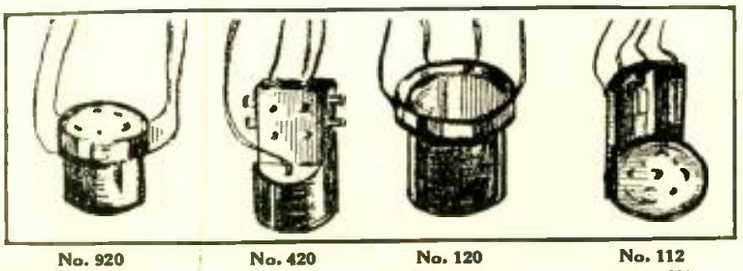
For heavy duty service, to hold the big, expensive power tubes, surely, with clean, quiet contact use the Na-Ald No. 400 DeLuxe Socket. This socket mounts rigidly on a broad firm base; ample spacing of the triple laminated dual contacts makes the highest voltage safe. The famous side scraping contact is just as effective with the UX tubes as with the older UV types. Simply rotate the tube three or four times without removing it from the socket. Corrosion is positively scraped away, and the contact comes to rest on the clean surface. You will be surprised at how much more quiet this sure, clean contact makes a set. Not only for the power tubes, but whenever you need a rigid socket with absolute, assured contact use this reliable Na-Ald DeLuxe Socket. Price 75c.

Na-Ald Connectoralds
A Simple Way to Clearer Radio

YOU can improve the performance of your present set, particularly in ability to handle large volume, with the use of a power tube with a Na-Ald Connectorald.

There is a Na-Ald Connectorald for every tube and set requirement. Of course, the use of the power tube in the last stage cannot correct errors in earlier couplers; in other words, cannot do the whole work as does a Truphonic Unit. However, it does provide a means for economically obtaining very real, worth-while improvement. The Connectorald holds the tube in the socket, and provides means for attaching the necessary extra B and C batteries. No changes in sockets or wiring are necessary. Just clip the Connectorald to the tube, snap on the extra B and C batteries, insert the tube and Connectorald in the socket, and see what a difference it makes.

Na-Ald Connectoralds



No. 920	No. 420	No. 120	No. 112
for UX 120 Tube in W 199 Socket	for Radiola Super Heterodyne	for UX 120 Tube in UV 201 A Socket	for UX 112 and UX 171 Tubes

Price $1.25 each

ALDEN MFG. CO., Dept. C-15
52 Willow St.
Springfield, Mass.
Please send me further information on:

- ☐ Truphonic Amplifier
- ☐ Localized Control Unit
- ☐ Sockets

Name.....
Address.....
City..... State.....

The Quack Doctors of Radio

(*Continued from page 314*)

the human skin to protect the skin from injury and to increase the energy of the person so treated. According to the inventor, the idea was that everybody is continually loosing energy by some mysterious form of "radiation" supposed to be emitted from the skin. This was not heat (which actually is emitted, of course, so long as the body is warm) but some other kind of ray. The application of the chemical stopped this radiation. Energy was saved. Here we see the touch of radio again. Without the development of this science and the growing public interest in it, no one would have thought of recommending a nostrum by ascribing to it a potency in reducing "radiation."

The curious thing about this French preparation was that it really did make people more active, at least for a few moments. The secret was that it contained a slightly irritant chemical which brought the blood to the surface of the body and increased the circulation. It had about the same effects as a mustard plaster or an alcohol rub. The scientific hocum about radiation had however one real purpose. It tremendously increased the price.

Medical Fakers Who "Cure" Human Glands by Radio Waves

Recently there has appeared in America a form of radio quackery which makes great use of the recent scientific knowledge of the glands. By mysterious kinds of radiation, sometimes described as related to radio, sometimes to ultraviolet light, sometimes to X rays, the worn-out glands of the human body are supposed to be restored to youth and usefulness. It is true that the ductless glands, like the thyroid gland in the neck or the adrenal gland near the kidney, do have profound effects on health. It is not impossible that the physicians who are working on these subjects may learn how to stimulate and control these glands, with resulting benefits to human well being. But these matters are still experimental and uncertain. They cannot be accomplished as yet, by any form of radiation, let alone by radio waves. Anyone who pretends to transmit helpful messages to your glands in this way, you may set down as a fool or a crook, possibly both.

The "Radio Divining Rod" Fake

Finally, leaving the matter of the human body aside, we have the great fake of the radio divining rod.

A divining rod is a very ancient instrument with which the adept is supposed to be able to find precious metals, water, valuable minerals or other things which are hidden underground. The simplest form is a forked stick. When held in the hands of a "sensitive" person this stick is supposed to turn by itself and to point downward toward the ground at places where the desired treasure lies. In this form it is at least three thousand years old.

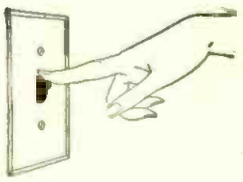
Recently the diviners, too, have sought the aid of radio. It is quite true, of course, that radio waves can be used by those sufficiently expert to obtain information about underground conditions. It is possible, even, that methods of locating ore bodies or water strata by radio waves may be worked out, some day, and put to practical use. These facts have not been overlooked by the fakers. Numerous complicated combinations of coils and "receptors" and "sensatizors" and a hundred other contraptions have been put together and sold or rented to the unwary for finding oil or gold or water. Needless to say none of these instruments has worked. At present, the only way to predict what is underground is to hire a good geologist to study the country for you and to make the best guess that he can. The radio divining rod—or the "electronic emanation detector"—is nothing but a fake.

In one sense, of course, the radio engineers cannot be held responsible for these misuses of our science. But in another sense they are responsible. They have succeeded in making radio popular. Millions of people have heard about electrons and waves and frequencies and resonance and a score of other scientific conceptions utterly unknown ten years ago. This knowledge will do good. It is already serving as the introduction of thousands of persons to the real and useful truths of science.

But knowledge misused will do harm. A smattering of radio knowledge is being misused by fakers.

It is one job of the radio engineers to see that this is stopped.

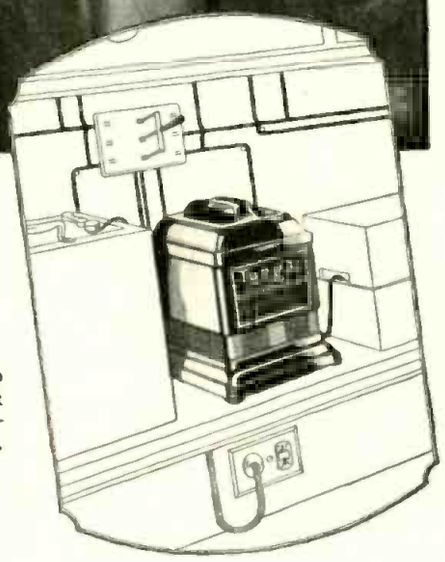
The next and last installment of this series will expose the use of radio in fake fortune-telling and character-reading schemes for preying upon the pocket-books of the credulous.



As easy as turning on the light

Throw a switch—and charge your batteries. That's all there is to it, if you have a Tungar permanently installed.

The batteries themselves may be placed in a cabinet, a closet or down in the cellar. And, at night, when you sign off, all you have to do is throw a switch—to the right for "A" batteries, to the left for "B." It's no more bother than turning on a light.



Tungar charges 2, 4 and 6 volt "A" batteries, 24 to 96 volt "B" batteries, in series: and auto batteries, too. No extra attachments needed.

It causes no radio interference.

It cannot blow out Radiotrons.

An overnight charge costs about a dime.

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

East of the Rockies:
2 ampere Tungar $18
5 ampere Tungar $28
60 cycles—110 volts

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar
Reg. U.S. Pat. Off.
BATTERY CHARGER

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

GENERAL ELECTRIC

A New Method of Using Harmonics for Determining Frequencies

(Continued from page 318)

gested above, and by estimating from the settings of the condenser dial (semi-circular plate condenser). This latter method takes into account the fact that the dial settings are inversely proportional to the square of the frequency. Thus if a dial setting of 80 has been found to give a frequency of 600 kilocycles (wavelength of 500 meters), a dial setting of 20 will give a frequency of 1,200 kilocycles (wavelength of 250 meters). It must not be assumed that this method is exact. To obtain reasonable accuracy, extremely high and low dial settings should not be used.

Some Special Precautions That Should be Observed

The following suggestions will assist in obtaining harmonics between generators:

(1) When adjusting the second generator to zero-beat with the first, determine the approximate required condenser setting from the rough calibration previously obtained. A beat note should be heard very near this condenser setting of the second generator. Varying the coupling between generators is usually necessary.

(2) The beat note is most easily detected in the phones inserted in the plate circuit of the generator giving the higher harmonic. If the generator employs a power tube the phones should be shunted by a suitable resistance or impedance.

(3) The beat note between generators may sometimes be more readily heard in phones connected to the receiving set tuned to one of the utilized generator harmonics. If the set is provided with sufficient amplification, a loudspeaker may replace the phones. This will, however, produce a somewhat broader region of zero beat since the tones of lower frequency will not be effectively amplified.

(4) Stronger generator harmonics will sometimes result if the filament currents in the tubes are reduced somewhat below the normal values and if increased plate voltages are used.

(5) As each new zero-beat adjustment of a generator is obtained, lay a card near the generator upon which is marked the fundamental frequency. This plan is of great assistance in keeping track of the generator adjustments.

(6); When calibrating a frequency meter, plot a few preliminary points on cross-section paper as soon as they are obtained. This will indicate other frequencies most needed to give a smooth calibration curve.

Calibration from Harmonics

By the use of harmonics from a local generator, the known frequency of a distant station which is *above* the range of the frequency meter can be used for a calibration point.

Suppose the transmitting station is known to be 2,000 kilocycles (150 meters) and suppose that the frequency meter will not measure above 700 kilocycles (below 428 meters). The receiving set is tuned to the transmitting station and the generator is carefully adjusted in the region of 666.7 kilocycles ($= 2{,}000 \times 1/3$) until a zero-beat is obtained. This is produced by the third harmonic of the generator beating with the received frequency. The frequency meter is now tuned to the fundamental frequency of the generator, giving the calibration point of 666.7 kilocycles.

A study of harmonics as outlined in this article gives a good background for experiments with a piezo oscillator (so-called "quartz crystal" oscillator).

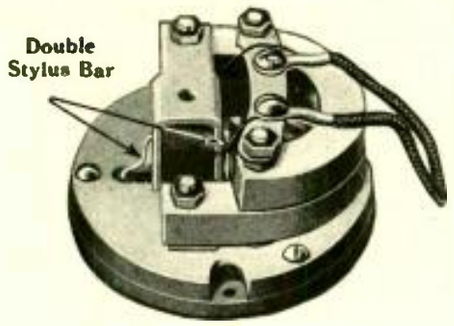
Although this device is comparatively new it is coming into extended use for those purposes where one or more frequencies of extreme accuracy and constancy are required. This instrument is essentially a radio-frequency generator in the circuit of which is included a quartz plate cut from a natural quartz crystal. The quartz plate has the property of responding to certain definite fundamental frequencies fixed by its dimensions. These frequencies are determined by comparison with a reliable standard and are usually three in number; they also have numerous harmonics.

The piezo oscillator is used in conjunction with the ordinary radio-frequency generator to obtain numerous other frequencies in the manner described in this article.

COMING—

"How to Build the LC-27 Receiver"

Ever since the development of the now famous LC-26 Receiver by Laurence M. Cockaday, work has been under way on the latest and best product of the POPULAR RADIO LABORATORY—*a non-regenerative, five-tube set that operates from the alternating current house-light, socket plug without "A," "B" or "C" batteries, and that is distinguished by an extraordinarily clear tone without distortion—particularly on the low tones.* *For further details, turn to page 306.*



The Velvet Speaker Unit -- *bringing new radio satisfaction*

The Borkman Velvet Unit is the first unit to be developed that reproduces naturally, the articulation of clear speech and yet yields both high and low overtones of the whole range of musical instruments. Not merely "low pitch," for Velvet Speakers retain the higher tones unimpaired.

The double stylus bar construction is patented. The wonderfully balanced diaphragm of unusual thinness, specially formed, is extremely sensitive--yet won't blast and won't distort on the heaviest power amplification.

Tone qualities like velvet! Smooth, clear, delightful. At last Radio reception as you dreamed it should be!

Dealers!

Watch next month for complete Velvet Radio Speaker line--four table models, an unusual cone type, and three rarely beautiful cabinet models. Perfect acoustic engineering!

Sales Department
The ZINKE COMPANY
1323 So. Michigan Ave.
Chicago, Illinois

Manufacturers
The BORKMAN RADIO CORP.
Salt Lake City, Utah

The Atom

(Continued from page 326)

and also—this is a hard-won result obtained by a few workers, especially at the National Physical Laboratory—that the atoms of the alloying metal are substituted for some of the atoms of the metal which is the base of the alloy. When a metal gives under strain, slip takes place between layers in which the atoms in each layer are arranged, as in Figure 7; such layers would be horizontal in a tightly packed pile of cannon-balls. A single large crystal is very easy to deform; but a mass of metal consisting of an irregularly arranged crowd of crystals does not give way so easily, because, in whatever direction the strain is applied, there are crystals which will stand strain in that direction, though weak in others.

When the atoms of the alloying metal are inserted, they form projections in the planes of easy slip, which stiffen their resistance to sliding, acting like nails in one's boots on slippery ground. This is Rosenhain's explanation, and it seems sound, up to the present state of development of the new X-ray analysis. Atoms which strain the structure of the crystal can only be introduced in small numbers. Thus copper will accept any proportion of nickel, but the alloy is little harder than the pure metal; while only a small percentage of tin or aluminum can be introduced, but the resultant hardening is considerable.

The distortion of the structure by the introduction of foreign atoms may also account for the increased difficulty of passing electricity through the metal. A pure metal is generally a good conductor of electricity. There are plenty of free electrons and a regular structure to flow through. It is natural to expect that the flow is impeded if the structure is deformed. When a pure metal has its temperature lowered, its resistance to electric current is diminished; the atoms are now quieter and the electrons move more easily. But there is little temperature change in an alloy, because the chief obstruction is the distortion due to the stranger atoms. This is illustrated in Figure 1.

Metals are conductors of heat; and there is a close relation, imperfectly understood, between the conductivities for heat and for electricity.

In Figure 8 is shown a beautiful piece of apparatus designed and made at the National Physical Laboratory; it depends for its working on the very expert preparation of plane surfaces. This process was carried to a high pitch of perfection during the war in order to meet the demand for accurate gauges. If the hand is placed on top of the horse-shoe, its warmth causes the steel pins at the bottom to converge and pinch the steel ball. If it is then placed underneath, the pins open out again and the ball once more moves freely between them.

The metallurgy of iron is extraordinarily complicated. The constant practice of thousands of years has accumulated a mass of technical knowledge which will take long to unravel. Nevertheless, the microscope, and—we may now add—the X-rays, are doing much to explain the many processes.

When carbon is put into iron, the atoms seem to be inserted between the atoms of iron, not to act as substitutes as in a copper-aluminum alloy. In both cases, however, there is resulting strain. Moreover, the iron and the carbon form molecules, called cementite, very hard and unyielding (Figures 3, 4 and 5). In the wonderful old Indian steel, that came to Europe through Damascus, the cementite crystals are clearly seen under slight magnification as white spots; and, as they occur in masses aggregated in broad wavy lines on the surface of the steel, they give it the famous "watered" appearance which was so prized as an evidence of quality (Figure 6). In sharpening the steel these hard particles seem to have furnished the minute teeth of the saw, which in effect the scimitar really was; its curve contributed to its sawing action. Saladin, in Scott's "Talisman," cut a fine gossamer veil in two. Cœur-de-Lion used a straight, heavy sword as one would an axe, and clove a bar of iron.

The idea of an atom or molecule attaching itself to others at definite points underlies the explanation in this and the preceding articles. At the surface, some of these points of attraction are uncovered. If no atoms or molecules of like kind are present to extend the solid by their accretion, others may take their place, and prevent further growth or the attachment of any other atoms. A clean glass surface is wetted very easily; but if it stands exposed to the air for a while it is covered with a foreign layer and can be wetted no more. Surface actions of this kind are of extraordinary importance in many industrial processes, and especially in physiological actions.

The experiment of Figure 11 is a simple illustration. A glass bead, just heavier than water, sinks to the bottom of a glass vessel containing soda-water. Neither bead nor vessel collects bubbles if they are clean and smooth. The water fastens on to the glass, or "wets" it; the gas bubbles are not encouraged to form between the liquid and the wall.

But, if the bead is taken out, dried, rubbed with greasy fingers and replaced, it collects bubbles in profusion, which, acting like buoys, bring it to the surface.

