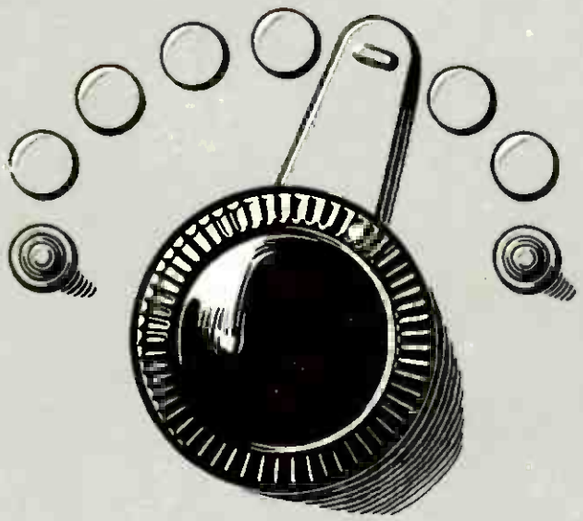
Popular Radio

25¢

Edited by KENDALL BANNING

OCTOBER
1924



This Number contains a Complete Description of the Latest Development in Receivers—

• THE FOUR-CIRCUIT TUNER •
***with* A RESISTANCE-COUPLED AMPLIFIER**

★

The shell is **ORANGE** *Bakelite—the base genuine Thermoplax*

At Last—A Radio Socket Worthy of This Famous Trade Mark

After months of experiment and research the Cutler-Hammer engineers announce this masterpiece of radio socket design. With features never before found in any socket, it brings to your set a degree of efficiency that means added miles of range and hours of clearer, more enjoyable reception.

Capacity has been absolutely minimized—without sacrifice of mechanical strength, and its base of ebony black Thermoplax in beautiful color contrast with the thin shell of orange Bakelite adds as much to the appearance of any set as this socket's construction does to its efficiency.

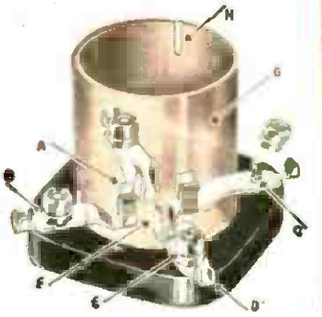
You'll like all of its many exclusive features—the silvered bronze contacts that afford *permanently* perfect contact; the slotted binding nuts; the handy terminals for soldering; the wide spacing of current carrying parts.

You'll like its appearance—neatness—small size. You'll like the way the tube is inserted and removed without twisting. And best of all, you'll like the price, 90c. *This socket that meets the specifications of the most exacting radio engineer costs no more than most of those on the market today.* Until all dealers have been stocked, you can be supplied direct from the factory at the retail price plus 10c for packing and postage. Be sure you have the genuine—it will pay you in every way to refuse all substitutes.

THE CUTLER-HAMMER MFG. CO.
Member Radio Section, Associated Manufacturers of Electrical Supplies
MILWAUKEE, WISCONSIN

C-H

These Exclusive Features Assure Better Reception



A
Perfect contact. Both sides of tube prong cleaned when inserted—no contact or wear on soldered end.

B
All metal parts *silver* plated—perfect contact for the life of the set. Silver may tarnish but its contact resistance does not change.

C
One piece contact construction. The binding post is NOT a part of the circuit—the wire to the socket always touches the contact strip which carries the current direct to the tube prong—no joints to cause losses.

D
Convenient terminals for soldering—full length to allow bending down for under-wiring. Ears hold wire in place for soldering.

E
Extra handy binding posts—tight connections with either wrench or screw-driver. Lock washers hold terminals rigid.

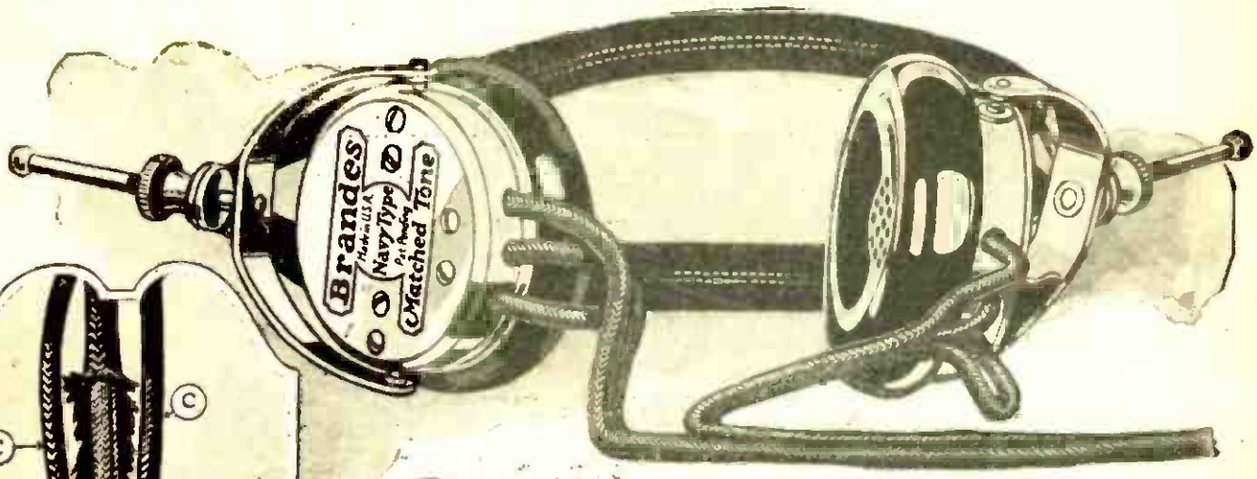
F
Wide spacing of current carrying parts both in air and insulation—true low-loss construction.

G
A minimum of both metal and insulation for low capacity. Shell of thin Bakelite—the base of genuine Thermoplax.

H
The tube is held in place by merely a vertical motion—no twisting to separate bulb from base.

The attractive orange shell helps identify this better socket, but the famous C-H trade mark both on the socket and on the orange and blue box is your genuine protection.

C-H **RADIO SOCKET**



A—*Weather-proof cloth covering*
B—*Braided copper tinsel radio-frequency shield*
C—*Headset conductors (+ and -)*

3 *exclusive features of the* Navy Type Headset

TWO extra technical developments and one extra testing operation! These add clarity and distance. These are the three exclusive features which make the Brandes Navy Type the ideal long distance headset.

1.—The development of the braided copper tinsel radio-frequency shield [shown at the left] surrounds the conductor cords and grounds all radio-frequency currents which might cause detoning effects in the receivers. And in addition, it eliminates cord capacity.

2.—The use of inside terminals, so designed that the cords may be removed or replaced without taking off the cap of the receiver or in any way disturbing the perfectly matched tone.

3.—A very delicate testing operation matches the tone of the two receivers so that both ears hear exactly the same sound at the same instant.

And to assure absolute perfection of every detail, every Navy Type Headset must pass 22 different tests and inspections.

Brandes

Superior *Matched Tone* Headset $6
$7 in Canada

Table-Talker $10.
50¢ extra west of the Rockies
In Canada $14

Navy Type *Matched Tone* Headset $8
$11 in Canada

The name to know in Radio

POPULAR RADIO

EDITED *by* KENDALL BANNING

CONTENTS *for* OCTOBER, 1924

(*Cover design by Frank B. Masters*)

VOLUME VI NUMBER 4

DEPARTMENTS

VOLUME VI OCTOBER, 1924 NUMBER 4

Published monthly by Popular Radio, Inc., 627 West 43rd St., New York, N. Y., telephone number Chickering 1906; Douglas H. Cooke, President; Kendall Banning, Vice-President; H. C. Bodman, 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.