An important process in ore separation is worked thus; the heavy metal sulphide particles, made slightly greasy, are brought to the surface of a tank and stay there in a foamy mass, while the lighter particles of silicate and other matter are left at the bottom.

Does the Human Body "Reflect" Radio Waves?

(Continued from page 321)

wire measurement method is shown in the illustration on page 321.

The floor was marked where the assistant stood in each case when the maximum current was obtained, and it was found that these points corresponded to the half, whole, and one-and-one-half wavelength points as determined by the measurement of the wavelength of the set.

It was found that the effects obtained were considerably enhanced when the plane of the inductance of the transmitter coincided with the plane connecting the transmitter and the moving body, although readable deflections were obtained when these coils were at right angles to the line of advance.

It is certainly clear that shielding of the apparatus is even more necessary when working with these ultra-short waves if any degree of transmission stability is to be attained. We hear much at present among short wave enthusiasts about "shifting" and "fading."

How much of this phenomenon is directly due to unshielded sets and to the variation of the conditions surrounding the set while it is in operation?

One perfectly logical conclusion which we can draw from this experiment is, that, when we come to beam transmission, utilizing a parabolic reflector, particularly with waves under five meters in length, the maximum effect can be produced only when the focus of the system, at which the transmitter is placed, is located one-half wavelength from the middle point of the reflector, instead of one-quarter wavelength from it, as in the recent experiments of Marconi, and those of Dunmore at the laboratory of the Bureau of Standards. In such a case the energy returned to the antenna by the screen or reflector will effect the transmission of still greater energy to the distant point.

The simple experiment described in this article points the way to many other interesting ones along the same line; for example, the determination of whether this phenomenon will still be observed if the entire set, with the exception of the antenna and counterpoise are completely shielded.

It is also suggested that examination be made of the difference in effects which may be obtained with reflectors of various kinds, not only of metal, but such as trees, buildings and other objects, which might influence the transmission of these short waves. Many other desirable experiments will immediately suggest themselves to the reader.

There is a vast unexplored region concerned with the possibilities and difficulties of beam transmission which may well occupy the attention of many

investigators. One of the most important questions to be answered is:

"How soon does a beam cease to be a beam?"

Radio experimenters everywhere are urged to set up apparatus and obtain more data concerning these questions. The writer will be glad to hear further from anyone who may be stimulated to further research along these lines.

The Word of God— on 500 Watts

(*Continued from page 327*)

tically every live denomination appear before the microphone of the station. At its inauguration, representatives of nine different sects were present. So it is apparent that the spirit of religious cooperation may be carried out in this way for the interest of the listeners to the Radio Parish sermons, regardless of their doctrinal leanings.

Station WCSH, which serves as the pulpit of the radio parish, is modest, as broadcasting stations go. It is of 500 watts power and transmits on a wavelength of 256.3 meters. Although this type of station has a consistent range of only about 100 miles, letters already received from "parishioners" show its influence as far as California, Alberta, Cuba and the Atlantic coast.

Already, letters that are being received show that there is a genuine interest in this novel form of ministry. Expressions of opinions from the members of the radio parish are the sole guide as to the future of the station, and so far, these have been encouraging.

As the letters which are received at this station are of a type not ordinarily found in the usual broadcasting mail, answers of a special nature are required. All of the replies bear a personal stamp, and as the case decrees, it will be a message of thanks, counsel, sympathy, encouragement or of cooperation that will be written.

To those members of his far-reaching parish who are in remote sections apart from regularly founded churches; to shut-ins and invalids; to those at sea, the radio pastor plans to devote a great deal of time. It is indeed to those parishioners that radio will bring comfort and happiness, inaccessible otherwise.

The young minister—for Mr. Hough is not yet thirty—may indeed look for duty in a path that extends way beyond any man's horizon. And doubtless it is the privilege of radio to enlarge it.

During six months the Signal Corps radio net is said to have effected a saving of $48,086 in handling governmental messages.

* *

The rumor is again being revived that the Pope's voice may be broadcast.

The YES *and* NO MAN

O.P.Y.—We are sorry that we cannot get the full history of the Clicquot Club Eskimos for you. * * * However, we have managed to find a photograph of them and Mr. Rodney J. Clicquot (he is the brother of J. Jerome Clicquot, the one who sold the old family home to start the business) has kindly supplied us with a few pertinent facts concerning the lives of the boys. * * * They are shown here just as they stepped off Mr. MacMillan's boat last fall. * * * Kubo, the one on the right, left Greenland and eleven children, that he might sing for you. * * * Zeck, the one shown next to Kubo, still insists upon a blubber diet and he has eaten fourteen seal skin coats since arriving in New York. * * * The other two Kimmo and Clie (*Clie* means Clicquot in Persian) are awfully nice boys. * * * They speak wonderful English now and are helping their two younger brothers, Rippo and Icicle through the University of Greenland. * * * Zeck, in giving his first impressions of New York, said that we are very pale, dry people and that the man who owns the gum machines in the subway must have an awful time keeping them filled.

ALICE M. RADIOLAND.—Yes, the Stanbury-Gambie romance is still burning fiercely. * * * Gambie is Italian, Stanbury is Scotch. * * * Ah, Romance, my dear, we are many years beyond it—ever so many!

W.B.—Harry Richardson is the announcer at KFJF. How should *we* know if he has a brother in the laundry business in Ilion, N. Y.? * * * This is not a geneological bureau.

F.H.C.—Vincent is Spanish. * * * Yes, he owns *Casa Lopez*. * * * No, to your third question; you should know better. * * * So Uncle Geebee has got under *your* skin too! * * * Isn't he a dear? * * * If we ever meet him on a rainy day we shall take his rubbers and umbrella away from him. * * * My, wouldn't that make him mad!

M. McQ.—The idea of a sorority for tea-sipping announcers is old. * * * We are now thinking seriously of organizing a "Society for the Development of the Masculine Idea." * * * Uncle Geebee (WGBS) is our inspiration.

DAVID P.E.—Yes, Bertha Brainard is still on the staff of WJZ but she does not broadcast much. * * * You are right about Granlund (NTG); he worked on a fishing smack out of Boston. * * * So you think he is quite a poet after listening to some of his sonnets? * * * If you want to test your own poetical prowess, write an "Ode to Spring" and put it away in the trunk for a year. * * * If you like it after that you are a poet; if you feel like committing *hari-kari*, you are not a poet. * * * If you cannot decide one way or the other, keep your job on the grocery wagon.

D.W.P.—Yes, we also heard that Graham MacNamee was writing a book; it is to be called, "Before the Microphone." * * * It should be a wow. MacNamee is full of wows.

A.W.P.—Lewis Reed is the "nice voice" at WJZ. * * * Reed still requires a normal hat band and we regard him as a class A announcer.

EDDIE.—Robert Casey, the man who wrote "The Step On The Stairs" is a member of the staff of the *Chicago Daily News*.

E.F.F.—No, Lamdam Kay (Atlanta, Ga.) is *not* the son of the southern Colonel who wrote "Way Down Upon the Swanee River." * * * This song was written by Stephen Foster and it was named by his brother. * * * Your musical history is simply *terrible!*

BALL-BEARING.—Your "Society for the Muzzling of Irish Tenors" is premature; the matter of sopranos is more pressing. * * * We know that John McCormack started the "Irish Tenor" stuff but we are still searching for the guy who put the "song bird" idea in the heads of 1,481,781 female choir singers.

HENRY.—Jim Hughes is the funny man at the KADA Teaberry Time; he is the author of a number of humorous sketches. * * * If you think we should have more sopranos on the air, you are thinking destructive thoughts. * * * You are no prospect for our Society for the Abatement of the Soprano Nuisance.

DAVE.—Very few "microphone names" are used, so the lady's name is probably correct. * * * WMCA gives the stock market reports throughout the entire day.

CURLS.—*Please*, Lady, this is *not* a matrimonial bureau. * * * No, Brokenshire is not married. * * * Sure he's the "Valentino of radio."

V.P.—You are an ingratiating writer of notes; what a *lovely* piece of sentiment to read on a nice summer morning! * * * We don't know what happened to Eddie Squire, the old announcer of WMCA. * * * Eddie, where are you?

D.D., JR.—Where have you been? * * * WJY gave up the sponge last year. * * * It was a great blow to the sopranos, as WJY was sure a soprano-fed station.

A.L.—WHN is a very crude advertiser, but what are you going to do about it? * * * Some day we expect NTG to throw off a spasm of "Boots" for the "Broadway Shoe Shop."

JAMES P. McD.—"The Record Boys," Al Bernard, Frank Kamplain and Sammy Stept, are vaudevillians. * * * While we have never fallen out of our chair laughing at them, they *are* funny. * * * Yes, they all live in New York City.

S.P.—The Eveready Programs are invented and staged by a very alert young man named Paul Stacey; we regard him as the heaviest thinker in the broadcasting business. * * * Stacey used to be a newspaper man; he represents the "dawn of intelligence" in broadcasting.

E.F.F.—WHN is the world's greatest *rendezvous*, for jobless vaudeville actors and actresses; out of its daily callers you could make up the casts for nine burlesque shows. * * * Yes, there is always a gorgeous assortment of blondes and brunettes, but they are all hungry enough to eat you into a second mortgage.

MIKE.—Will Oakland (WHN), the "high tenor with the mint-julep personality," seems to be quite sure that he is a wow. * * * My, what a lot of damage the high school girls do to radio with their mush notes! * * * We don't know how Mr. Oakland got his start in radio but we do know how he would finish if we were king.

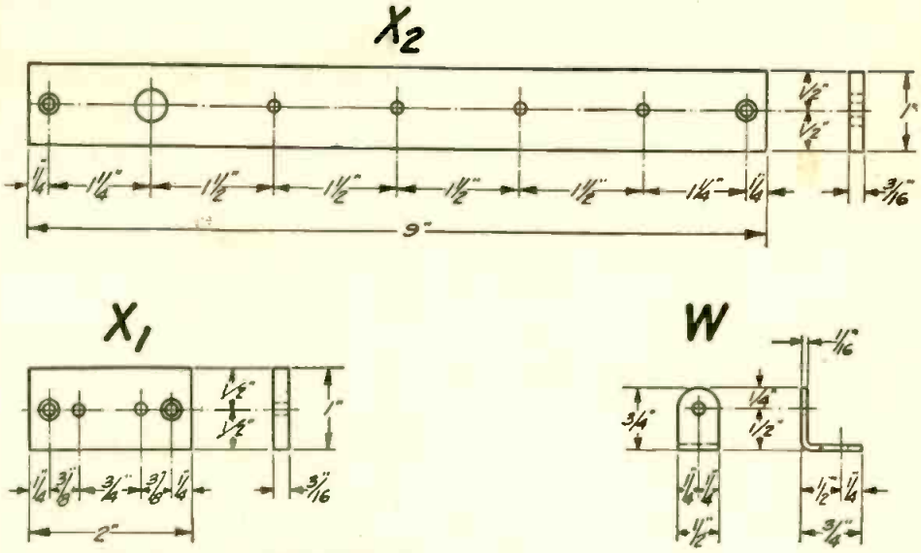
POW-WOW.—You've got a fly-paper memory. Edgar Rice Burroughs, the author of "Tarzan of the Apes" read the Evangeline poem on the Eveready Hour. * * * Yes, he *is* a splendid reader; we were charmed with his work.

B.S.—Choc Phillips, Billy Horan, Eddie Chittenden and Leslie Appelgate, make up the Sunny Southern Four that you heard from WSMB. * * * So you think they are good enough to be in grand opera, do you?

NO-NAME.—Emma Raff played the lead in the "The Step On The Stairs" microphoned at KOA. * * * If she sounded like a divorced woman your hearing is better than ours. * * * No, we have no information concerning the matrimonial status of the lady.

How to Build the Improved Browning-Drake Receiver

(Continued from page 334)



HOW TO MAKE THE SMALL PARTS

FIGURE 9: *The necessary data for making the insulated blocks on which the binding posts are to be mounted as well as the dimensions for the small, brass brackets that are used to fasten these connection blocks to the base are given in this diagram.*

board, Z, and the main panel, Y, is ready to be fastened to the baseboard itself. Attach the two aluminum brackets T1 and T2 to the panel by means of two flat-head machine screws and nuts.

Now, place the baseboard, Z, in the cabinet, V, and adjust it in place so that the connection blocks X1 and X2 are flush with the outside back of the cabinet. Then, place the panel, Y, in its proper place in the cabinet and mark the centers for the screw holes in the two aluminum brackets T1 and T2, as they come opposite to the proper places on the baseboard.

Then, take the baseboard and the panel out of the cabinet again and fasten two strong wood screws through each of the aluminum brackets into the baseboard itself. This makes a good fit for the whole outfit and holds the panel rigidly in place.

You are now ready to start in wiring, as the construction work is completed.

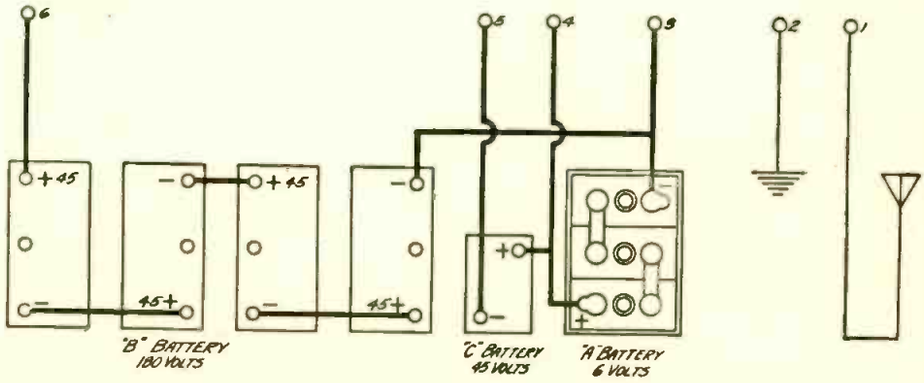
How to Wire the Set

The design of the receiver is such that the wiring of the grid circuit of each of the three tubes is as short as possible and is isolated from the other parts of the circuit. In fact, this idea has been employed throughout; and the leads have been so arranged that the shortest possible connections may be used.

Because of this, the set should be wired with bus bar. Either a tinned-copper, round bus-bar or an insulated, round bus-bar such as "Celatsite" may be used for all connections. All wires should first be shaped to fit; and all connections should be made permanent by soldering.

It is best to refer constantly to the wiring diagram in Figure 5 and more specifically to the picture diagram in Figure 2 for the exact way in which to run the wires.

Start by running the most inaccessible wires in the receiver.



HOW TO HOOK UP THE BATTERIES

FIGURE 10: *The builder cannot make a mistake in connecting the batteries to the terminals of the receiver if he follows these instructions carefully. The terminals that are shown in the wiring diagrams are marked with numbers that correspond exactly to the numbers that are given here.*

The hardest wires to attach are those that run from the primary of the transformer, E, to the tuning unit, CD, and the resistor, P1. Wire up the filament circuits, as shown in the picture wiring diagram Figure 3 and follow through with the plate and grid circuits of each tube. If the picture wiring diagram is strictly adhered to the reader will have no trouble in making a proper connection for all of the instruments.

The neutralizing condenser, I, should be fastened in place to the grid binding-post of socket N1; this is all that is required to hold it in place. The three fixed condensers, H1, H2 and U, are held in place by the wires themselves and should be placed in about the positions shown in Figure 2.

After the wiring has been completed, it should be carefully rechecked with the picture diagram to be certain that there have been no wires left out or no wrong connections made. When the wiring has been completed and the various resistances and the automatic filament units placed in the holders, the set is ready to be installed and placed in operation.

How to Install the Set

With the type of antenna coil used in this receiver, it has been found that the most satisfactory length of antenna for ordinary use is 75 feet, exclusive of the lead-in. Where a longer antenna is used, it is sometimes advisable, particularly in the vicinity of strong local stations, to insert a fixed condenser or a small variable condenser such as the Precise model 940 which has a maximum capacity of .0001 mfd. in series with the antenna.

The advantage of a variable condenser is that it may be used to adjust the antenna circuit for various antenna lengths so that the dials will run alike over the entire wavelength range. Once this condenser is adjusted, it is as a rule unnecessary to change it. For this reason, it is recommended that the condenser be placed inside the cabinet and it may be fastened directly to the baseboard, Z.

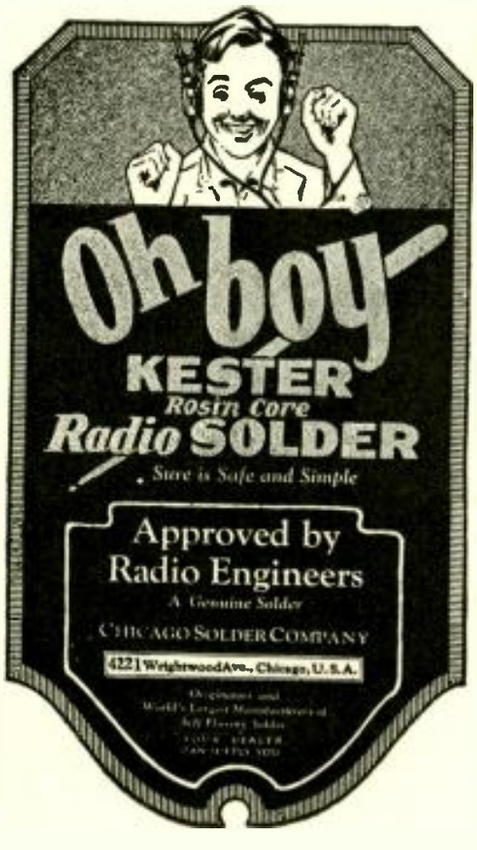
It is advisable to use a good ground connection.

The determination of a good ground is a particularly simple matter. It may best be done by disconnecting the antenna and connecting the ground wire to the antenna post of the receiver. The receiver should give satisfactory loud-speaker operation when used in this way for local reception.

The trial of several grounds is recommended where they are available. General experience indicates that the most suitable ground is usually a direct connection to a cold water pipe made by means of a ground clamp.

The Batteries

We now come to a consideration of the "A," "B" and "C" batteries.



It will be seen from Figure 10 that there are but four battery binding-posts which are connected as follows:

Looking at the set from the rear, the left-hand binding-post is connected to the "B" plus (+), the next to the "C" minus (−), the third from the left to the "A" plus (+) and the "C" plus (+) and the right-hand post to the "A" minus (−). The connection to the "C" plus (+), however, must be varied, according to the type of output tube used, in the following manner—

When a UX-171 tube is employed, and this tube is recommended, and 180 volts are applied to the plate, the best connection for the "C" battery, which should be a small size 45-volt battery, is, positive "C" to positive "A" and the negative side of the "C" battery to the second terminal from the left-hand end.

When the 171 is used with 180 volts on the plate, the drain on the "B" batteries is rather high and the large size is advisable. The author has also procured very satisfactory results with this tube by using the high voltage tap on a Mayolian "B" supply unit employing a standard Raytheon tube.

When a UX-171 tube is used with less than 180 volts on the plate, the best "C" battery connection may be found by placing a milliammeter in the negative lead of the "B" battery and watching the milliammeter on a strong local signal. Adjust the voltage of the "C" battery until no variation in plate current occurs.

When this receiver is employed at some distance from local stations, it will be found that the output tube is not so likely to overload and that a UX-112 or 201-a tube may work out in a fairly satisfactory manner. When a UX-201-a is used for the output, the plate voltage should also be 135 and the "C" voltage between minus 4½ and minus 8. A ¼-ampere filament ballast should then be used at Q.

The variation of the voltage applied to the radio-frequency tube and to the detector tube may be had by replacing the fixed resistors in these circuits according to the following scale:

When 180 volts are used for the plate supply, a resistance of 25,000 will provide 90 volts for the radio-frequency plate and a resistance of 90,000 will provide about 45 volts for the detector plate. The resistance values for various plate voltages from a given plate supply are included in the accompanying table.

Total "B" Voltage	*Resistance*	*Circuit*	*Voltage Required*	*Amount of Resistance*
180	P2	Det.	45	90,000 ohms
180	P1	RF	90	25,000 ohms
135	P2	Det.	45	60,000 ohms
135	P1	RF	90	12,000 ohms

A TABLE OF
RESISTANCES FOR UX-199 TUBES

Before placing any of the tubes in the sockets, it is advisable to disconnect the "B" battery and to turn the filament switch, S, to the "off" position. Then, place the power tube in socket N5, the second socket from the left, looking from the front of the receiver, and turn on the filament switch.

Place two UX-199 or Ceco type C tubes in sockets N1 and N2. These sockets have their filament circuits wired in series so that approximately 3 volts is applied to each. Both tubes should light when the filament switch, S, is turned on.

Place the last two UX-199 or Ceco type C tubes in their sockets N3 and N4 and follow the same procedure. If all of the tubes light satisfactorily, the negative lead to the "B" battery should be put in place.

Then, the positive lead should be lightly touched to the high voltage side of the "B" battery. If the tubes brighten when this momentary connection is made, it is an indication that some of the wiring has not been carried out correctly and that the tubes are likely to burn out. If no increase in brilliancy occurs, it is safe to go ahead with the operation of the receiver. In making this test it is always better to use not more than 45 volts of "B" battery. If this does no damage it is safe to go to the high voltage.

How to Operate the Receiver

As the coils and condensers, used in this design, have been built with the idea of having the two dials assume similar positions for a given wavelength, it is only necessary to rotate them together from one end of the scale to the other.

As soon as a station is picked up, it is advisable to adjust the neutralizing condenser I. This may best be done by turning up the volume control to a point near maximum and then reducing it slightly.

Adjust the right-hand dial to a point where the signal is loudest. Then, rotate the left-hand dial up and down the scale to a point above and a point below where the strongest intensity is observed.

If a squeal takes place as this left-hand condenser is rotated, it may be entirely eliminated by properly adjusting the neutralizing condenser I, which is mounted on the base inside the receiver. The best means of adjusting this condenser is to use a rather long stick with one end sharpened to resemble a screw-driver. The use of a screw driver or other metal tool is not advisable as it is likely to cause a capacity to ground through the body.

Once this neutralizing condenser, I,

has been properly adjusted, it will be found that further adjustments are unnecessary, unless some change is made in the circuit or one of the tubes is replaced. Neutralizing the receiver where tubes of the 99 type are employed is a very simple matter.

In order to locate stations, it is merely necessary to follow the procedure outlined above and, as the variable condensers are of the Equicycle type, it will be found that the stations come in at equal distances from each other on the dials. The variable ratio feature of the National Velvet Vernier dials used by the author make either delicate tuning with a nicety or rapid changes in wavelength available by the simple shift of the ratio changing lever. This lever provides any ratio between six and twenty to one.

When the desired station has been tuned in satisfactorily, the volume may be regulated by an adjustment of the volume control.

A Measurement Chart

(*Continued from page 315*)

inches long that is located within a coil 3 inches in diameter and 4 inches in length:

Connect 4 on scale No. 1 with 1.5 on scale No. 2. Then connect the intersecting point on scale No. 3 with 3 on scale No. 4; and connect the point where this line intersects reference line No. 5 with 2 on scale No. 6. Connect the point where this line intersects reference line No. 7 with Parallel (which in this case is the relative location of the coils), on scale No. 8. This line will intersect scale No. 9 at .166, which is the coupling factor of the two coils.

If the inner coil is turned fifty degrees the line from reference line No. 7 through scale No. 8 will intersect scale No. 9 at .104 which is the coupling factor for this position of the coils.

If we assume the self-inductance of the coils to be 100 and 400 microhenrys, respectively, the mutual inductance (as calculated from Equation 1) will be 33 microhenrys.

Then, if the coils are connected in series, the values between which the inductance will vary (as calculated from Equations 2 and 3) will be 434 to 566 microhenrys.

Not waiting for a tenant to mar the architecture by an unsightly antenna the new Castle Rose Apartments in Portland, Oreg., are reported to be all wired up in advance.

* *

German letter carriers collect fifty cents a month license fee from every broadcast listener.

* *

It is estimated that 5,000,000 farms are yet without radio.

With the Experimenters

(Continued from page 346)

ment current of the last tube, which leaves eight tubes on the rheostat as before.

Either a UX-112 or a UX-171 should be used in the last stage. If the former is used, the "B" battery voltage should be increased to 157.5 volts and the bias on this tube to from 9 to 12 volts.

The use of the UX-171 is recommended although several precautions are necessary. The plate voltage should preferably be increased to 180 volts as this permits maximum output from this tube and allows the first resistance-coupled stage to handle more energy without distortion.

Three flexible leads should be connected to the points shown as T1, T2 and T3. The positive "C" battery terminal should be connected to the terminal T3 and the 3-volt negative terminal to T2.

The negative bias that is used on T1 will vary between wide limits depending upon the tube and plate voltage used. The bias that is recommended by the manufacturer for the tube with the plate voltage that is used should be employed. About 40 volts will be satisfactory where a UX-171 with 180 volts on the plate is used.

To prevent the addition of more binding-posts, the total amplifier voltage is applied to all audio-frequency stages. As the first stage is not biased, this voltage will be excessive when phones are plugged into the first jack. The direct current resistance of the phones or speaker is very low and the effective plate voltage on the UX-201-a used in this stage will be too high. Some provision should be made for connecting about a 10,000 ohm resistance in series with the phones or speaker when they are plugged into the first stage.

The two coupling resistances (which correspond to O3 and O5 in the original circuit) should have a value of approximately .1 megohm, and the two leaks, O4 and O6, .5 megohms. The resistances originally employed, with the exception of O3, may be used although they will not be quite as satisfactory.

The additional socket placed just back of the Autodyne coupler holds the oscillator tube. This should be of the rigid or uncushioned type.

The new UX-200-a tubes may be used in both the first and second detector sockets and will greatly improve the operation of the receiver.

Note that 45 volts are used on the intermediate stages, oscillator and detectors. This, combined with the use of a "C" battery in the amplifier, will considerably lower the "B" battery current consumption and the life of the usual battery will be increased from 200 to 300 percent depending on the type of tubes that are used in the receiver.

Failure to operate may be due to most of the causes that were enumerated in Parts I and II of this series. Check over the suggestions that were given, keeping in mind the parts that have been removed from the circuit.

The condenser, C5, corresponds to G in the original receiver and it should be adjusted in accordance with the original instructions. Try all of the usual measures such as changing the tubes around. If no heterodyning takes place, try reversing the connections to either of the coils on the Autodyne coupler.

The receiver will operate best with the rheostat turned about three-quarters of the way on. The fact that a change in filament current causes a marked change in the stability of the receiver does not mean that the filament current is critical in the usual sense of the word. The original operating conditions may be restored even when the filament current is changed considerably by readjusting the positive bias on the IF stages (by changing the adjustment of the potentiometer) and by readjusting the oscillator dial. The change in plate resistance of the tube, due to change in filament emission, will slightly alter the frequency of the oscillator and this is sufficient in some cases to completely detune the station.

Although regeneration is not usually to be recommended, due to the resultant increase in instability, difficulty in operation and loss of quality (due to the loss of the higher audio frequencies, that is to side band cutting) regeneration may be used by connecting a small variable condenser from the plate of the first detector tube to the inside lead on a mid-tapped loop. The center tap should go to the filament side of the input circuit and the outside lead of the loop to the grid side.

—HUGH S. KNOWLES

A Handy Accessory for Testing Loudspeakers

This small rotary switch is a quadruple-throw, double-pole rotary switch that contains pin jack terminals for loudspeakers. It will accommodate four sets of loudspeaker terminals at the same time and by rotating the small knob on the top of the instrument, any of the loudspeakers may be switched on instantaneously for direct comparison as to their tone qualities. Experimenters will find it a handy unit for connecting loudspeakers in circuit.

"Trouble Shooting" in the Orthophase Receiver

IN operating the Orthophase receiver, which was described in the February, 1926, issue of POPULAR RADIO, several possible causes of trouble have been located and are printed here for the benefit of readers who have built or wish to build this receiver.

In the first place, it is essential, if the correct operation of the Orthophase is to be insured, that the transformer which is used at H has the correct capacity between the primary and secondary windings. The old type Amertran, as specified, has been found to be most satisfactory in this respect, and should be used.

A common source of trouble is the small plate coil, D. In assembling the set and wiring it up, it may happen that one of the fine, wire leads may be broken off at the terminals of the coil. This is difficult to determine by inspection; but it may be detected by connecting a battery and head set in series with the coil in the usual manner of testing for an open circuit. Before making this test, remove the crystal from its mounting.

A defective crystal detector or one of a wrong type may cause the receiver to function improperly. A detector which utilizes iron pyrites as its mineral should be used, as the resistance of such a detector is correct for this set. While an adjustable type may be used, one of the fixed variety is preferable; and the Rasla, as specified, has been found to perform consistently.

To determine whether or not a fixed detector is sensitive is not so easy, but a rough test may be made as follows:

Connect one tip of your headset cord to the positive binding-post of a single dry-cell. Now, touch the other tip on the negative binding-post and a loud click should be noted. Then connect one end of the fixed detector to the negative post of the dry-cell, and touch the free tip (of the phone cord) to the other end of the detector.

Reverse the detector and repeat. With the detector connected in one direction little or no click should be heard when the phone cord tip is touched on the detector, while with the detector connected in the reverse direction, a click almost as loud as when the phone tip is tapped directly on the negative post of the battery should result.

In some cases it may be found that the condenser, G, as specified (.00015 mfd). may have too low a value of capacity to enable the antenna to be tuned to the higher wave-lengths. It may also happen that the condenser may have an incorrect marking on it. The condenser should be replaced with one of higher capacity.

If possible, different values of leaks for K2 should be tried. If more volume is required it might be advisable to run the lead from the F— (minus) terminal of the resisto-coupler directly to the A— (minus) binding post instead of to the grid of tube O3, as shown.

Care should be taken that the loudspeaker cord is kept away from the front of the set and away from the coils or howling may result. Failure to regard this suggestion may also cause undue hand-capacity.

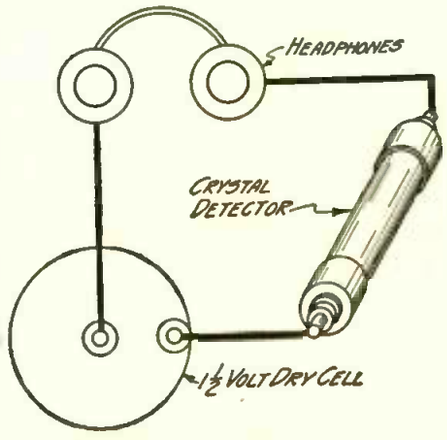
The operation of the Orthophase Receiver is slightly different from that of most receivers, so a few words regarding the proper manipulation is given here. A slightly different procedure is followed in tuning "local stations" in, from that used when "searching for distance."

For "locals," it is advisable to start with dials Q and R1, dial R2 being disregarded at first. Dial Q should be set to a point corresponding to the wavelength of the station desired and dial R1 revolved slowly until the station is heard with the most volume. In all cases the dials should be turned very slowly, as otherwise the station may be passed over and not heard.

After dials Q and R1 are adjusted as above, dial R2 should be adjusted by turning slowly from 0 towards 100. When R2 reaches a setting about the same as that of Q, a hum or "moan" will be heard and dial R2 should be turned back toward 0 (very slowly), until the hum just stops. After this, readjust dial Q and R2 *at the same time* until the desired volume and quality are received. Finally, it may be desirable to readjust R1 to improve volume or eliminate an interfering station.

In searching for "distance," dials Q and R2 are adjusted first, instead of Q and R1 as above. Starting at the low numbers on Q, this dial is turned slowly toward the upper numbers. As Q is turned it is followed up by dial R2 as follows:

Immediately below the "moan," referred to in the preceding paragraph, that is, at a setting slightly lower on dial R2, a faint hiss will be noticed. In tuning, dials Q and R2 should be revolved *slowly* and at the same time,



THE TEST FOR THE CRYSTAL DETECTOR

FIGURE 3: *This test is accomplished simply by the use of a pair of head phones and a single dry-cell battery.*

keeping them so adjusted relative to each other that the hiss just mentioned is sustained. In this way, as the station settings are passed over, they will be manifested by the whistle or "beat-notes" caused by the carrier waves of the stations, similar to the method used in tuning ordinary regenerative receivers. As Q and R2 are revolved, R1 should be advanced a few degrees each time the other two dials are advanced ten degrees or so.

After the station is located, readjustment of all three dials may be made just as in tuning-in "locals."

It may be noticed that when dial R1 is adjusted to the wavelength of a strong signal, this signal may be heard at any setting of dials Q and R2. This is normal and does not indicate that the receiver is tuning broadly, as the interfering station may be eliminated by turning R1 away from this station's setting. It is only on nearby or strong stations that this effect will be noticed.

—RICHARD J. GRIFFITH

How to Get the Most Out of Your New Home Receiver

So much interest has been shown by set builders in the fine qualities of the new Home Receiver (described in the June issue of this magazine), that this article has been written to take up in greater detail the various phases of installation to insure the best possible results to every one who constructs the set.