Printed in U. S. A.

LAURENCE M. COCKADAY, R.E., *Technical Editor*

E. E. FREE, Ph.D., *Contributing Editor* JOHN V. L. HOGAN, *Contributing Editor*

PAGES WITH THE EDITOR

BEGINNING with this issue, POPULAR RADIO is making formal announcement of a procedure that it first put into actual effect two years ago for the protection of its readers. Since that time it has gradually developed it until it has finally assumed the proportions of a definite policy.

* * *

All sets and parts offered for advertising in POPULAR RADIO *must be tested and approved before publication.*

* * *

POPULAR RADIO guarantees that all sets and parts described in its advertising pages are good value, justify the manufacturer's claims for them and give satisfaction under normal and proper use.

* * *

To this end, Mr. Laurence M. Cockaday, R.E., and his associates have for the past two years been developing the personnel, equipment and procedure of the POPULAR RADIO Laboratory.

* * *

ALL of the apparatus that is now being advertised in POPULAR RADIO has been tested and approved and a certificate to this effect has been issued to the manufacturer.

* * *

THEREFORE, in setting up this new standard, an established procedure is being carried to its logical conclusion—that readers and advertisers alike may enjoy a full measure of protection against poor goods, misleading claims and unfair competition.

* * *

WITHIN ten days of the tentative announcement of this policy 158 radio manufacturers wrote not merely to approve of but to urge the establishment of this policy—saying that, in their judgment, it must benefit the entire radio industry, and must result in time in the setting up of similar standards by the other radio magazines.

* * *

FROM one of the most experienced and best-known of Oldtimers comes this pointed message:

"I think that antennas and what they deliver have proved to be a healthful substitute for:

Sidewalk strolling;
traffic;
theatres;

From a photograph made for POPULAR RADIO

WHERE COMPLETE SETS ARE TESTED

A corner in the POPULAR RADIO *Laboratory, where research and development work on various sets to be described in future editions of* POPULAR RADIO *is carried on with the aid of the best facilities that radio science has developed.*

"Experience is the Vital Factor in Excellence"

The Thompson reputation is a reputation gained from making radio products *exclusively* for over 14 years. It is a reputation which is meaning more and more to those who want to get the best that experience can build.

THOMPSON Neutrodyne Radio

Thompson power and selectivity, Thompson ease of operation, and Thompson freedom from trouble, are features that should be investigated before an investment in radio entertainment is made.

The Thompson 5-tube, factory-built Neutrodyne Radio is made up of parts that are known to be the standard in their group. Yet, the manner in which these parts are built into the finished instrument is the chief reason why the Thompson Neutrodyne Radio is a revelation to both layman and expert.

If your dealer does not handle Thompson radio products, write to us for descriptive literature and the name of a Thompson dealer near you.

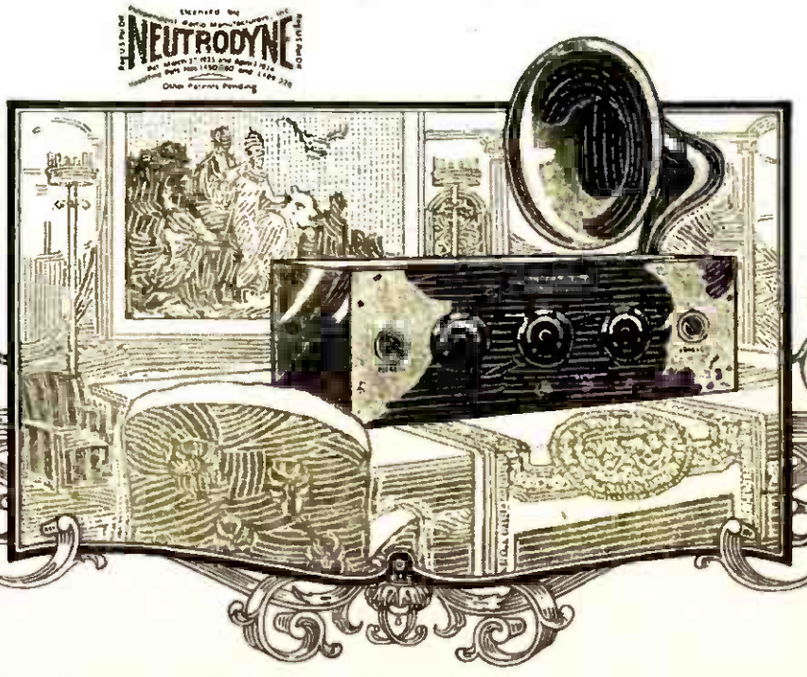
The Thompson Neutrodyne Radio is NOW $125 without tubes or batteries. The Thompson Speaker with adjustable sound knob is $28.

R. E. THOMPSON MANUFACTURING CO.

Manufacturers of Radio Apparatus for the U. S. Army and Navy and numerous foreign governments

30 CHURCH STREET • • NEW YORK, N. Y.

FACTORY: JERSEY CITY, N. J.



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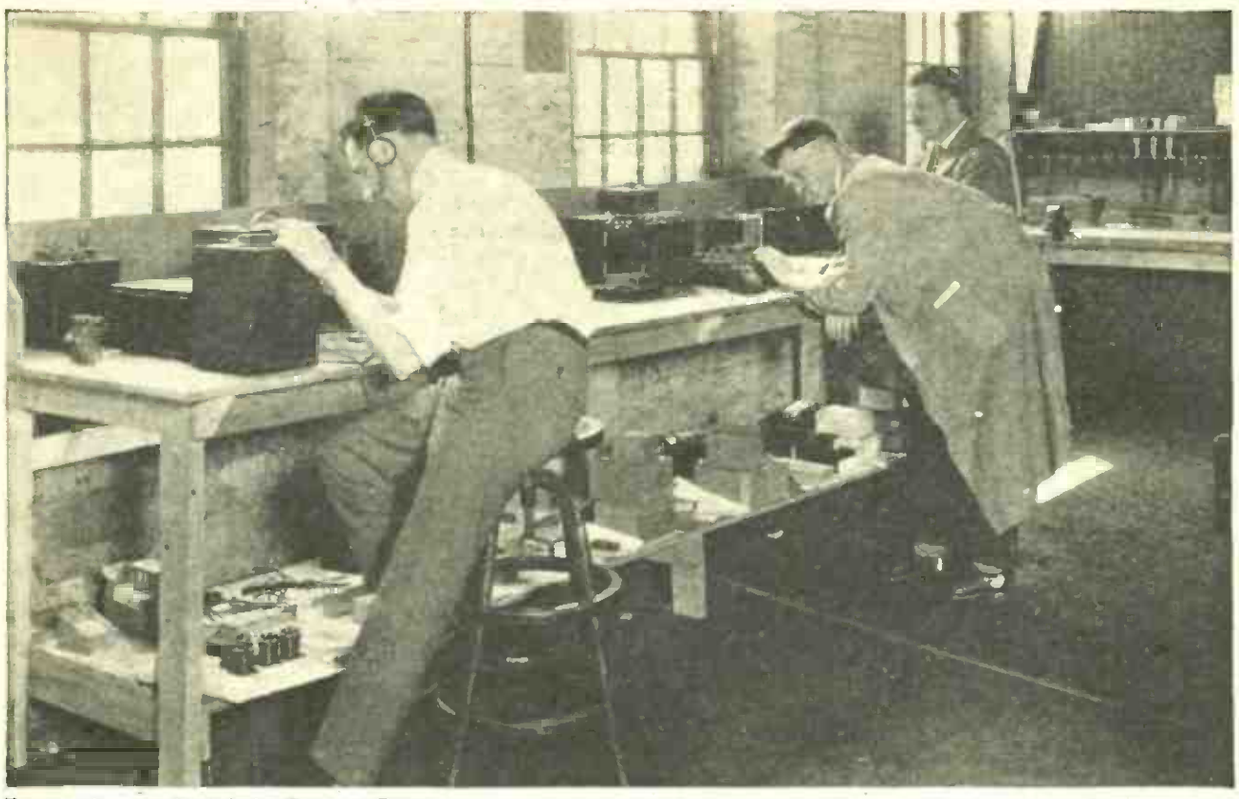


From a photograph made for POPULAR RADIO

WHERE NEW TYPES OF RADIO APPARATUS ARE TESTED

In addition to practical tests in receiving circuits, all new apparatus submitted to POPULAR RADIO *for approval goes through a rigid scientific examination. On this bench condensers are tested for capacity, dielectric losses, phase angle and resistance. Tuning units are studied to determine inductance values and losses.*

pool rooms;
poker and bridge;
public dances;
smokers;
any kind of booze;
and Lodge Night lunches of potato salad, ice cream, coffee and cake."