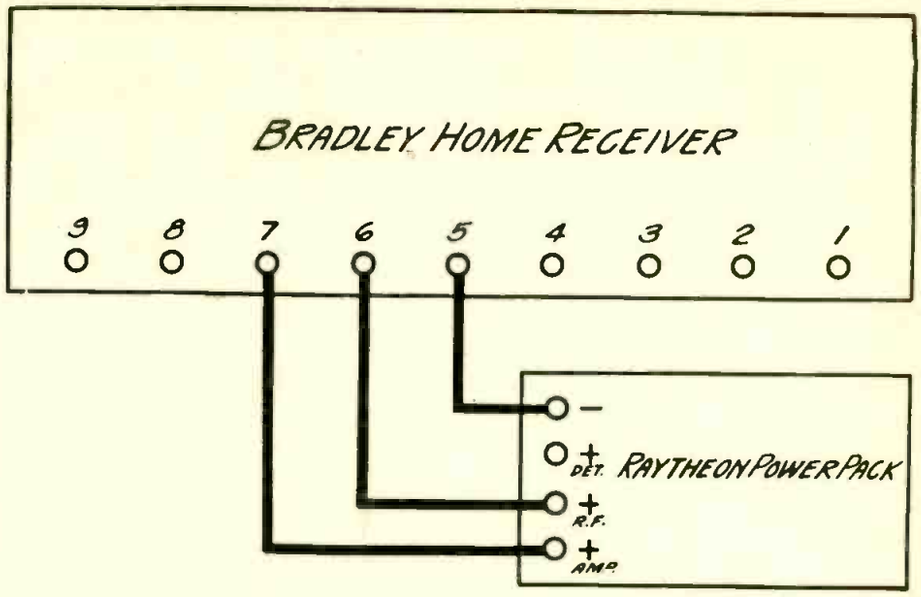
This receiver was designed primarily for faithful reproduction; and good tone quality is contingent upon so many factors that it will be necessary to take them in order from the aerial installation straight through to the loudspeaker.

The Theory of Operation

The variable coupling coil that is used in the antenna circuit of the receiver, makes it possible to adapt the set to either an indoor or an outdoor aerial and to arrange the selectivity to suit the needs of the individual. This coil and in fact all three coils are solenoid wound on low-loss quartzite forms and are tuned by straight-line-frequency condensers, thus assuring ample selectivity as well as separation of the lower wavelength stations.

It will be noted that the first stage of radio-frequency is neutralized in a manner which accomplishes two purposes: one, the prevention of reradiation; and the other the opportunity of using sufficient inductance in the plate circuit of the first tube to operate efficiently over the entire broadcast wave-band.

The peculiar absorption characteristics of the crystal circuit in combination with the second tube, make it advantageous to utilize a tapped plate inductance on this tube. This feature, which may be entirely forgotten for all local reception, is of great aid in boost-



CONNECTIONS FOR USING THE POWER-PACK

FIGURE 4: *Only three leads are taken from the power-pack and these three are connected as shown by the heavy black lines that are attached to the binding-posts 5, 6 and 7.*

ing the strength of weaker impulses on the higher wavelengths. It also permits the grid of the second tube to be operated with a negative bias by taking full advantage of the voltage drop across the resistance in the negative filament lead of this tube. The importance of this may be readily understood when it is realized that this tube is amplifying at both radio and audio frequencies.

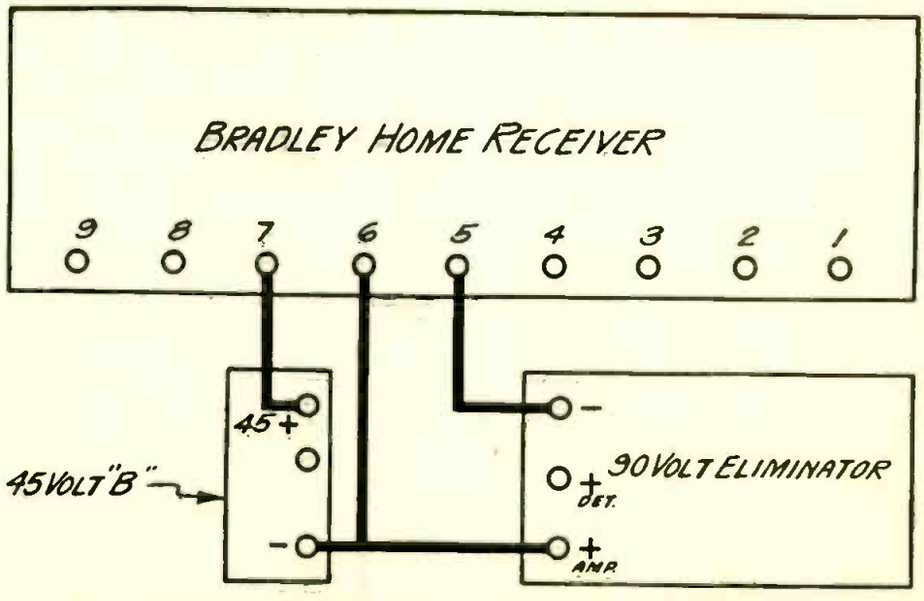
Thus the signal reaches the rectifying crystal after passing through two stages of radio-frequency amplification; and this ingenious stabilizing unit, placed at this point, entirely eliminates tube noises.

From the crystal circuit, the signal, now at an audible frequency, is impressed back upon the grid of the second tube, passing on its way through an audio-frequency transformer. At this stage the lack of bypass condensers permit the full use of the straight-line-frequency characteristics of the transformer.

The output from this tube is now fed through a second audio transformer and into the power tube; this gives the equivalent of five-tube efficiency with the economy afforded by the use of only three tubes.

The desirability of using a power tube in the last stage cannot be over-emphasized, particularly when the receiver is used with a cone-type loudspeaker, for it is on this stage that any possibility of distortion from overloading must be guarded against.

A very strong signal passing into the third tube will tend to swing the grid too far positive; this is so often characterized by blasting in a speaker. To prevent this, it is necessary to place enough negative "C" battery potential on the



THE CONNECTIONS FOR A 90-VOLT POWER-PACK

FIGURE 5: *If a 90-volt power-pack is used, an additional 45-volt "B" battery must be used to supply the higher voltage that is required by the last tube.*

grid to neutralize this action. With an increase of negative grid-bias the plate voltage must be increased to balance the amplifying characteristic of the tube or, on strong signals, the negative peaks in the plate current will be cut off. Thus it will be necessary to use a tube that is capable of standing high plate voltages.

A milliammeter placed in the negative lead from the "B" battery source, is of the greatest value in determining the proper voltages to be applied. For distortionless amplification, voltages must be applied until the milliammeter needle does not fluctuate on strong signals. An upward movement will show the need of more plate voltage, while any downward fluctuation shows that more "C" battery should be used.

The Antenna and Ground

In the January, 1926, issue of POPULAR RADIO there were taken up, in minute detail, various installation features of the LC-26, all of which are applicable to the new Home Receiver. The reader is therefore referred to this article.

The Batteries

The storage "A" battery should have a capacity of 90 hours or more.

For "B" batteries, three 45-volt blocks of the heavy-duty type are the most advantageous if the set is used at all extensively. These permit the use of the power tube without the bother of frequent replacements.

For those who have an alternating current supply, the use of a Raytheon Power-pack as described in the May, 1926, issue of this magazine is perhaps the most ideal arrangement.

The tap for the detector voltage should be disregarded and the voltage from the radio-frequency tap be applied to binding-post No. 6 on the set. Adjust the variable resistance of the eliminator until approximately 90 volts is applied.

If the reader already possesses a 90-volt eliminator which is not designed for a separate radio-frequency voltage tap, it will be necessary to apply the entire voltage of the eliminator to binding-post No. 6 and to add a block of 45-volt "B" batteries in series from this tap to take care of the power tube.

For the "C" battery supply two 4½-volt batteries in series should be ample to take care of the grid-bias when either "B" batteries or eliminators are used.

It will be noted that, in all of the illustrations of this receiver, a cone-type speaker is shown. This model of the receiver has been designed to take full advantage of such a speaker. Of course, any speaker may be used, but with the idea of quality uppermost it is of great importance that the type selected should permit the reproduction of all tone frequencies with the same volume.

—WILL BRADLEY, JR.

How to Get the Most Out of Your "Town and Country" Receiver

(*Continued from page 340*)

foreign broadcasting and a good slice of the domestic and foreign ship and land commercial wavebands.

The capacity of the receiver to go down to the short-wave broadcast band is of particular interest during the summer months because many times when static is bad in the 200-550 meter band it is almost entirely missing around 60 meters.

This short-wave broadcasting reaches out to much greater distances than does the regular broadcasting. At times when reception conditions are particularly poor, station KDKA, for instance, may be brought in with good volume on the loudspeaker on their 63-meter wave while on their 309 meter wave they cannot be heard at all.

The loop that is used with this receiver is intended for use only on the broadcasting band between 200 and 550 meters. To receive signals on wavelengths lower or higher than this band it is necessary to use an antenna and ground in conjunction with a suitable coil plugged into socket A, for the antenna tuning coil, and the corresponding size of coil for the oscillator, in socket B.

The following table gives the proper coils to use for the various wavebands:

Wavelength in meters	*Antenna Coil No.*	*Oscillator Coil No.*
50-110	110C	111C
90-210	110B	111B
190-550	110A (or loop)	111A
550-1500	110D	111D

For those who wish to wind their own coils, bare coil forms have been placed on the market by the coil manufacturer. These forms are identical with those used in the finished coils.

The proper number of turns for the various coils are:

Coil No.	*Rotor*	*Upper Stator*	*Lower Stator*
110C	6 turns No. 32 DSC	6 turns No. 26 bare or enamel	6 turns No. 26 bare or enamel
110B	10 turns No. 32 DSC	12 turns No. 26 bare or enamel	12 turns No. 26 bare or enamel
110A	30 turns No. 32 DSC	45 turns No. 26 bare or enamel	45 turns No. 26 bare or enamel
110D	60 turns No. 32 DSC Bank-wound	140 turns No. 26 DSC Bank-wound	120 turns No. 26 DSC Bank-wound
111C	6 turns No. 32 DSC	12 turns No. 26 bare or enamel	20 turns No. 34 DSC Scramble-wound
111B	10 turns No. 32 DSC	24 turns No. 26 bare or enamel	20 turns No. 34 DSC Scramble-wound
111A	30 turns No. 32 DSC	90 turns No. 26 bare or enamel	50 turns No. 34 DSC Scramble-wound
111D	60 turns No. 32 DSC Bank-wound	260 turns No. 26 DSC Bank-wound	100 turns No. 40 DSC Scramble-wound

In the case of the type 110 coils, the top of the upper stator winding goes to coil terminal No. 3, the lower end to terminal No. 4. The top end of the lower stator winding is connected to terminal No. 5 and the lower end to terminal No. 6. Either end of the rotor windings may be connected to terminal No. 1, and the other end to terminal No. 2.

In the type 111 coils the upper stator winding is in a single layer while the lower stator winding is "scramble-wound" in a narrow slot cut around the bottom of the coil form. The upper end of the single-layer winding should be connected to terminal No. 3 and the other end to terminal No. 4. The inner end of the scramble winding (the end next to the form) is connected to terminal No. 5 and the outer end to terminal No. 6.

The exception to the foregoing paragraph is the type 111D coil, the stator windings of which are placed the same as the windings on the other type 111 coils; the terminals are connected in the same manner but the difference lies in the fact that the upper stator winding of the type 111D coil is bank-wound.

When the receiver is used to receive short-wave broadcasting, the tuning becomes sharper and more critical than on the higher wavelengths. Usually, the left-hand dial will tune a little higher than the right-hand dial.

To become familiar with the tuning on short waves it is well to start with the left-hand dial at about 10 and the right-hand dial at zero. Then turn the dials slowly throughout their entire scales, keeping the same difference between the two.

If this procedure fails to bring in signals, turn the potentiometer knob all the way to the right and repeat the above process. This time some whistles should be heard as the dials are rotated.

Pick out the loudest whistle and readjust both dials to make the whistle as loud as possible. Then turn the potentiometer back until the whistle stops.

At this point the signals should be clearly heard and slight readjustments of the two tuning dials, the potentiometer and the small knob at the lower left hand corner of the panel can be made to bring the signals in with the desired volume.

Some peculiarities will be noted in short-wave reception. For instance:

You may tune in a station at 70 meters, only to find out, when the call letters are given, that it is a local station working on 280 meters.

This condition is no reflection on the receiver but rather on the transmitting station. It is due to the fact that the

broadcasting station has not taken the trouble to install apparatus for the elimination of its harmonics. There is one station in New York City, for instance, that may be heard distinctly, although somewhat distorted, at every harmonic down to the ninth. This means that, if a receiver has a sufficiently broad wavelength range, this station may be tuned in at one-half its regular wavelength, again at one-third its wavelength and so on right down to one-ninth of its wavelength which is about 30 meters.

Reception of actual short-wave broadcasting may be distinguished from harmonic reception, as a rule, by the quality. Harmonic reception is usually distorted while straight short-wave reception may be as good in quality as that on the longer waves.

In long-wave reception, from 600 meters up, it is essential that extremely loose antenna coupling be used. This is accomplished by turning the rotor of the antenna coil almost at right angles with the stator winding.

The reason for this is that where broadcasting stations are operating nearby they will be heard when the oscillator is so tuned that its second or third harmonics heterodyne with the wave of the broadcasting station. The loose coupling of the antenna coil prevents the broadcast wave from entering the receiver and thus eliminates this trouble.

Navy Radio Men Win Hero Medals

THREE Navy radio men have won special honors and awards; Elmer E. Wisendanger, Joseph Henry Aubin, and Otis G. Stantz.

The first, radioman Wisendanger, "displayed heroic daring in aiding in the rescue of the survivors of the wrecked destroyer *Delphy*, off Point Honda." He was not only commended for this deed by the Secretary of the Navy, but received a gold life-saving medal from the Secretary of the Treasury.

Radioman Joseph Henry Aubin was commended for the heroic rescue of a shipmate by swimming in freezing waters at New Dungeness, Wash.

Changes in the List of Broadcasting Stations in the U. S.

These corrections and additions to the list which was published in the March, 1926, issue of POPULAR RADIO *(together with the changes which have been published in each succeeding month) make the list correct as of June 20, 1926. Further changes will be published each month in this magazine.*

STATIONS DELETED

WEBE	Cambridge, Ohio	234
WWAD	Philadelphia, Pa.	250

CHANGES IN LOCATIONS

KFWC	Upland, Cal., *change to*	San Bernardino, Cal.
WGES	Oak Park, Ill., *change to*	Chicago, Ill.

In the World's Laboratories

(*Continued from page 348*)

tempted radio will be one of its chief necessities, for continual touch with civilization would be necessary so that the weather information and other facts could be passed on daily to the experts who will need them.

Do Electrons Spin?

ONE of the chief problems in all electric sciences, including radio, is the problem of what electricity is. Electricity is composed, we say, of electrons, but this helps little for we have virtually no idea what an electron is. That is why so much interest resides in a discussion now going on in the columns of the English scientific periodical, *Nature*, concerning the possibility of finding experimental evidence of the spinning of electrons on their axes, just as the earth revolves daily on its axis.*

This evidence is being sought, where so much atomic evidence has already been found, in the study of the light rays sent out from atoms. Readers of POPULAR RADIO are already familiar with the modern ideas of atoms and with the conclusion that the spectra of light sent out by them are related to the positions of the electrons inside the atoms. Some details of the spectra of certain elements cannot be explained by a simple theory of electron movements and the suggestion now is that a few of these mysterious details may be related to the spinning of the electrons on their axes, not to their movement in orbits or otherwise.

To the radio expert the chief interest of this is in the light which it might throw on what the electron really is. We are likely to think of electrons as being mere small bits of matter, like tiny marbles. That is a very crude and incorrect picture. Whatever the electron may be it certainly is not in the least like a small dust mote of iron or gold or any other material. The properties of ordinary substances are properties of large masses only, each containing billions on billions of electrons. Some speculative scientists have imagined that the electron is a state of strain in the ether, like a small knot of ether or possibly a small empty bubble with no ether inside it. Other suggestions have been made. No one has much idea which of them, if any, are close to the truth. But if we can get a hold of any property of the electron itself, as, for example, its spin on its axis, we may be able to learn the secret of its construction.

*The discussion began with a note by G. E. Uhlenbeck and S. Goudsmit, of the University of Leyden, Holland, in *Nature* (London), volume 117, pages 264-265 (February 20, 1926). The second of these pages contained also a note by Professor Niels Bohr, the greatest living expert on atomic theory. Later contributions have been supplied by Dr. L. H. Thomas, of the University of Copenhagen (issue for April 10); Dr. R. de L. Kronig, of Columbia University (issue for April 17); Dr. J. C. Slater, of Harvard (issue of April 24); and Professor A. S. Eddington, of Cambridge, England (issue of May 8).

Captain Eckersley Criticizes American Broadcasting

Captain P. P. Eckersley, chief engineer of the British Broadcasting Company, was recently in the United States on a visit. One result is a London interview in which the Captain pays his respects, none too admiringly, to the condition of broadcasting in America.* We have been sunk, he believes, by the load of advertising which American radio is permitted to carry.