—R. H. MARRIOTT, *Bremerton, Wash.*

* * *

"IT may be of interest to POPULAR RADIO," reports H. D. Cushing, of New York, "to know that I recently advertised for a small house to rent and that several of the answers made special note of the fact that theirs was an excellent place for radio reception."

* * *

So many of our readers write in to tell of the good results that they have obtained from the famous "How-to-build" articles that only on rare occasions can the Editor find space to print one of them. Here, for example, is a representative letter that reports the extraordinary success of the Simplified Neutrodyne set described by Mr. Albert G. Craig in POPULAR RADIO for April:

* * *

"I BUILT the Simplified Neutrodyne described in the April number and met with such success thought you probably would like to know about it. I failed to get the receiver finished in time for the good reception during the spring months, but have been listening in to stations on both coasts when static is not too bad, as it is some of these summer evenings. I found it rather hard to neutralize, and have not learned to tune it just right yet, but I manage to log many stations, nevertheless. The volume is better than I have ever had on any set, as I operate a phonograph-attachment loudspeaker with sufficient volume for an ordinary living room. Tuning is sharp enough to cut out entirely the harmonics of local amateurs with their high-power CW sets, the bane of the owners of regenerative sets.

* * *

"I HOPE to get considerable enjoyment out of the set during the fall, but expect to break all records next winter. Please accept my sincere thanks for this hook-up, and the easily understandable directions for building it."

—WM. H. SMITH, *Winfield, Kansas*

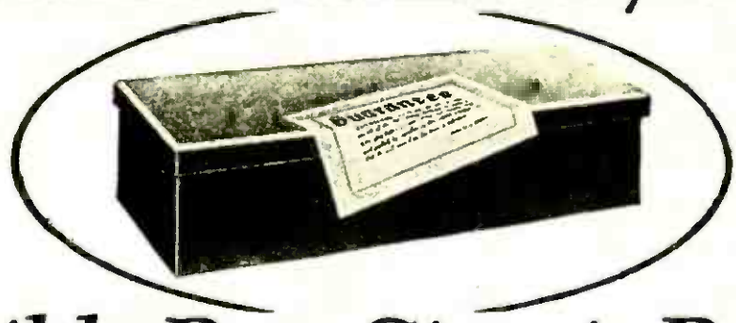
* * *

FROM present indications, the coming issue of POPULAR RADIO—for November—will be the largest and best that has yet been published.

Kendall Banning

Editor, POPULAR RADIO

Latest Radio Science by the Box



Builds Best Circuit Best

With marked improvement in ease of control, Erla Selectoformer assures maximum range and volume. Cost and complication are reduced. $5 each

Distortionless amplification of 3 stages, exclusive in Erla Audio Transformers, indicates their vast superiority. Price $5.00

Millions of rla Bezels are in use, enhancing beauty and utility in any set. 1" and 1½" diameter for ⅛" to ¼" panels. Nickel, black and gold. Price 20c–30c

Actual construction of Erla Duo-Reflex Circuits now is vested with advantages paralleled only by the matchless reception that is assured.

So much more powerful, tube for tube, these extra-efficient circuits now, too, are easiest to build.

Under warranty, factory sealed, the Erla blue-and-white protective carton brings every last thing needed for success. From synchronizing reflex and audio transformers, tested capacity condensers, balanced crystals, clear through to the drilled and lettered panel, stenciled baseboard and full size blueprint, nothing is lacking for correct, confident, precision assembly by any amateur. Professional results are assured.

Typifying the perfect simplicity to be expected, are Erla ingenious solderless connectors, which banish soldering; so that the only needed tools are screw driver and pliers.

The completed receiver is bound to represent in their most intensive, *accumulated* form, all those superiorities of tone quality, selectivity, range, volume and ease of control, which make Erla units preferred in any set. Ask your dealer about Erla knock-down receivers, factory sealed in the blue-and-white carton, fully warranted. Or write direct, supplying your dealer's name.

Electrical Research Laboratories
Dept. R 2500 Cottage Grove Avenue, CHICAGO

ERLA

Precise synchronization of received and reflexed radio frequency impulses is assured by technical perfection of Erla Transformers, best for reflex work. $5.00

Recognized Erla precision, refinement and scientific excellence are offered in the Erla Socket, with neat nickel shell on strong Bakelite base. 2 sizes, 65c—75c

The push-pull principle in an audio transformer of Erla original design and technical excellence, assures unequaled clarity and volume. List $5.00

1934 Trained Factory Representatives

Are Now Entitled to Wear That Button

Ozarka Four Tube Sets As Low As **$39.50**

Radio With Service

OZARKA radio instruments are demonstrated, sold, installed and serviced by direct factory representatives only. These men have been thoroughly trained by our own engineers who designed and perfected Ozarka.

The success of any radio instrument, like the automobile, depends on the quality of service rendered.

No matter how perfect any radio instrument leaves the factory, little things may sometimes go wrong. You've no doubt learned, by costly experience, that the ordinary handy man cannot properly service your automobile. The same is true of Radio. Troubles are generally caused by very little things which are exasperating to the owner, but are quickly corrected by the man who is trained on that instrument.

Today 1934 factory trained representatives are authorized to wear the Ozarka button. These men know the Ozarka perfectly; more are now being trained; soon there will be one in every town.

Without obligation to you, the Ozarka representative will set up an Ozarka in your home on trial. He won't claim that it is better than others. All he asks is the opportunity of letting the Ozarka do its own selling. With *your own operating* you must satisfy *yourself* that it has no equal for volume, tone, distance and ease of operation.

The Ozarka Representative will erect the most effective aerial possible. He will teach every member of your family how to receive results from your Ozarka which will make you the envy of your radio friends. More than this, he *can* and *will* keep your instrument working perfectly at all times. Ozarka quality speaks for itself. Ozarka prices, quality considered, are low. $39.50 and up.

Let us send you the stories of Ozarka long distance reception—from many people who have heard London and Manchester, Eng., Cardiff, Wales. Glasgow, Scot., Buenos Aires, So. Am. and even Honolulu, Haw. Is. Write for *Free* illustrated book No. 200. Please give name of your county.

More Ozarka Representatives Wanted

1934 factory representatives are today making a success under the Ozarka plan and are building up a profitable, substantial business of their own. Many started by giving us only their spare time, but their profits soon justified breaking away from their salary job for all time.

Possibly Ozarka is just the opportunity you have been looking for. A technical knowledge is not essential. In fact, we prefer men who know nothing of radio that we may teach them our way.

Compensation is on a commission basis only. The investment to start is small but absolutely necessary.