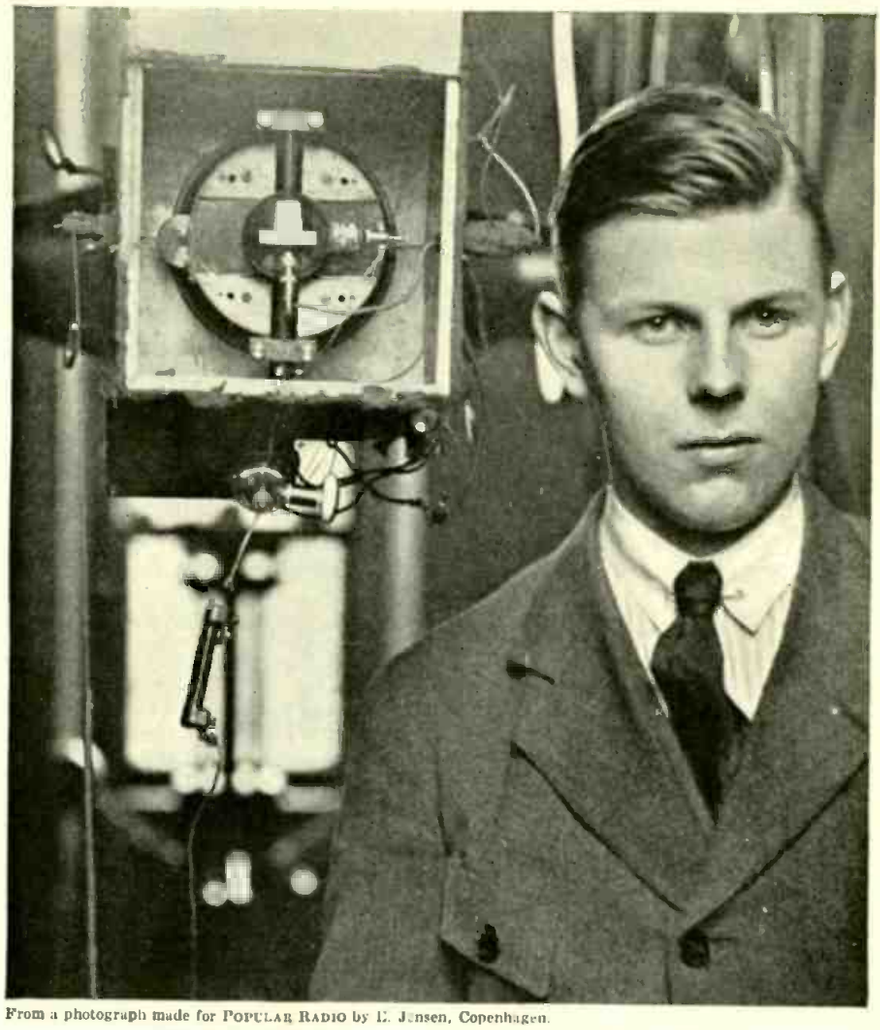
"Broadcasting in America is chaotic," says the Captain. "There is no organization in the United States, and advertising through the ether has been the means of its downfall. * * * * They (the Americans) now feel that if broadcasting had been one official organization, as it is in England, it would be the most popular entertainment in existence. As it is, it is nothing of the kind. The craze is dying off and the public is getting bored." The Captain concludes with some humorous examples of radio advertising gone astray, examples which we may be excused for regarding as imaginary or, at least, as brightened up a bit in the telling.

Undeniably broadcasting in the United States is far from perfect. There are important problems to be solved and one of them really is the problem of advertising. It may be doubted, however, whether our difficulties are any greater with advertising than are England's with monopoly. The truth is that no country has yet hit upon exactly the right way to manage radio and to regulate it. But, difficult as broadcasting problems are everywhere, we think that Captain Eckersley's gloomy report of the death of American broadcasting is, to quote the old gag of Mark Twain, greatly exaggerated.

*"British versus American Broadcasting," an interview with Captain P. P. Eckersley, by "Ariel." *Popular Wireless* (London), volume 9, page 382 (May 1, 1926).

A New British Plan for Regulating Broadcasting

THE committee headed by the Earl of Crawford, which has been studying for many months the situation and possibilities of broadcasting in Great Britain, has made its report. At present, all broadcasting in Great Britain is a private monopoly of the British Broadcasting Company, a cooperative organization of the manufacturers of radio apparatus, with a considerable element of Governmental control. The committee reports in favor of altering this plan to one of complete Governmental control, vested in a board of Commissioners appointed by the King but allowed as much freedom as possible in operating the broadcasting stations. Expenses would be paid, as now, out of the annual fee of ten shillings (about $2.50) which is charged in Great Britain for a receiving license.



From a photograph made for POPULAR RADIO by E. Jensen, Copenhagen.

A YOUNG EXPERT ON PHOTOELECTRIC CELLS

Mr. Bengt Strömgren, of Copenhagen, has developed an improved radio apparatus for detecting by photoelectricity the instant at which a star crosses the telescope wires. The apparatus, attached to the eye-piece of the telescope, is just to the left of Mr. Strömgren's head.

A New Radio Device That Takes Accurate Time from the Stars

OVER a year ago, General Ferrié, M. Jouaust and M. Mesny devised and attached to a telescope in Paris an electric apparatus for the automatic recording of the exact instant at which the image of a star crosses the fine spider web at the focus of a telescope.* The observation of this passage of the star image across the center of the telescope field is the way in which astronomers determine the exact time. All the standard time in the world is set thus. Astronomers at the Naval Observatory in Washington, make this observation for the United States. Other astronomers at Greenwich Observatory, in England, do the same for the clocks of London. The Paris Observatory sets the time for France and for the world-wide time signals sent out daily from the radio station at the Eiffel Tower.

Ordinarily this is done by the eye. An astronomer watches the image of the star. At the instant when its image crosses the thin line of the spider web in the telescope, he presses the telegraph key which gives the time signal and corrects the clocks. It is desirable, however, to do the job automatically. Personal errors can be eliminated; many records can be made, for star after star, and recorded automatically on the moving tape of a chronograph. To do this was the purpose of the device of General Ferrié and his associates. A similar device, somewhat more accurate and constant, has now been perfected by a young Danish astronomer and radio experimenter, Mr. Bengt Strömgren, son of Professor E. Strömgren, Director of the University Observatory at Copenhagen.†

The method used by Mr. Strömgren differs from that used by the French experimenters chiefly in that the loading of the grid of the first amplifying tube

*For accounts of General Ferrié's work, see POPULAR RADIO for April, 1924, page 409, and for October, 1924, page 406. A more complete account of the possible applications to astronomy is "Amplification of Weak Currents and their Application to Photoelectric Cells," by G. Ferrié, R. Jouaust and R. Mesny. *Proceedings of the Institute of Radio Engineers* (New York), volume 13, pages 461-470 (August, 1925). A general account of photo-electric cells and their operation will be found in POPULAR RADIO for November, 1925, pages 397-404. For further details see "Photo-Electricity," by H. Stanley Allen, 320 pages, second edition, published 1925, by Longmans, Green and Company, London and New York.

†"Photoelectric Registration of Star Passages" (in German) by Bengt Strömgren. *Astronomische Nachrichten* (Kiel, Germany), volume 226, pages 82-87 (December, 1925). POPULAR RADIO is indebted to Mr. Strömgren for additional information, as well as for the special photograph accompanying this note.

is controlled by means of a grid-leak. The French method was to allow the natural leakage through the insulation to take the place of this grid-leak. The more definite control permits, Mr. Strömgren finds, a more exact estimation of the time-lag of the apparatus, and hence a more accurate determination of the exact time of passage of the star. The possible amplification is somewhat higher, also.

The photoelectric cell is placed at the eyepiece end of the telescope. In front of the cell is a plate in which are cut a series of slits, so that the light of the star will pass through them, in turn, as the image of star passes across the field of the telescope. When the star passes one of these slits, its light enters the photoelectric cell. The photoelectric current then acts to load the grid of a special two-grid vacuum tube, the other grid having a positive potential of approximately 5 volts and operating to create the stream of electrons through the grid which is connected to the photoelectric cell. The photoelectric loading of this grid affects the current through the tube. This difference is magnified, by a four-tube cascade amplifier, so that it will operate a relay. The relay makes the record on the tape of the chronograph.

Two dots or taps are recorded on the chronograph record for each of the slits in the plate between the telescope and the photoelectric cell. From this series of records, the mid-point of the time of passage of the star through the telescope field can be read off. There is a certain lag, due to the time necessary for the current of the photoelectric cell to load the grid of the special two-grid tube. This lag, approximately one-tenth of a second, is constant so long as the tube and grid-leak are the same, and may be allowed for. The photoelectric cell used has an active deposit of metallic potassium and is filled with argon gas.

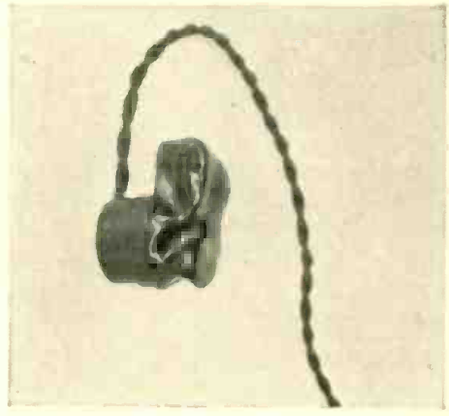
Since the publication of his paper, referred to above, Mr. Strömgren has been able, he writes, to improve the details of the apparatus so that the amplification attained, between the photoelectric cell and the relay, reaches approximately 300 billions. The passage of stars as faint as the eighth magnitude can be recorded, which means that the apparatus will operate on a star far too faint to be visible at all to the unaided human eye.

There is no apparent obstacle to the use of such a device to automatically broadcast the actual passage of a selected star across the meridian position. Thus the time signals of radio might be sent out by the stars themselves.

This would be more romantic, even if less convenient than the use of the customary clocks. Of more practical importance, however, is the increased accuracy in the measurement of time.

THE TINIEST TELEPHONE

The photograph above shows how a plaster cast is made of the ear canal, in order to mould the receiver to it. At the right is the receiver itself. The crumpled-looking extension of the receiver is the part which fits into the ear. The coils and magnet are in the small, disk-shaped part which fastens to this extension.



A Midget Earphone

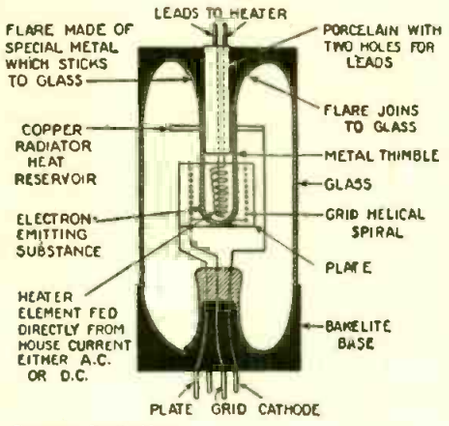
ONE of the objections which deaf persons have to using the loud-speaking telephones, which have been marketed in recent years as aids to hearing, is the weight and unsightliness of the telephone receiver which must be clipped or strapped to the ear. To obviate this, at least in part, the Bell Telephone Laboratories has developed a new midget receiver, so tiny that it fits into the opening of the ear itself. It is still visible and it has the usual telephone cord attached to it; but it is much less unsightly and much more comfortable than the usual, and much heavier, forms.

As yet, the receiver is not procurable except for use with devices for the deaf. It is reasonably certain, however, that the new receiver will be available, in the not distant future, for other uses, especially for telephone operators and for radio use. The advantage of such a receiver to anyone who uses head telephones for hours at a time is immediately obvious.

According to a bulletin of the Western Electric Company, the new receiver weighs only six-tenths of an ounce, although its overall efficiency and electrical behavior are quite as good as those of the more usual larger forms. The only disadvantage is that each receiver must be made for its user, like a tailored suit. The human ear is as variable in size and shape as are other parts of the body. An ear-plug made to fit one ear will fit no other. Even the two ears of a single individual are usually unlike.

Accordingly it has been found necessary to mould the hard rubber case of each receiver to fit the individual ear of the prospective user. This is done by first plugging the ear canal, a little way in, with cotton and then filling it with plaster of paris, so that an exact cast of the canal is made. The hard rubber case is then moulded to fit this cast. Needless to say, the making of such casts is not to be undertaken by unskilled persons. If the plaster of paris happens to run back too far into the ear the consequences may be painful.

Ferry boats plying in Danish waters are being equipped with radio phones.



Courtesy *Radio News*

A TUBE WITHOUT A FILAMENT

Electrons are emitted from the hot metal thimble, heated internally by the heating coil. This coil is not connected electrically to the thimble.

A Vacuum Tube With No Filament

As one way to do away with "A" batteries and to permit the operation of vacuum tubes from any house lighting circuit, without either hum or undue loss of power, Dr. A. N. Lucian, of the Department of Physics of the University of Pennsylvania, has devised a tube in which the hot element is not a filament at all but a metal thimble heated internally by an electric heating coil of any type.†

There is no electric connection between the thimble and the heating coil, the heat passing from the latter to the former by radiation and convection. The hot metal of the thimble serves as an emitter of ions in exactly the same way as does the hot metal of the ordinary filament. Surrounding the hot thimble is the grid and surrounding this is the plate, all in much the same manner as in vacuum tubes of the ordinary type.

†"A 110-volt Filamentless tube," by A. N. Lucian. *Radio News* (New York), volume 8, pages 1546-1547 (May 1926.)

The First Book of Radio Talks

What the publishers state to be the first book of radio talks ever published has just been issued by the Harvard Observatory of Cambridge, Massachusetts.* Its subject matter is astronomy and it reprints a series of talks given regularly last season by the staff of the Observatory and broadcast from station WEEI in Boston. The book is of interest to radio fans not only because of its origin but because the twenty-two talks which it contains supply an excellent introduction to the facts of modern astronomy, the best popular introduction, with which the editor of this Department is acquainted.

*"The Universe of Stars, Radio Talks from the Harvard Observatory." Talks given by Harlow Shapley, William J. Luyten, Willard P. Gerrish, Edward Skinner King, Leon Campbell, Willard J. Fisher, Annie J. Cannon, Cecilia H. Payne, and Solon I. Bailey. Edited by Harlow Shapley and Cecilia H. Payne. Published by the Observatory, 1926, 205 pages, $2.00.

BROADCASTS

By RICHARD LORD

The First "Radio Museum"

IN the U. S. National Museum at Washington, D. C., will soon be portrayed the progress of radio from the earliest days to the latest developments. The work of assembling the apparatus has already begun. In the radio exhibits now completed may be seen radio apparatus used by the A. E. F., French and German Armies. All of this material has been contributed by the U. S. Army Signal Corps, and dates mostly from the Great War. In the display are featured portable trench sets, air-craft instruments, headquarters installations, radio trucks and various accessories developed through the exigencies of the War, and now commonly used in everyday radio.

* *

Reserve Officers to Receive Instruction by Radio

LT. COL. H. EDMUND BULLIS, General Staff, is making use of radio broadcasting to give Reserve Officers military instruction at home. Through this channel, he expects to reach 40,000 reservists who are out of touch with regular army activities; in fact, he may establish a small broadcast school next fall.

He plans to have broadcast from cooperating stations eight ten-minute talks to be given by army officers, once a week, for eight weeks. At the end of the series, an examination will be held, and all Reserve Officers who send in their solutions to the problems will have their papers graded and returned by an army officer designated for this work. The stations and dates will be announced at the summer training camps, and through various army publications.

Lieut. Col. Edmund Bullis, War Department, Washington, D. C., would like to receive suggestions on this idea.

* *

A 24-Mile Ski Trip to Mail an Applause Card

IT took two years for two prospectors, lost in the snowy mountains of Idaho, to write—and mail—a card of applause to KGO. This is the card:

"Two old prospectors in the mountains at Summit Flat, Idaho, wish to express their gratitude to you and all who broadcast. We have listened in for two years, and we can stand it no longer. Even if it does mean a trip of 24 miles on skis, we are going to do it to tell you how much we enjoy your programs. We are at an elevation of 7,200 feet, and programs come in so clearly that we can imagine ourselves seated in the station studios."

* *

How the English Strike Boomed the Radio Business

WHILE most of the industries in England were hard hit by the strike, it is an interesting fact that over a million radio receivers were sold in the brief period of a week. Houses, offices, hotels and public places were equipped with apparatus to pick up the brief and terse *communiques* broadcast six times a day by the British Government over the broadcast chain. In spite of the usefulness of radio broadcasting, the reception of the dry and sparse news from radio sources did not satisfy the populace, who eagerly sought to purchase the bulletins published by the two contending forces.