The man we want is mechanically inclined and willing to learn. He may not be a salesman but he can talk convincingly on something he knows perfectly and firmly believes in.

The Ozarka Plan will give such a man more money, more independence, and a real opportunity for a permanent, profitable business of his own, which will quickly justify giving it all of his time.

The Ozarka Plan is fully described in a large illustrated book. A copy will be sent to men who are willing to tell us fully about themselves. The Ozarka book is a true and interesting story of life, of men, of why some fail, while others succeed.

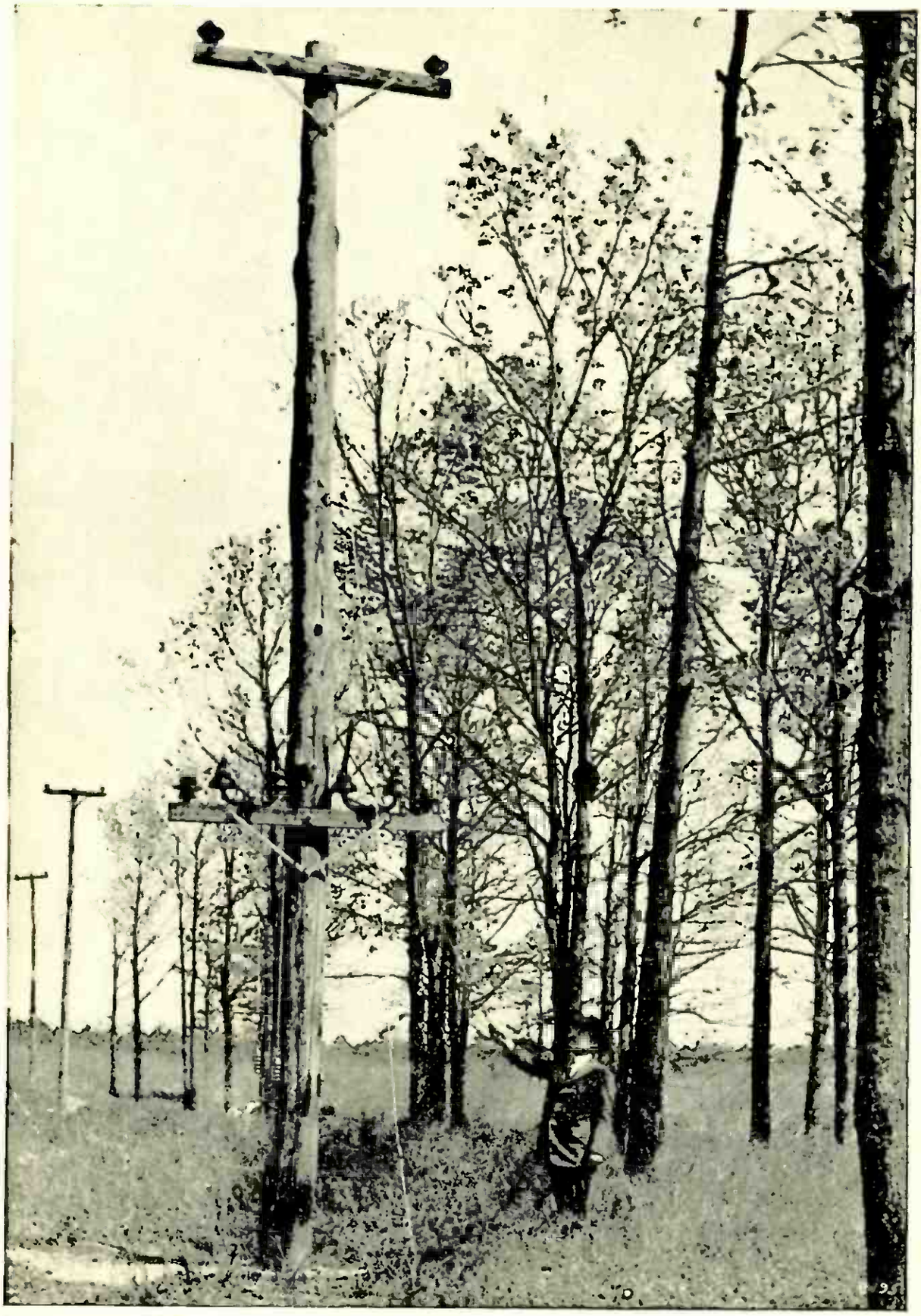
In territory not now covered the right man is wanted—one who is determined and willing to put forth the necessary effort to obtain a splendid, profitable business of his own. If you are that kind, simply write and say "Send me your Ozarka Plan Book No. 100." It may be the turning point in your life. Don't fail to mention the name of your county.

OZARKA, INC., 806 Washington Blvd., Chicago, Ill.

From a photograph made for POPULAR RADIO

A New Editor on the Staff of POPULAR RADIO

WITH this issue, POPULAR RADIO takes pleasure in announcing the appointment to its staff as Contributing Editor one of the best known radio engineers in the country—Mr. John V. L. Hogan, scientist, inventor, lecturer and author. After a special course at Sheffield Scientific School at Yale he became a consultant to Peter Cooper Hewitt and later to large and important electrical concerns. Mr. Hogan is a Fellow of the Institute of Radio Engineers (of which he is an ex-president), a member of the American Institute of Electrical Engineers, of the Yale Engineering Association, of the Radio Club of America and of other scientific organizations in which membership is accorded only to men of achievement.



Radio Corporation of America

HOW THE BEVERAGE ANTENNA HELPS TO OVERCOME STATIC

The big transatlantic radio stations find that a wire stretching for miles and grounded at the far end through a relatively high resistance, helps to bring in the signals louder than the static. The length of the wire must bear a definite relation to the wavelength. *(See "Tracking Static to Its Lair," page 342.)*

Popular Radio

VOLUME VI OCTOBER, 1924 NUMBER 4

Can Human Thought-waves Reach Mars?

"Perhaps the Martians are sending us now some signal that we fail to recognize; some form of communication so advanced that our intelligence is too rudimentary to catch." This is the statement made to M. Frederick M. Delano, the Paris representative of POPULAR RADIO, by the eminent French scientist—

CAMILLE FLAMMARION

SOME day we will exchange experiences with the inhabitants of Mars, perhaps by light signals or by radio, but much more probably by projected waves of thought—by what scientists are now studying under the name of "mental telepathy."

This is the conclusion reached after long study and careful consideration by the dean of the world's astronomers, Camille Flammarion.

It is what he authorizes me to say to the readers of POPULAR RADIO, in whose behalf I have visited the remarkable eighty-two-year-old savant in his famous observatory, laboratory and museum at Juvisy, just outside of Paris.

About the basic fact that Mars is inhabited by some variety of intelligent creatures, M. Flammarion has no doubt. Mars is a much older planet than the earth. It is certainly farther along in the march of evolution. And life must exist on it, "for life," says M. Flammarion, "is the great law of the universe."

But communication, M. Flammarion insists, is a different matter. How the Martian creatures communicate even among themselves, is an unknown factor. The famous "canals" of the ruddy planet are probably to be interpreted as evidences of the existence of intelligent creatures who are endeavoring to conserve a deficient water supply. The seasonal alterations in the tints of certain areas on Mars—light colors of regions near the equator becoming darker as the season advances—indicate, presumably, a vegetable world that obeys the same general laws of life as obtain on earth.

But these facts tell us nothing about

the arts of Martian communication, and it is these that we must know if we would "talk" to Mars.

The Martian inhabitant will differ, essentially and unavoidably, from the human inhabitants of the earth. In the first place, M. Flammarion points out, as he taps the little white globe that represents Mars in his laboratory model of the solar system, Mars and the earth are of different sizes. Mars is only about one half as large as the earth. It follows that the pull of gravity on Mars is only about thirty-seven percent of its pull on earth. The weight of the Martians will be lessened in the same proportion. The members of the famous one hundred-kilo club of Europe, a club whose candidates must weigh two hundred pounds apiece, before being even considered for membership, might be veritable sylphs on Mars, for there they would only weigh seventy-four pounds.

Then too, there seems to be very little water on Mars; no seas, lakes or rivers are visible on the planet, and it is probable that what water there is exists mainly as vapor in the atmosphere or as supplies that are artificially conserved. Again, the lesser size and weight of the planet must affect the density of its air; the barometric pressure cannot be greater than it is on the tops of the highest terrestrial mountains. The evaporation of water will be much more rapid, its boiling point will be much lower, the intensity of the sun's rays will be greater in the daytime, and night-time cooling of the planet's surface will go to far lower temperatures under the thin air and cloudless skies of Mars than are possible here on our well-blanketed earth.

The Martian seasons, however, are about the same as ours, though they are longer. Mars is farther from the sun than we. It has, therefore, a larger orbit which it must circle in a year. The time needed for one complete revolution around the sun—the Martian year—equals a little over two of our years.

The Martian spring lasts one hundred and ninety-nine terrestrial days and their summer equals one hundred and eighty-two days. These two seasons, which constitute their annual period of vegetable growth, total more than an entire year on earth. A Martian individual who has lived twenty years on Mars will be as old, according to our time scale, as a terrestrial man of forty.

All these physical differences between the Martian conditions and our own must have reacted, M. Flammarion points out, upon the bodily form and habits of the Martian inhabitants. Their breathing, if they have any, may be based on some mechanism quite different from ours; their foods will probably be different; their manner of life may show wide variations from anything we know on earth. Even the ways in which they see and hear may be essentially different from ours. It is almost unthinkable that they should possess anything which we would call a "language."

How, then, would we ever be able to get into touch intellectually with creatures that are probably so dissimilar from ourselves in bodily character, in mode of life, in manners and in language?

Several methods suggest themselves, says the venerable savant, but the most promising one is telepathy. Among all the diversities between Martian and terrestrial life, one thing—if the laws of life be universal—may be expected to be the same. This is intelligence.

If there is intelligence on Mars, its possessors must be able to understand the universe as we do, to express this understanding in the form of thought.

We know that atoms in the distant stars behave as atoms do in earth. We know that gravity is universal. We know that the ether waves of light produced by some tremendous stellar cataclysm off on the other side of the universe are the same light waves that go outward from a burning match.

We believe, therefore, that the laws of physics and of chemistry are uni-

From a photograph made for POPULAR RADIO

"MARTIANS MAY HAVE BEEN SIGNALLING THE EARTH FOR 100,000 YEARS"

To penetrate the Heaviside Layer (which some scientists believe envelopes the earth), with radio waves sent in reply, Camille Flammarion suggests that power-projecting waves may not only be used to sustain an airplane at great height, but also to actuate a transmitter that may send impulses to distant planets. M. Flammarion has been an astronomer for seventy-seven years.

From a photograph made for POPULAR RADIO

A COMPLETE PICTURE OF THE HEAVENS

In front of M. Flammarion is his wonderful celestial globe, on which are painted all the constellations of the sky, each as traced by the ancient astronomers. Among the curiosities in M. Flammarion's museum are a book bound in human skin, a suit of clothes worn by a man when he was struck by lightning and a famous collection of ancient human skulls.

versal. And if this be true the intelligence that understands these laws must also be universally the same.

There was a time when telepathy was considered by scientists to be no better than a dream of fools or a resource of charlatans. That time has passed. Serious and responsible investigators all over the world have carried out investigations on these mysterious phenomena. The results indicate, most scientists now agree, that there is at least a strong probability of some form of thought transference between human minds, although it has not been reduced as yet, to conditions that we can control.

M. Flammarion has followed these experiments for years. He has made similar experiments himself. He is convinced that many facts remain to be discovered about the intercommunication of minds without the use of speech, radio or any other of our familiar devices. He states it as a fact that mental communication, often more or less unconscious, is something that exists. "And why," he says, "may not these uncontrolled channels of intelligent communication be put to use some day, for inter-planetary communication?"

That we will attain success in reaching Mars with the suggested methods of exposing geometrical designs on the ground or of displaying brilliant lights, such as were to be used this summer on the snow-clad heights of the Swiss Alps, M. Flammarion frankly doubts. As to the possibilities of radio he will not commit himself. Nor will he predict that the success which he foresees with inter-

planetary telepathy is to arrive this year or even in this century.

A lifelong student of all manner of scientific wonders M. Flammarion has grown to realize, he says, "that nothing can be impossible, nor is anything sure until it has been proved."

"But why," he suddenly breaks off, "is it not possible, or even probable, that the Martians have already attempted, ages ago, to call *us?*" Theirs is presumably a civilization many times older than ours. Who knows but that they may have tried to talk to us ten thousand or even a hundred thousand years ago. They may have spent centuries striving to send some sort of a call across the empty miles of intervening space and ask us what we were about.

"If so, they doubtless have given it up, at least for a while. They would have been signalling to a world occupied only by the great beasts of past ages; by the mammoth, the cave tiger, the bison and the polar bear, with here and there a few low-browed ape-men who could not even talk among themselves let alone listen to the messages of a civilization existing across the void of space.

"Who could blame the Martians if they said to themselves, 'Oh, well, those life creatures on earth are a silly bunch. We cannot be bothered with them if they lack the intelligence to understand this simple stuff that we are sending them.'

"Or perhaps the Martians are sending us even now some signal that we fail altogether to recognize; some form of communication so advanced that our intelligence is still too rudimentary to catch it at all.

"Signalling is, after all, a very new art among humans," the old gentleman continued, as he took down a volume from a nearby shelf. "Look," he said, "here is an original work by Galileo, the greatest of medieval astronomers and the man who proved that the earth is round. It is inscribed only five hundred years ago, and yet how absurd some of its theories and conclusions appear to us today!

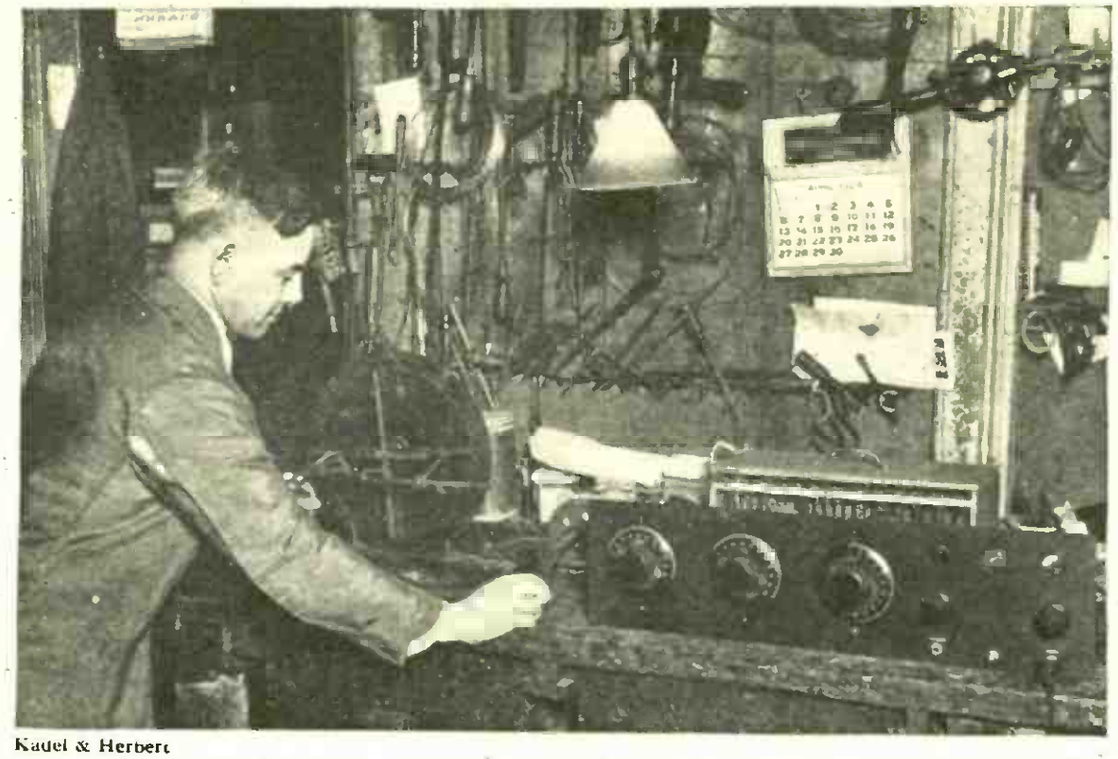
"How dare we to conjecture whether or not we will be able, a few hundred years from now, to signal to another planet? In less than a hundred years we have developed our own signal system from the ancient one of signalling with fires to the modern marvels of radio.