Radio did much, however, to relieve the tenseness due to the lack of information, and supplemented a crippled press service to an admirable extent.

* *

A Radio Station for West Point

THE new broadcasting station for West Point will be located in the observatory on the hill above the Chapel. The antenna will be supported by two masts, 200 feet high. A broadcasting plant of 400 watts, transmitting on a wavelength of 435 meters has been installed. Another Signal Corps set will be used in case of emergency.

The complete equipment, which will be under the direct supervision of Major Alfred E. Larabee, will cost the Government $16,000 and will be of the latest design. It will be used for instruction purposes for the cadets as well as for broadcasting.

922 Broadcasting Stations in the World

BROADCAST listeners who are proud of the fact that they have logged two or three hundred American stations are only hitting an average, when it is considered that there are in all 922 broadcasters, sending at all hours, from all points of the globe.

If you had a 12,000 radius receiver, and could tune in to all of the waves, every civilized country would register at your receiving station. In fact, there are stations located in many localities unknown to the average man.

The United States leads with the greatest number of stations. Little Cuba has 36 of them, and the lowest number is credited to the Canary Islands, Iceland, Venezuela, and Peru. Of these last, OAX, in Lima, is the best known.

* *

Good Grammar—by Legislation!

JUST as everyone was congratulating the effort of practically every broadcasting station in improving the quality of the announcements, another reformer with protestation-censorship proclivities comes along with a suggestion that poor grammar announcers be sent to jail. Arthur R. Tucker, who is president of the American Radio Foundation, would make the use of poor language before a microphone a misdemeanor punishable by fine or imprisonment, or both.

"Announcers do not realize the responsibility that is placed on them. Their words go directly into hundreds of thousands of homes," says Mr. Tucker. "They are heeded and studied, remembered and repeated. Announcers have the role of teachers, editors, ministers: they should be of the same type as professional men and fully as careful of their choice of words, and in their use of the English language."

* *

This Is the Time to Get a Receiver

No less an authority than Dr. J. H. Dellinger, Chief of the Radio Section of the U. S. Bureau of Standards believes that there will never be a better time to get a radio set than now.

"There is no longer any more reason for waiting to buy a good radio set," says Dr. Dellinger, "than there is waiting to buy a good piano. While there doubtless will be occasional refinement in receiving equipment, these are not likely to affect appreciably the comparative values of the standards of today. Tubes, of course, will lose their efficiency after from 1,000 to 2,000 hours of use, but most of these can be reactivated at small cost. The set as a whole, however, will retain its value and efficiency indefinitely."

Guessing the Size of a Band

AN altogether unplanned "guessing contest" has been wished on KDKA. It takes the form of guessing how many players there are in the KDKA band, which is a regular feature from the station. Reports from listeners vary greatly; the conductor of a band in St. Petersburg, Florida, for instance, reported that the majority of the musicians in his group who had listened to these band concerts thought the organization consisted of at least 50 pieces.

Actually, the KDKA band consists of only 14 pieces.

* *

Radio Brings Relief to Tornado Victims

RADIO played an important part in the American Red Cross's campaign to raise funds for relief work in behalf of the victims of the middle-western tornado, which spread so much death and devastation over Missouri, Illinois and Indiana last year. This work is just now drawing to an end. A good part of the $3,000,000 which were raised in this emergency has been secured through the cooperation of the broadcasting stations, and the generosity of listeners-in all over the country.

* *

How Radio Guards Our Seacoasts

THERE are just about as many radio beacons dotting the coast line of the United States as are along the coast lines of all other countries combined. This is reported in a recent announcement of the Bureau of Lighthouses. Our coasts are protected by a system of 24 radio-beacon stations, soon to be augmented by two more. These stations transmit special warning signals during thick or foggy weather, and may be picked up by all vessels on 1,000 meters.

Foto Topics

A PORTABLE "RADIO SHACK"

Small enough to satisfy even the exacting demands of a feminine "ham" is this miniature model of a modern shack, with its complete equipment of transmitting and receiving apparatus and even a bunk room.

A "Radio Weather" Service for Fans

A RADIO observation station will henceforth tell New England radio fans how the air is each night for reception. The information gathered by the observer in the early part of the evening will be broadcast through station WEEI, Boston. Thus the radio fan who is doubtful as to the performance of his own receiver may have a checking factor which will make his enjoyment of his reception more positive. If the observers station reports, for instance, that reception from the west is good, with a minimum of static and distortion, and the listener's receiver gives him the same results, he will know that his instrument is in good order.

A standard five-tube receiver is to be used in this unusual service to fans, and the information gathered and broadcast will include weather facts; data on sections of the country coming in best; general quality of reception for local section; static conditions; best programs for the evening, and any special notices of interest to fans generally, regarding reception conditions.

* *

Short-Wave Schedule from Greenland for U. S. Amateurs

RADIO fans who are equipped to listen-in on the short waves will have still another station to tune in to for news from Greenland. The American Museum Expedition's schooner, *Morrissey*, in command of Captain Robert Bartlett will carry a short-wave transmitter adjusted to 33 and 20 meters. The call letters of the ship are VOQ, an unfamiliar group of letters, because the ship is registered in Newfoundland.

Special schedules have already been arranged with 1AR, Nova Scotia, 8 GZ, Columbus, O., and 8 FJ, Marietta, O., by Chief Radio Operator Edward Manley. Of course, many other amateurs will no doubt succeed in "working" the *Morrissey* by radio, and the exchange of messages should prove interesting even to the listeners-in.

* *

Radio Improves the Musical Tastes of Nation

FOLLOWING an analysis of the "request mail" received for the past two years by the broadcast directors of two prominent radio stations, more classic music and less jazz will be included in their programs from now on. The proportion of fans asking for jazz music decreased from 80 percent the first year to 5 percent during the second year. The proportion of listeners to really good music and classics has been continually on the increase.

One of the factors which is at least partly responsible for this shift is the broadcasting of famous artists.

LISTENING IN

PRACTICAL pointers from experimenters and broadcast listeners. What helpful hints can YOU offer to your fellow fan? Readers are invited to address their letters to the Editor of this Department.

CONDUCTED BY LLOYD JACQUET

A Quick Changeover Switch for Battery and Charger

SOME time ago, I built a Four-circuit Tuner, and for more than a year ran this in connection with a storage battery and charger which were always connected together. When I ran the charger, I could listen in at the same time, without difficulty.

When I attempted the same stunt with my newly constructed LC-26 set, I picked up a hum which was most annoying, particularly on the lower frequencies. This hum, I found, originated in the battery charger.

It was explained to me that, as the newer receiver was designed to amplify the lower frequencies better, I was amplifying the local hum to a greater degree than with my first receiver.

It then occurred to me to arrange some sort of a changeover switch so that I could quickly transfer the battery from the charging to the discharge side without disturbing the wiring to any extent.

All I needed was a double-pole double-throw switch, which I secured from my local dealer. Then, by connecting it up, as shown in Figure 1, I could place my battery on charge as soon as I was through receiving or disconnect it from the line when I wanted to listen in.

In addition to this, I placed the switch in a position that made it convenient to connect both to the battery and the charger. Whenever either one or both of these units are to be taken out for inspection, they are easily accessible.

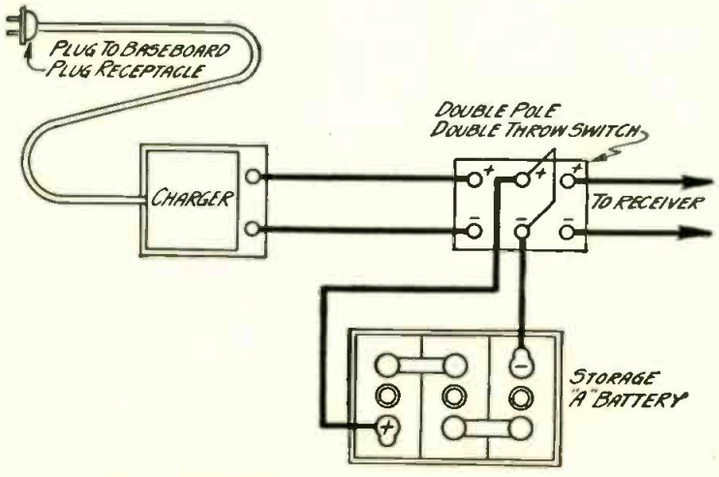
—HENRY PLATT, *Buffalo, N. Y.*

How I Connect Test Antennas to My LC-26

I RECENTLY constructed an LC-26 receiver; and it certainly lives up to the reputation accorded it by POPULAR RADIO. It has truly wonderful reception tone quality.

I do quite a little experimenting on my set with various antennas so, I devised this scheme for changing connections quickly.

The parts needed are: a piece of bakelite, or other insulating material, about three inches square; a piece of wood of the same dimensions as the panel and



A BATTERY CHARGING HOOK-UP

FIGURE 1: *The wiring for the switch, the charger and the battery, from the lighting plug to the receiver in the quick changeover arrangement for battery and charger which is described above.*

½-inch thick, for the baseboard; a switch lever arm and three contact points.

Drill the holes for the switch arm, screws and contact points as shown in Figure 2. Then mount the switch arm and the contact point on the panel, which may now be screwed to the base, with three wood-screws.

I use an inside antenna 25 feet long, wound along the molding of the room. Besides, I have two outside aerials, one 60 feet long, and the other, 150 feet long, running at a wide angle from each other.

The leads of these three aerials come to the three contact points of the change-over switch, the base of which is fastened down upon the table with the receiving sets. A short wire is run from the antenna binding-post of the receiver, and soldered to the lug on the switch-arm lever.

This simple arrangement will save the time and trouble that is usually experienced in reaching to the rear of the receiver to make connection to the various antennas when testing.

—B. G. ARMBRECHT, *Richmond, Va.*

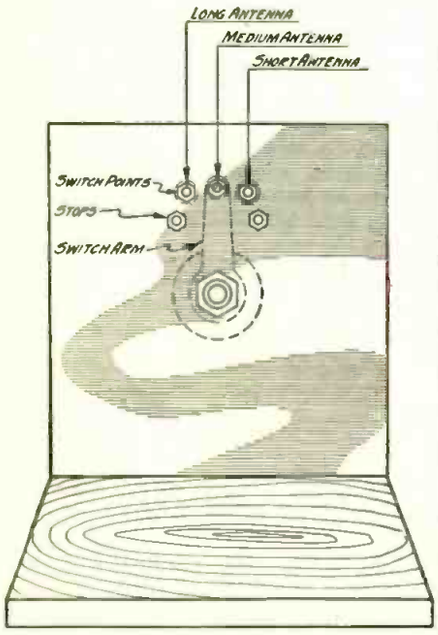
* *

How I Built a Simple Tube Rejuvenator

WHEN my tubes failed to function properly at a critical moment, and the local dealers could not furnish me with a reactivator I decided to rig up a simple device of my own. (Figure 3.)

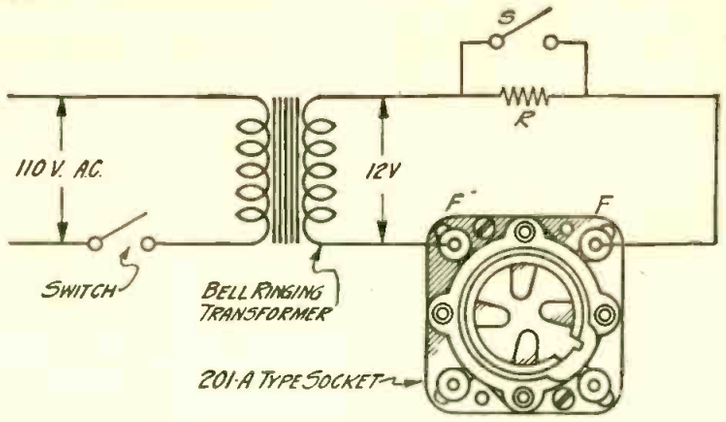
The emergency set-up worked so well that I thought I would pass on the information regarding its construction to other Listeners-in who may want to build it.

It is built around a toy, or bell-ringing transformer. Such a transformer may be bought for a few dollars



A CONVENIENT CHANGEOVER ANTENNA SWITCH

FIGURE 2: *A simple three-point switch may be employed to change antennas quickly when testing out a receiving set.*



A SIMPLE TUBE REJUVENATOR

FIGURE 3: *The hook-up for the method used by Mr. Mitlag to restore the filaments of his vacuum tubes to good working condition.*

from most electrical dealers. A small resistance and a tube socket complete the layout.

All of this apparatus is placed on a wooden board.

If the rejuvenator is to work with 201-a tubes, get a large-size socket suitable for that tube. The universal sockets available nowadays are suitable but other parts of the circuit will have to be altered in proportion.

The resistance, R, should be 20 ohms, approximately, and capable of carrying a little current without undue heating. It may be short-circuited by switch S. This is the way I operated my 201-a rejuvenator.

The "run down" tube is placed in the socket, and the current turned on in the primary. The switch, S, is closed, and the full voltage of the secondary is applied to the filament for a period of about 60 seconds. The voltage in the secondary should not exceed 15 volts for this tube.

Be careful to watch this short "flash" period. Then open switch, S, and leave the tube in circuit for at least three-quarters of an hour, for "ageing."

Of course, rejuvenation of this sort may not bring all tubes back to their first sensitivity, but a marked improvement will be noted in the tubes that are treated that have not suffered from an excessive filament voltage.

—HARRY M. MITLAG, *Portland, Ore.*

How I Prevented Short-circuits in My Portable Receiver

IN my portable receiver, which is a four-tube, neutralized radio-frequency affair, all of the apparatus was necessarily crowded together. In fact, in spite of careful attention to insulation and general layout of parts, I managed to short-circuit my "B" battery.

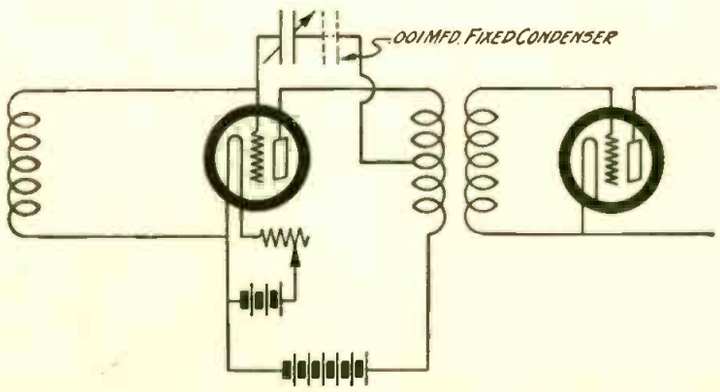
Not only was this unfortunate from a financial standpoint, but it was difficult to remove the swollen and sticky battery from the nice case which had been provided for it.

Upon a thorough examination of the circuit, I found that the defect was in the neutralizing condenser, which had become broken and had short-circuited. As anyone can see, the "B" battery discharged through the grid and plate coils.

I eliminated any possible recurrence of this accident by inserting a small mica condenser with a capacity of about 0.001 microfarads in series with the neutralizing condenser (see Fig. 4). In this way, if the first condenser goes, the second will prevent damage.

The capacity of the extra condenser will not greatly affect the setting of the neutralizing condenser. In fact, it is possible to place it in the circuit of a neutralized circuit without the necessity of rebalancing it.

—EARL C. BREESE, *Providence, R.I.*



HOW TO PREVENT SHORT-CIRCUITS

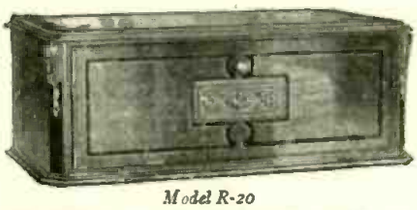
FIGURE 4: *The addition of a series, fixed condenser in the line that includes the neutralizing condenser will reduce the voltage across the latter unit by one-half.*

Blandin

TRIPLE A Radio Cabinets

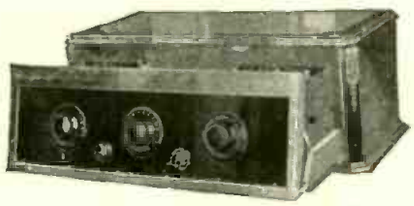
Cabinets, Battery Tables, Speaker Tables, Consoles, or Highboys in striking designs, finished in rich tones of walnut, hand rubbed lacquer and highly polished. Color decorations in ebony. Carvings antique glaze.

Write for circular covering entire line



Model R-20

The Model R-20 Cabinet is virtually 750 cabinets in one. No matter how often you change sets, the R-20 will fit it. Inside dimensions, 8¾" high, 28" wide, 13½" deep (front to back).



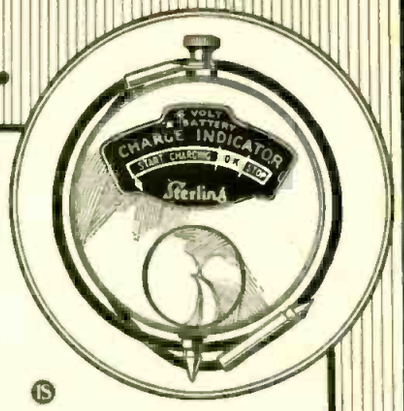
Model R-20 Open Patents Pending

The R-20 is easily adjustable to any size of panel from 6" x 17" to 8" x 26", and to any angle from vertical to 25 degrees sloping for slant-face sets. The drawer-tray feature allows ease of accessibility.

Jobbers and Dealers write for discounts

BLANDIN PHONOGRAPH CO., Inc.
Racine, Wis.

Charge Indicator



Test Storage "A" Batteries
The New, Quick, *Clean* Way!

This instrument tells at a glance:

1. **when the battery needs recharging**
2. **when the battery *on charge* has been charged enough**

It not only shows whether battery is capable of operating set, but also *warns* of approaching discharge. Simple, nothing to get out of order, accurate!

Price $2.00

RADIO **Sterling** DEVICES

Here's the latest type battery charger with all modern improvements—
for charging either "A" or "B" Batteries

You'll like its quiet, thorough way of charging your batteries. Meter-equipped to show actual rate of charge. Built according to latest battery requirements, and bound to serve you faithfully and lastingly.

(*Price $18.00*
14.00 without bulb)

THE STERLING MFG. COMPANY
Dept. V Cleveland, Ohio

Battery Charger
BULB TYPE

It Delivers Full "B" Voltage

Burns

B—BATTERY ELIMINATOR

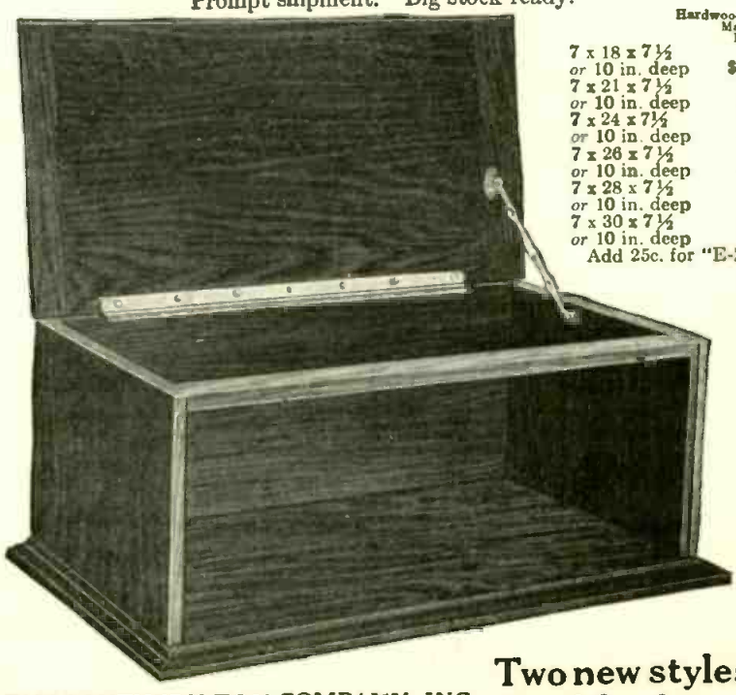
Operates from lighting current like other household appliances. Uses Raytheon rectifying tube. Furnishes smooth unfailing plate current without hum or vibration.

Write the Manufacturer

American Electric COMPANY
State and 64th Streets
CHICAGO, U. S. A.
Makers of BURNS Speakers

A Radio Cabinet of Beauty and Elegance Direct to You at Lowest Cost

Lid splined both ends to prevent warping.
Nickeled piano hinge—Full length.
Nickeled lid support of artistic design.
Anti-vibration cushion feet (not visible in cut).
Edges of lid moulded to match bottom.
Shipped securely packed in strong carton.
Prompt shipment. Big stock ready.



	Hardwood, Rubbed Mahogany Finish	Solid Black American Walnut
7 x 18 x 7½ *or* 10 in. deep	$3.50	$5.00
7 x 21 x 7½ *or* 10 in. deep	3.75	5.25
7 x 24 x 7½ *or* 10 in. deep	4.00	5.50
7 x 26 x 7½ *or* 10 in. deep	4.75	6.25
7 x 28 x 7½ *or* 10 in. deep	5.50	7.00
7 x 30 x 7½ *or* 10 in. deep	6.00	8.00

Add 25c. for "E-Z" Fone plug.

CASH WITH ORDER or C. O. D. if ¼ of price is sent with order.
Prices F. O. B. Hickory, N. C. Order express shipment, often cheaper than mail and much safer from damage.
FREE WITH EACH CABINET a glued-up stock non-warping ½-inch BASEBOARD.

THE SOUTHERN TOY COMPANY, INC.
Dept. N. HICKORY, NORTH CAROLINA

Two new styles just out
Send for free catalogue

WHAT'S NEW IN RADIO

THIS *department is conducted by* POPULAR RADIO LABORATORY *for the purpose of keeping the radio experimenter and the broadcast listener informed concerning the newest inventions and the approved developments in radio equipment. Only such apparatus as has been tested and endorsed by the Laboratory is noted in these columns.*

A NEAT RESISTANCE-COUPLING UNIT

Name of instrument: Resisto-coupler.

Description: This unit comprises a bakelite base upon which are mounted the spring clips for holding the resistors of suitable values and a coupling condenser of the molded bakelite type which is removable and interchangeable. The unit is a handy one and of very neat appearance.

Usage: In a vacuum-tube circuit as an audio-frequency interstage coupling unit.

Outstanding features: Compact. Neat appearance. Efficient. Interchangeable elements.

Maker: Micamold Radio Corp.

AN IMPROVED AC TUBE

Name of instrument: McCullough AC tube.

Description: This improved tube is a further development of the original AC tube. It contains a heater element that brings the temperature of the cathode up to a point where filament emission is suitable for operation as a detector or amplifier. The heater operates at a potential of 2.8 to 3 volts on 60 cycles alternating current and outside of this the tube will function with the same plate potentials as the standard DC tube. The AC tube, however, has a higher amplification constant than the standard DC tube.

Usage: In a radio receiving set as a detector, amplifier or oscillator.

Outstanding features: Operates without batteries on 110 volts AC. Rugged construction.

Maker: F. S. McCullough Co.

Apparatus Approved by Popular Radio

This list of apparatus approved by the POPULAR RADIO LABORATORY will be continued as a part of the WHAT'S NEW IN RADIO department until all instruments, parts and complete sets have been included. The listing is alphabetical by manufacturer's name and the installment in this issue includes only the letters R and S.

AERIALS

Balloon aerial (for amateur experimental purposes only); Everett Scanlon
Stranded braided antenna wire; Springfield Wire & Tinsel Co.
"Key to the Air" cage antenna; Stafford Radio Co.
Subantenna; Subantenna Corp.
Super-antenna; Super-Antenna Co.

AUDIO-FREQUENCY TRANSFORMERS

"Thorola" audio reproducing transformer; Reichmann Co.
"Reliable" audio-frequency transformer; Reliable Parts Mfg. Co.
Rhamstine audio-frequency transformer; J. Thos. Rhamstine
Multistage Meloformer; Robertson-Davis Co.
"Rubicon" audio-frequency transformers; Rubicon Co.
"Samson" helical-wound transformers; Samson Electric Co.
Giblin audio-frequency transformer; Standard Radio & Electric Co.
"Starr" Quality audio-frequency transformer; Starr Equipment Corp.

BATTERIES

"Robat" rechargeable wet "B" batteries; Radio Robat Co.
"B" batteries; Sidbenel Electric Co.
Storage "B" battery (wet); B. Hawley Smith
Storad "A," "B" and "C" batteries; Storad Mfg. Co.

BATTERY CHARGERS AND RECTIFIERS

Battery Chargers; P. C. Rumbold
Storad "B" battery charger; Storad Mfg. Co.
Syd radio storage "B" battery; Syd Radio Storage "B" Battery Co.

"B" BATTERY ELIMINATORS

Dis-ton eliminator; Radio Products, Inc.
Wilson "B" radiopower unit; Radio Units, Inc.
Raytheon plate-supply unit; Raytheon Mfg. Co.
"Ford Beidler" Perpetual "B" eliminator; Romco Storage Battery Co.

BINDING-POSTS

Snap-On binding-post; Snap-On Elec. Co.

CRYSTAL DETECTORS

Goldwhisker; Rep Radio Co.
Roll-O crystal; Roll-O Crystal Co.
Ross radio ring; Ross Merchand Corp. of New York
R-U-F semifixed detector; R-U-F Products Co.
R-U-F "Rough Wonder" crystal; R-U-F Products Co.
Rusonite fixed detector; Rusonite Products Corp.
"Perfect" detector; S. A. M. Radio Co.
Silvertone crystal detector; Silvertone Crystal Co.
Sensitive cartridge detector; Stafford Radio Co.

DIALS

"Tune-Rite" S. L. F. dial; Radiall Co.
Tiny-Turn vernier control; Radio Units, Inc.
"Rathbun" S. L. F. converter; Rathbun Mfg. Co., Inc.
Hemco dials; Geo. Richards & Co., Inc.
Visidials; Harold M. Schwab, Inc.
Stasco vernier dial; Sheffield Trimming & Stamping Co.
Universal vernier dial; Silver-Marshall, Inc

FIXED CONDENSERS

Sangamo bypass condensers; Sangamo Electric Co.
Sangamo mica fixed condenser; Sangamo Electric Co.
Built-up mica condensers; Chas. Schindler
Fixed condenser; Stafford Radio Co.

GRID-LEAKS AND RESISTANCES

Nonoise variable grid-leak; Radio Foundation, Inc.

HEADPHONES

Randolph special headphone; Randolph Radio Corp.
"Royalfone" headset; Royal Electrical Laboratories
"Deveau Gold Seal" headset; Stanley & Patterson

INSULATORS

Vitrox glass antenna insulator; Radio Products Co.

JACKS

Saturn jack; Saturn Mfg. & Sales Co., Inc.
"Radjo" anti-capacity jack; Sharpe Spark Plug Co.

KITS

Vir Bren kit; Radio Instrument Co.
"B" battery eliminator kit; Radio Television Co
"Raven" superheterodyne kit; Raven Radio, Inc.
Rubicon kit; Rubicon Co.
Samson Super-Kit; Samson Electric Co.
De Luxe neutrodyne kit; Harold M. Schwab, Inc.
Shamrock tuned-radio-frequency kit; Shamrock Mfg. Co
Silver superheterodyne kit; Silver-Marshall, Inc.

LIGHTNING ARRESTERS

Anchor lightning arrester; Radio Receptor Co.
Simplex lightning arrester; Simplex Radio Co.

LOOPS

Flat back-wound loop; Radio Appliance Laboratory
Collapsible loop aerial; Radio Association of America
Duo-Spiral folding loop; Radio Units, Inc.
Hemco 18-inch loop aerial; Geo. Richards & Co., Inc.
Ritter loop aerial: Ritter Radio Corp.
Volumax loop; Scott & Fetzer Co.
Hexloop; R. B. Scribner Co.
Table type loop; Signal Electric Mfg. Co.
Bracket type loop; Signal Electric Mfg. Co.
Silver collapsible tapped loop; Silver-Marshall, Inc.

LOUDSPEAKERS

RCA Loudspeaker, model 100; Radio Corporation of America
R. F. I. Speaker; Radio Foundation, Inc.
Radiolamp loudspeaker; Radiolamp Co.
Music Mirror; Radio Panel & Parts Corp.
Radio vase; Radio Vase Co.
American Bell loudspeaker; Randolph Radio Corp.
Thorola loudspeaker; Reichmann Co.
Thorophone loudspeaker; Reichmann Co.
Remo Trumpet; Remo Corp.
"Royalfone" loudspeaker; Royal Electrical Laboratories
"Saal" Soft Speaker; H. G. Saal Co.
Sheltone loudspeaker; Sheltone Co.
Complete parts for cone loudspeaker; Scientific Radio Laboratories

MISCELLANEOUS ACCESSORIES

"Radeco" safety fuses; Radio Equipment Co.
Step-down transformer; Radio Foundation, Inc.
"Rajah" snap terminals; Rajah Auto Supply Co.
"Rajah" radiator ground; Rajah Auto Supply Co.
Rhamstine electric solder set; J. Thos. Rhamstine
Safe-Guard insulation; Safe-Guard Insulation Co.
Saturn Connector; Saturn Mfg. & Sales Co., Inc.
Battery clips; H. B. Sherman Co.
"Sherman" rigid battery connector; H. B. Sherman Co.

"Sherman" extension connector; H. B. Sherman Co.
Steinite interference eliminator; Steinite Labs.
Steinmetz amplifier for crystal sets; Steinmetz Wireless Mfg. Co.
Lastite (soldering terminals); Wm. Stevens Co.

PANELS
Insuline panels; Radio Panel & Parts Corp.
Bakelite radio panels; Sturrett Mfg. Co.
Spalding Bakelite-Duresto; Spaulding Fibre Co. Inc.

PHONE PLUGS
Saturn automatic plug; Saturn Mfg. & Sales Co., Inc.

PHONOGRAPH ATTACHMENTS
Super-Power unit; Radiolamp Co.
"Thorola" phonograph attachment; Reichmann Co.
Rhamstine victorphone; J. Thos. Rhamstine
Rhamstine needlephone; J. Thos. Rhamstine
Royalfone unit; Royal Electrical Laboratories

RADIO CABINETS
Radio desk; Robbins Woodworking Co.
Radio tables; Salisbury Bros. Furniture Co.
Radio cabinets and furniture; Southern Toy Co.
Glass cabinets; Steffen Glass Cabinet Co.

RADIO-FREQUENCY TRANSFORMERS
Vir-Bren transformers, Radio Instrument Co.
Reliable radio-frequency transformers; Reliable Parts Mfg. Co.
Intermediate-frequency transformer; Remler Radio Mfg. Co.
Rubicon radio-frequency transformer; Rubicon Co.
Sangamo R. F. transformer; Sangamo Electric Co.
Charted transformers; Silver-Marshall, Inc.
Silver tuned output transformer; Silver-Marshal Inc.
Giblin radio-frequency transformer; Standard Radio & Electric Co.
Summit toroidal transformer; Summit Radio Mfg. Co., Inc.
Matched superheterodyne transformer; Sypher Mfg. Co.
Ultradyne transformer; Sypher Mfg. Co.

RECEIVING SETS
Radiola receivers; Radio Corporation of America
Tuned-radio-frequency receivers; Radio Frequency Labs., Inc.
R-212 receiving set; Radio Service Laboratories
Echophone receivers; Radio Shop
Randolph 5-tube set; Randolph Radio Corp.
American Radynola; Randolph Radio Corp.
Thorola Islodyne receiver; Reichmann Co.
Tone-A-Dyne receiver; Resas, Inc.
"Richardson-5" receiver; Richardson Radio, Inc.
Ritter crystal receiver; Ritter Radio Corp.
Apollo receiver; Rix Radio Supply House, Inc.
S-C receiver; S-C Merchandising Co.
Brunswick De Luxe Ambassador receiver; Harold M. Schwab, Inc.
Thermiodyne radio receiver; Shepard-Potter Co., Inc.
"Shepco" "All Purpose" receiver; Shepard-Potter Co., Inc.
Silver superheterodyne receivers; Silver-Marshall Co.
Silverset receiver; Sliverset Radio Co.
Simplex SR receivers; Simplex Radio Co.
Standardyne radio sets; Standard Radio Corp.
Giblin radiocar receiver; Standard Radio & Electric Co.
7-tube superheterodyne receiver; Stanwood Electric Specialty, Inc.
Steinite receiver; Steinite Laboratories
Stromberg-Carlson No. 601 neutrodyne receiver; Stromberg-Carlson

RHEOSTATS
"Amperite" self-adjusting rheostat; Radiall Co.

SOCKETS AND ADAPTERS
Mounting sockets; Radio Instrument Co.
Remler socket; Remler Radio Mfg. Co.
Hemco standard socket; Geo. Richards & Co., Inc.
All-Bakelite socket for UX tubes; Silver-Marshall, Inc.
Silver 5-gang 199 socket; Silver-Marshall, Inc.

SWITCHES
Saturn battery switch; Saturn Mfg. & Sales Co., Inc.
"Radjo" switch; Sharp Plug Co.

TESTING INSTRUMENTS
Reliable battery tester; Reliable Parts Mfg. Co.
Kant Stick hydrometer; Scranton Glass Instrument Works, Inc.
Ayanbee hydrometer; Scranton Glass Instrument Works, Inc.