"I dare to set no limit to the future of what mankind can do."

Even for the possibilities of radio communication, although he does not believe this method the most promising one for interplanetary use, M. Flammarion has an interesting suggestion. He has followed the development of radio as he follows everything else in science. It was he, indeed, who inspired the famous one-hundred-meter experiments of Captain Leon Deloy. And M. Flammarion has given much thought to the possibility of projecting radio waves outside the earth in spite of the blanketing effect of the Heaviside Layer.

Might it not be possible, he suggests, to make use of the power-projecting rays of Mr. Grindell-Matthews or of some similar device to sustain an airplane high up in the air and to transmit to this machine enough power to actuate a radio transmitter? From this aerial transmitter a radio message might conceivably go, free of all interference, not only to Mars, but to the most distant star in space.

But whether by radio or by thought waves, whether in this generation or only in future centuries, a word with Mars will come. In spite of all the failure of experiments bravely tried, that is still the hope of Camille Flammarion, the man who has been for more than half a century the astronomical genius of France.



Kadel & Herbert

ARTIFICIAL STATIC IS USED TO STUDY RECEPTION TROUBLES

To eliminate reception troubles one must know the nature of the cause. One man, F. Wundsam of New York, has tackled the problem of eliminating static. He turns the crank on a static machine when the atmospheric disturbances produced by nature are not sufficient for his experiments.

HOW TO IMPROVE BROADCAST RECEPTION

ARTICLE NO. 3

In the first article of this series (which was published in the August issue), Mr. Hogan described three of the troubles that may arise because of defects in the radio waves sent out by broadcasting stations. One of these prime defects—that of frequency variations—was described in the September issue; in it he told you how you may distinguish between slow or even moderately rapid changes in wave frequency that occur at the transmitter and similar fluctuations that may be caused by your receiving system. In this article he will consider the matter of more rapid alterations in the wave frequency

By JOHN V. L. HOGAN

YOU may remember that when alterations that occur in the wave frequency are of substantial amount and that when they occur at a rate that is in the low audible range (say from fifteen to thirty times a second), you will hear a fluttering noise in your receiver, from the carrier wave of the broadcasting station.

A nearly identical noise may, however, be caused by variations in the *intensity* of the radiated wave, as was pointed out in the first article. If, when you are listening to some particular station, you hear such a noise between the "numbers" on the program, your natural question will be: How can I tell whether this flutter is explained

by frequency variations or by intensity changes in the radio waves?

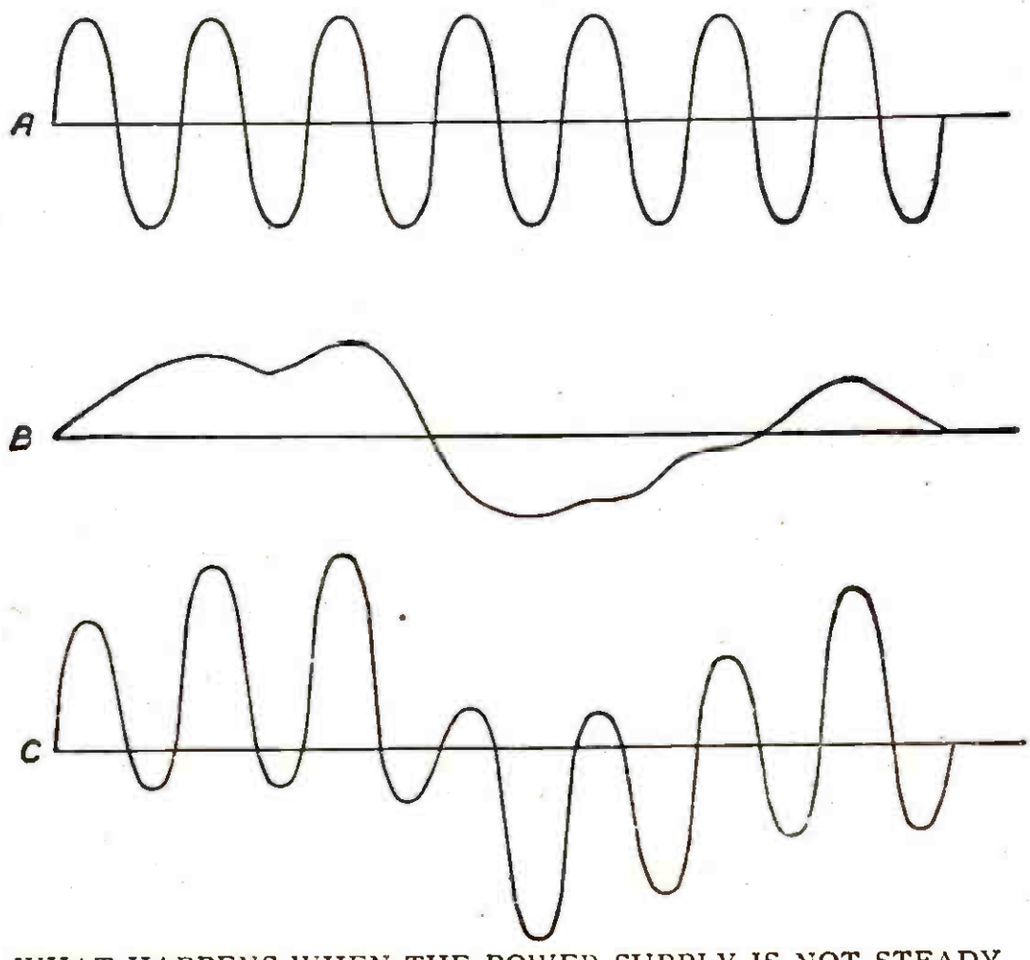
You may also ask yourself whether or not the sound is the result of something going on in your own receiver, and therefore, whether it marks a defect for which you are yourself responsible.

Flutters Produced Within Your Set

Fortunately there are not many things that can happen in a radio receiver that will cause a fluttering sound in the telephones or loudspeaker. Furthermore, anything that does tend to make such a sound will probably have the same effect on all the signals you hear and is likely to keep on going even if no signals are being received. The logical thing to do, then, is to distinguish first between the home-made noises that may be produced by your receiver, and the transmitter-made noises that come in with the waves.

Let us suppose that when you are listening to some certain broadcasting station you hear a fluttering sound whenever the carrier wave is being received. It may be heard above and along with the speech and music that is sent out, or it may be so much weaker that you do not hear it except between the successive items of the program.