TOOLS AND EQUIPMENT
Combination radio pliers; The Rance Corp.
Reliable filler and battery carrier; Reliable Parts Mfg. Co.
Samson electric soldering iron; Samson Cutlery Co.
Bernard hand-vise pliers; Wm. Schollhorn Co.
Schollhorn radio wrench; Wm. Schollhorn Co.
Universal coil winding machine; Specialty Automatic Machine Co.

Spintite wrenches; Stevens & Co.
Stevens speed-up tools; Stevens & Co.
Stevens combined drill and countersink; Stevens & Co.
Stevens panel cutter and bezel beader; Stevens & Co.

TUBES
Atlas tube; R-S-K Co.
RCA Duo-Rectron tube; Radio Corporation of America
RCA Uni-Rectron tube; Radio Corporation of America
UX and WX tubes; Radio Corporation of America
Blo-Pruf vacuum tube; Radio Equipment Co.
R. F. I. radio tube; Radio Foundation, Inc.
"Ravac" tube; Ravac Co., Inc.
"Raytheon" tube; Raytheon Mfg. Co.
Schickerling tubes; Schickerling Products Mfg. Co.
Sonatron tube; Sonatron Tube Co.
Aerodyn tube; Star Engineering Co.
Comet vacuum tube; Summit Radio Co.
Supertron radio tube; Supertron Mfg. Co.
Sylvania tubes; Sylvania Products Co.

TUBE REJUVENATORS
Remo Reactivator; The Remo Corp.
Rhamstine tube booster; J. Thos. Rhamstine

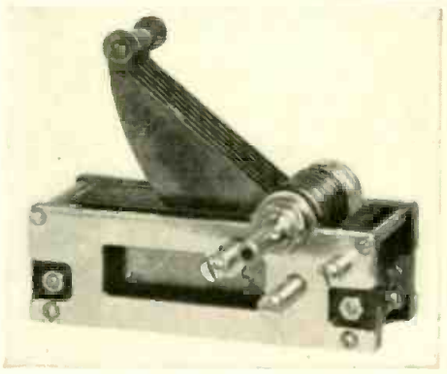
TUNING INDUCTANCE UNITS
REL low-loss wave coils; Radio Engineering Laboratories
Lopez low-loss tuner; Radio Engineering Laboratories
Doubletoroid coil; Radio Foundation, Inc.
Vir Bren oscillator coil; Radio Instrument Co.
Vir Bren antenna coil; Radio Instrument Co.
"R. P. C." variometer; Radio Products Co.
"R. P. C." variocoupler; Radio Products Co.
"Receptrad" oscillo-coupler; Radio Receptor Co.
"Receptrad" filter coupler; Radio Receptor Co.
Andrews paddle wheel coil; Radio Units, Inc.
Variometer; Raven Radio, Inc.
Variocoupler; Raven Radio, Inc.
"Thorola" low-loss doughnut coil; Reichmann Co.
Coupling unit; Remler Radio Mfg. Co.
Variometer; Ritter Radio Corp.
Samson oscillator coupler; Samson Electric Co.
Samson R. F. choke coil; Samson Electric Co.
Sangamo oscillator coil unit; Sangamo Electric Co.
Ray coils; R. C. Schoonhoven
Variocoupler; Shamrock Mfg. Co.
"Radjo" 180° low-loss tuner; Sharpe Spark Plug Co.
"Shepco" all-wave coupler; Shepard-Potter Co., Inc.
Sickles diamond-weave inductance coils; F. W. Sickles Co.
Sickles variocoupler; F. W. Sickles Co.
Sickles tuned transformer coil; F. W. Sickles Co.
Knockout coil; F. W. Sickles Co.
Sickles coils for Roberts' circuit; F. W. Sickles Co.
Sickles coils for Craig reflex; F. W. Sickles Co.
Silver coupling unit; Silver-Marshall, Inc.
Silver oscillator coupler; Silver-Marshall, Inc.
Interchangeable coils; Silver-Marshall, Inc.
Simplex DX tuner; Simplex Radio Co.
Simplex variocoupler; Simplex Radio Co.
Oscillating coil; Sypher Mfg. Co.
Tuning Coil: Sypher Mfg. Co.

VARIABLE CONDENSERS
"R. P. C." variable condenser; Radio Products Co.
"Rathbun" condensers; Rathbun Mfg. Co., Inc.
Samson uniform-frequency condenser; Samson Electric Co.
Signal spiral cam condenser; Signal Electric Mfg. Co.
Silver compensating condenser; Silver-Marshall Inc.
Silver low-loss condenser; Silver-Marshall, Inc.

WIRE
Loop, Litz and cotton covered wires; Ross Antenna Co.

A DOUBLE PURPOSE UNIT

Name of instrument: Combination grid-leak and condenser.
Description: In this unit the qualities of resistance and capacity are combined to produce a small interchangeable unit that will serve in place of the usual grid-leak and condenser in a radio receiving outfit.
Usage: In a radio receiver as a grid condenser and grid-leak for the detector circuit.
Outstanding features: Simplicity of design. Compact. Interchangeable.
Maker: Daven Radio Corp.



A WORTHY SLF CONDENSER

Name of instrument: Straight-line-frequency variable condenser.

Description: This instrument is constructed with specially designed rotor and stator plates for producing straight-line-frequency tuning. In other words, the capacity is varied at such a rate that frequency change is uniform at either end and throughout the divisions of the dial. This eliminates crowding of the various stations that are transmitting on the higher frequencies as is usual with an ordinary straight-line-capacity condenser. The instrument is furnished with metal-end plates and genuine clear bakelite insulation. The shaft has an adjustable tension for obtaining the proper smoothness of operation without having the rotor slip during tuning.

Usage: In any radio-frequency circuit for tuning.

Outstanding features: Efficiency. Novel, compact design. Straight-line-frequency tuning. Elimination of crowding of high frequency stations on the dial.

Maker: Davidson Radio Corp.

ANOTHER TUNING UNIT

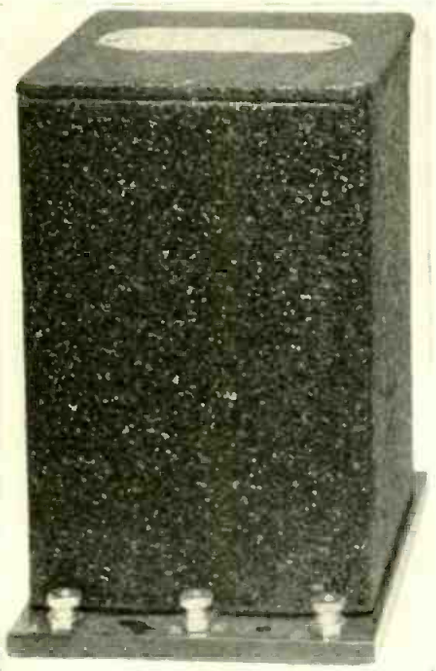
Name of instrument: Three-circuit tuner coil.

Description: This unit, which contains three sets of coils, is mounted on two bakelite rings that in turn carry the two fixed coils and the signal rotating tickler coil. The windings themselves are supported on glass rods that run from one set of bakelite rings across to the other bakelite rings. Terminals are brought out to binding posts for the three sets of winding, making six terminals in all. The lower set is the primary, the middle one is the secondary and the top rotating winding is the tickler.

Usage: In a three-circuit tuner as coupling inductances.

Outstanding features: Compact design. Efficient type of winding. Neat appearance. Easy to operate.

Maker: Bruno Radio Corp.



A SHIELDED RADIO-FREQUENCY COIL

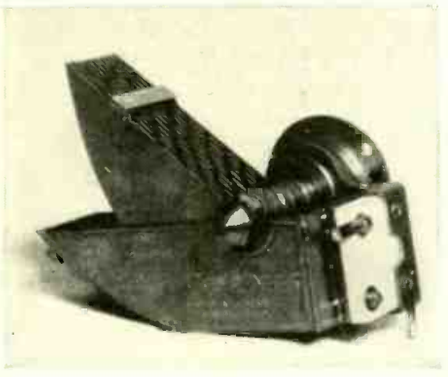
Name of instrument: Radio-frequency transformer.

Description: The coils in this unit are small in diameter and are wound with bare wire on a slotted cylindrical form. This construction makes it possible to manufacture a coil of uniform inductance and uniform distributed capacity. The metal shield, which is in the form of a rectangular box, is spaced sufficiently from the coil itself to reduce any currents to a minimum and at the same time to produce full electrostatic shielding.

Usage: In a radio-frequency circuit as an interstage coupling device.

Outstanding features: High L/R. Completely shielded. Neat appearance.

Maker: Cribben Radio Corp.



NOVEL CONDENSER DESIGN

Name of instrument: SLF condenser.

Description: In this instrument, the rotor plates, which are cut in a special cross-section to provide straight-line-frequency tuning, are mounted on a shaft with a single bearing. The stator plates are mounted on a block of isolantite, which is known for its high efficiency as an insulating material. The design of this unit is radical and the efficiency from an electrical standpoint is high. Both terminals are brought out to soldering lugs.

Usage: In any radio-frequency circuit for producing straight-line-frequency tuning.

Outstanding features: Compact design. High efficiency. Ease of mounting on panel. Straight-line-frequency circuits of metal cannot corrode.

Maker: Pacent Electric Co., Inc.

The obverse of the medal; this 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 cooperate 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 authorise.
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, 627 West 43rd Street, New York.

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DOUBLE IMPEDANCE AUDIO AMPLIFICATION

Broad Patent Issued!!

Look For: "Licensed Under Hiler Patent No. 1589692"

Quadruples Power Output of Audio Tubes:
Because Grid Currents are Permissible—No Magnetic Coupling

Volume Unlimited—No Tube Blocking:
On Account of Condenser Discharge Thru Inductance

All Frequencies Faithfully Reproduced:
By High Inductances—Ample Capacities

Quality Perfect:
Straight Amplification Curve

Compact Units:
By Means of Figure "8" Lamination

Watch for the Announcements of Our Licensees in an Early Issue.

IMPORTANT!

This announcement will clear the situation on the use of double impedance audio amplification, for the set and parts manufacturer can upon making arrangements with the Hiler Audio Corporation embody this perfect system of audio amplification in his set or line without fear of unfair competition or troublesome litigation.

A PRESS COMMENT

(Philadelphia Record, May 23, 1926)

Quality and volume without overloading, with ordinary tubes, is the apparently impossible accomplishment of a new audio unit embodying a revolutionary improvement in the impedance circuit. This invention was demonstrated and discussed at the convention of the Radio Manufacturers Association, held last week in Atlantic City. While a number of set manufacturers will incorporate this principle in their new set it has also only recently been decided to let the home-built set maker use the idea. Arrangements have been made whereby complete units will be available very shortly to the retail trade.

This refinement in audio amplification was described by E. E. Hiler, radio engineer and secretary of the Irvington Varnish and Insulator Co., inventor of the unit, who has been allowed a patent on it as "double impedance." In this demonstration he used a five tube neutrodyne with standard transformers and compared it with a similar set in which had been substituted his units with the incorporated impedance coils.

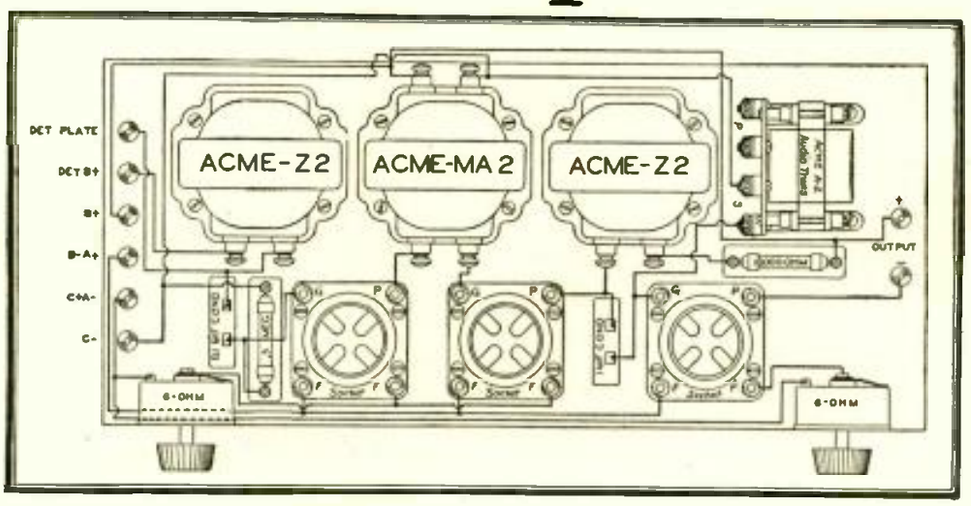
The two impedance coils of low D. C. resistance, and the condenser have been combined in a unit with four binding posts, similar to those on a transformer, and will be marketed in this form for the convenience of the set builder. The two coils are on one lamination, with by-pass iron between them enabling each coil to act separately, without outside magnetic fields. There is no disturbing of the phase relation as would occur if the coils were magnetically coupled as well as capacity coupled.

There is a very interesting explanation of why this arrangement is better than anything heretofore suggested. The basic facts regarding the circuit go into the principles of the charge and discharge of paper condensers, residual quantities of electricity in a condenser after discharge, method of obtaining high inductance of the order of 250 henrys with only 2000 ohms D. C. resistance, and, of course, involve a discussion of the human ear and its relation to overtones or harmonics by which quality is discernible.

HILER AUDIO CORPORATION

10 ARGYLE TERRACE IRVINGTON, N. J.

The Last word in audio amplification



Impedance .. Transformer .. Impedance

THE diagram above will give you some idea of the very latest step in audio amplification. This is the outgrowth of nearly 7 years of experience in working on proper amplification—the problem of "How well you can hear."

Whether you want to get a distant station or one right around the corner, the main thing is "How well you can hear." Today's broadcasting demands clear, understandable, full-noted music and voice. All the greatest artists are on the air; the greatest men talk to us. We don't want to miss a note or word, nor do we want this music or these speeches distorted in any way. You will probably remember the football game or the prize fights which were spoiled for you right in the most exciting part simply because you couldn't understand the announcements or they were so muffled you had to strain to hear.

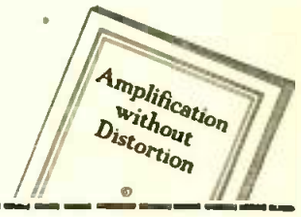
The Latest Hookup

Acme research work has been confined to audio amplification and reproduction and here you find the latest result. An audio amplifier using the combination of impedance and transformer coupling with over-all amplification greater than two transformers and far superior in quality, no matter what the type of transformer used. Whatever set you have, just add this amplifier to your detector and notice the difference.

Illustration above shows the Acme MA-2 Transformer, price $5, and the Acme Z-2 amplifying impedance, price, $4. Both look alike, yet both serve a separate purpose. You need them both.

Send for Wiring Diagram

A complete working diagram of the above chart will be sent you for 25c. in stamps or coin. It is easier to follow than the plainest road map. With this chart we shall be glad to send you free a copy of "Amplification Without Distortion," a famous radio book over 300,000 radio fans have found helpful. It tells the whole story of distortion and how it can be overcome. In it also is complete information on the famous line of Acme products including radio and audio transformers, amplifying impedance, the new Acme "double-free edge cone" loudspeaker, the new Acme B-eliminator. Use coupon below for convenience. Acme Apparatus Company, pioneer radio and transformer engineers and manufacturers, Cambridge, Mass., U. S. A.



ACME
~for amplification

ACME APPARATUS CO.
Dept. C-14, Cambridge, Mass.

Gentlemen: Enclosed find 25c. (stamps) (coin) for which please send me full diagram as shown above and a copy of "Amplification without Distortion."

Name.....

Street.....

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

CROSLEY

On June 8 and 9, the fourth Annual Convention of the Crosley Distributors was held in Cincinnati.

Powel Crosley, Jr., announced the most startling line of radio receiving sets in the history of the industry.

Every lover of radio is urged to get the story from his nearest Crosley dealer immediately.

RADIO

Better-Costs Less

PRESS OF WILLIAM GREEN, NEW YORK

Not a Wire Visible

TO MAR THE BEAUTY OF THE ROOM

This Beautiful Console

IN GENUINE MAHOGANY

New and Improved
FRESHMAN MASTERPIECE
$69.50

Over 300,000 of these wonder sets are spreading happiness, education and contentment in homes all over the world.

With the Freshman Masterpiece you get everything the most discriminating person could possibly demand from a radio receiver—greater distance, better tone, ample volume and, what's more, it is very easy to operate.

Sold, Serviced and Installed by Authorized Freshman Dealers only.
Write for 24 page booklet illustrating and describing our entire line.

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Price slightly higher Denver and West.