The first thing to do is to try detuning your receiver; that is to say, turning your tuning knobs (or one of them) a little away from the position where the signals are heard loudest. If the noise continues, you would be justified in concluding that it originated within the receiving set. To make sure, how-



WHAT HAPPENS WHEN THE POWER SUPPLY IS NOT STEADY

The upper curve A, shows the form of a perfectly oscillating wave. Curve B shows graphically the variations that sometimes take place in the voltage of the current supplied to the plates of the tubes. The lower curve shows the effect of this variation on the oscillating carrier wave.

ever, it is a good plan to disconnect the antenna so as to cut out the signals altogether; if the flutter is still heard you may be reasonably sure that something in the audio-frequency system is wrong. Likely places for such trouble are in the amplifier circuit and sometimes in the grid-leak and condenser used on the detector tube.

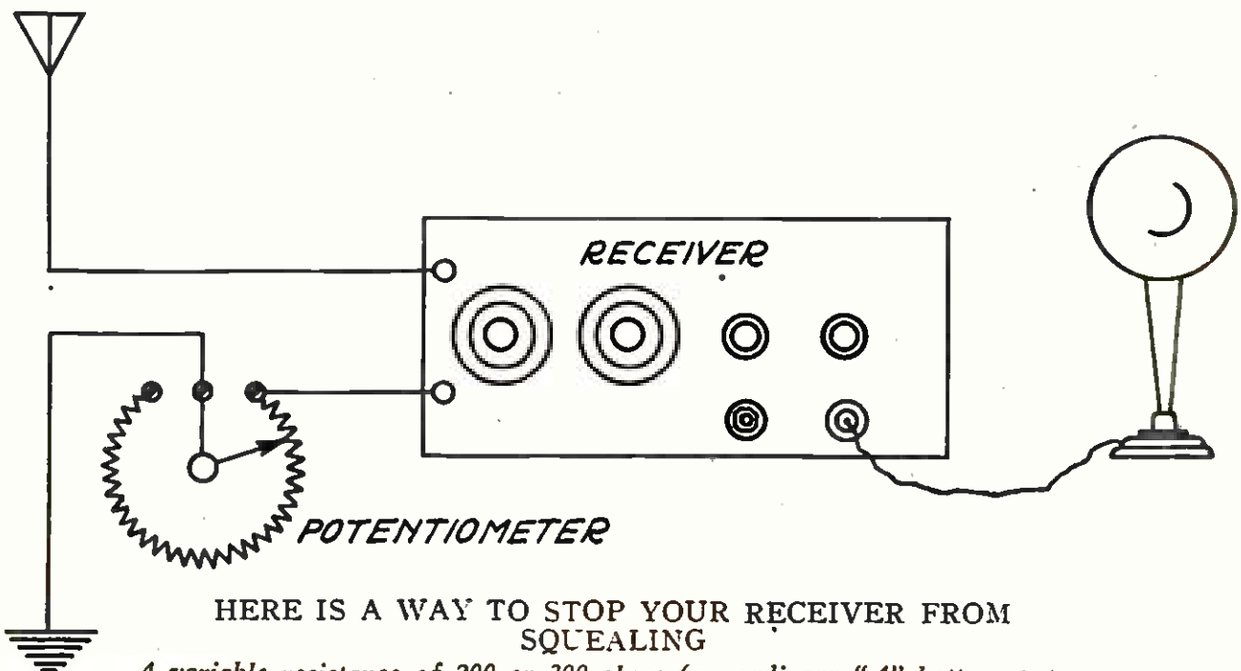
How to Cure an Oscillating Receiver

On the other hand, the flutter may "tune out" with the signal, but change in pitch from a low note (or even a rattle) up to a high whistle, which gradually disappears as the pitch increases, while you detune. This is proof positive that your receiver is generating radio oscillations within its own circuits. It is very difficult to receive broadcast telephony satisfactorily under such conditions, and you should arrange matters so that the oscillations are prevented. To do this may require merely the change of position of one of the adjusting knobs, such as a "stabilizer," "intensity" control or "tickler," or it may be necessary for you to provide an additional adjustment.

Many home-made receivers (and a good many that are put out by the factories) insist upon oscillating at certain wavelengths and so prevent, or at least make very difficult, the proper reception of broadcasting.

One of the simplest and most effective cures for this trouble is to connect a variable and moderately high resistance directly in series with the ground lead, and then to "cut in" enough of this resistance to overcome the set's tendency to oscillate. A standard potentiometer of 200 or 300 ohms is often useful for this purpose. The trouble is most likely to occur in receivers that have radio-frequency amplifier tubes, and is particularly common in reflex sets.

There is a third possibility which also indicates that the trouble is in your receiver. This is, that although the flutter vanishes when you tune out the station to which you began to listen, it comes in again in exactly the same way whenever you tune to any other station. If the coming and going of the fluttering sound is accompanied by changes in pitch, as just described, it means that your receiver is oscillating. If the flutter does not change in character or



HERE IS A WAY TO STOP YOUR RECEIVER FROM SQUEALING

A variable resistance of 200 or 300 ohms (an ordinary "A" battery potentiometer) connected in series with the ground lead can be adjusted to prevent the tendency of the receiver to oscillate on certain wavelengths.

From a photograph made for POPULAR RADIO

HOW TO SEARCH FOR POOR CONNECTIONS

With the antenna and ground disconnected, but the batteries hooked up and the phones on, it is easy to find a faulty connection. Press against each wire with the end of a hard rubber fountain pen or other piece of insulation and a grating or rasping sound will be heard in the phones when the poor connection is touched.

sound, but merely in intensity, and if it appears whenever you listen to any broadcasting station, there is something wrong with your receiver. Whatever causes this kind of flutter will probably be in the radio-frequency circuits, as your tests will have proved that it requires the presence of radio currents to produce the sound. However, such effects are both rare and obscure, and no diagnosis that could be given without inspecting the receiving set would be likely to be helpful. I mention the phenomenon with the idea of eliminating all the things that may occur in the receiver, so that you may have confidence in your observations if they point to a defect in the arriving wave.

Noises in the Carrier Waves

And, so, we come to the situation where (1) the flutter tunes out when the wave from the particular broadcasting station you are investigating is tuned out, (2) the flutter does not turn into a whistle as it is tuned out, and (3) it does not reappear as you tune to the waves from other stations.

Under these conditions it is a fair conclusion that the irregularity that produces the sound exists in the carrier wave, and that it has its origin outside of your receiving station.

Your next problem, if you really want to know what is wrong, is to find out whether the noise is caused by frequency changes or by intensity changes in the wave. If the fluctuations are small there may be some difficulty in doing this, but the test is so simple that it is worth trying in any event.

If the frequency of the incoming wave

changes from instant to instant. it is evident that a sharply-tuned receiver will not hear all of the wave all of the time, so to speak, at any one tuning adjustment. To hear the station at full intensity at every instant. it would be necessary to change the tuner settings continuously so as to follow the variations in wave frequency. The general effect of such fluctuations is, then, to broaden the range on the tuner throughout which the signals are heard.

How to Test the Sharpness of Tuning

By comparing the broadness of tuning, or the number of degrees you may turn the tuning dial away from the loudest position without completely cutting out the station, you can get some information as to the constancy of the wave frequency.

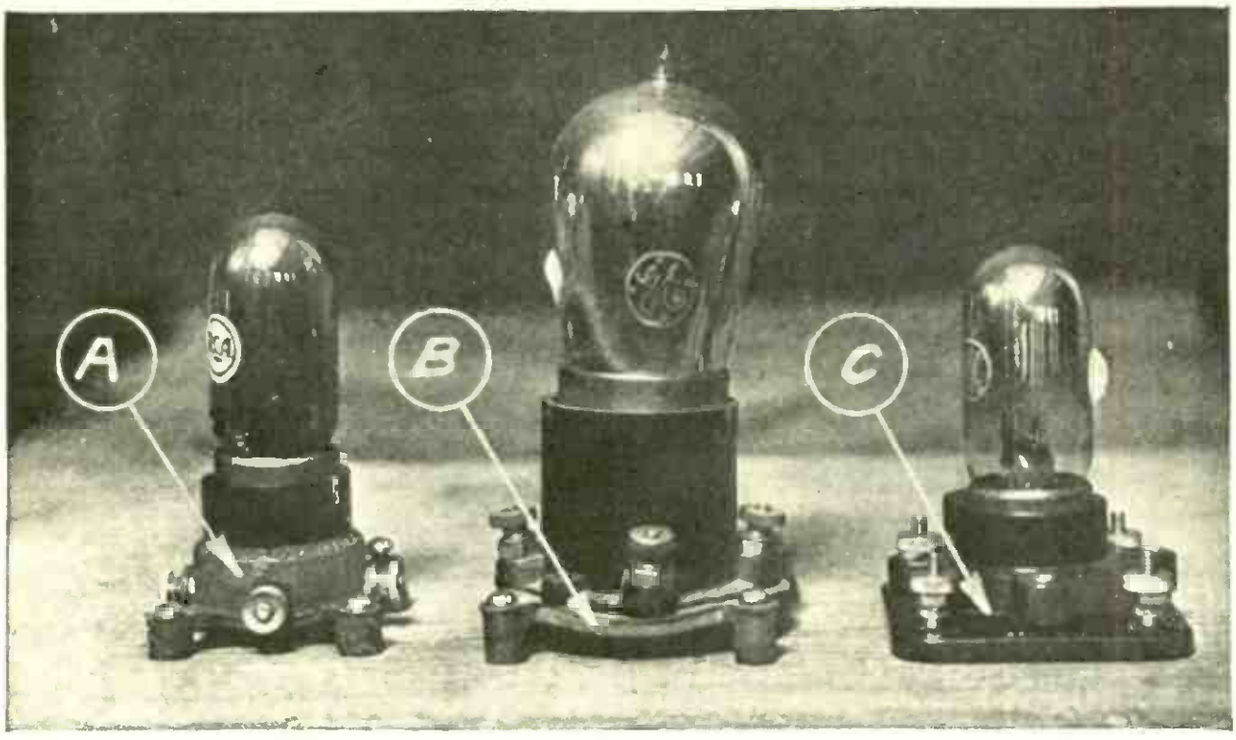
If you take as a standard some other station whose carrier wave does not flutter, and which you hear at approximately the same intensity as the plant you are studying (and which preferably has approximately the same wave frequency) you may find, for example, that the signals tune out when you move the dial about three degrees away from the maximum setting. If, then, you find that equally loud signals from the station having the fluttering wave persist when you move the tuning dial six or eight degrees from the best setting, it is a good indication that the wave frequency of that transmitter is varying.

On the other hand, if both the standard and the fluttering waves tune out in the same way, the probabilities are that the noise is caused by intensity variations. In either case you should write to the manager of the broadcasting station that is sending out the noisy wave and tell him of your observations; he can check them up himself, and thus determine the possibility of improving his transmitter.

There are two other possible causes of flutters in the received carrier wave, and as neither of them can be blamed upon your receiver or upon the broadcasting station, they should be mentioned here. If a second broadcasting transmitter, perhaps more than a thousand miles away, happens to be sending out a wave that is within a few cycles of the wave to which you are listening, the two will beat together. The beat will not produce a musical tone if the two frequencies differ by less than about 16 cycles a second, but it may cause exactly the sort of flutter we have been discussing. Such conditions are rare in practice, and should never occur except at the 833 kc. (360 meter) waves of the class C stations, for the Department of Commerce is doing its utmost to prevent undue duplication of wave frequencies among broadcasters. Occasionally a transmitter may get so far out of adjustment as to cause this effect, but the chance of striking so closely the frequency of another station is exceedingly remote. If you should hear two stations making low-frequency beats of this kind it is likely that you would find the wave frequency of either or both changing gradually while you listened, so that the flutter would drop out at one instant, come in again, change to a low musical note of varying pitch, return once more to a flutter, and so on. A

This Article Tells You—

1. *What causes the fluttering sound in your receiver;*
2. *How to distinguish a noisy carrier wave when you hear one;*
3. *How to suppress an oscillating receiver;*
4. *How to stop the grating noises in your set.*



CUSHIONED SOCKETS HELP TO MAKE YOUR RECEIVER QUIET

Socket A is made with the lower portion of soft rubber. At B is a soft rubber platform on which a standard socket can be mounted. The socket on the right is made in two pieces held apart by springs at point C. With such sockets and with all connections tight, there will be no noises unless they come from outside.

condition of this kind should be reported to the broadcasting station whose signals are affected.

Interference from Your Neighbors' Receivers

The second way that beat flutters may be made is by the reception, along with the signals you want, of waves sent out by an oscillating receiving set. The final effect is almost exactly the same as when you receive an interfering wave of the same frequency and intensity from a distant broadcasting station.

If one of your neighbors has a radiating receiver, and if, while it is in the oscillating condition, he tunes to the same station that you are listening to, radiation from his set will probably interfere with your reception. This is because, as has often been explained, any receiver that is so adjusted as to generate radio oscillations in its antenna circuit will act for the time being like a small transmitter.

Should your interfering neighbor tune his oscillating set to *exactly* the same frequency as the wave you desire to receive, you will *not* hear a beat flutter or note, but if he deviates from this exact frequency (or if the broadcasting station itself swings in frequency by even a few cycles), you will hear the fluttering sound that has been described.

Ordinarily you can tell whether such receiving interference is produced by a neighborhood "squealer" or by a distant broadcasting station, by observing the constancy of the beat note or flutter. It is unusual for a listener who uses a whistling receiver to leave his adjustments alone for more than a few seconds or at most a few minutes at a time. When he changes his tuner settings the beat noise will change correspondingly, usually turning into a musical note of gradually increasing frequency. When you hear such changes in the flutter you can be reasonably sure that the interference arises in your own vicinity, and that you will be repaid for making a

tour among the radio listeners who operate sets near your home. Most of the people who allow their sets to give this sort of trouble do so through inexperience or lack of appreciation that they are interfering with other people's reception, and it is ordinarily not difficult to build up a co-operative spirit among a group of closely adjacent listeners that will permit all to receive without such bothersome interruptions.

Noises that Are Produced by Intensity Variations

We have now considered most of the phenomena that are likely to occur as a result of frequency variations, either slow or rapid, in either the transmitters or the receivers; we have also looked into the possibilities of distinguishing between these various effects, so that any listener can find out whether the source of his disturbance lies in his own receiver or at a more distant point.

The next topic is that of noises produced by intensity variations either in the wave or in the response to the received signals.

If you hear unwanted noises while you are listening, the first thing to find out is whether they are produced by a defect in your own set or whether they come in with the waves. Much the same plan as suggested above for detecting frequency variations should be followed; if you hear the noises at all settings of your tuner, or if they continue when you disconnect your antenna, it is almost certain that something is wrong in your apparatus. Bothersome sounds of this sort, which persist even when no signals are coming in, can often be traced to poor connections in the set. If you bump your receiver with your hand while listening in the telephones, you should hear nothing but the ringing noise produced by the vibration of the tubes. If the tubes are well mounted on a cushioned base, you may not hear even that. If the jar causes a rattling sound in the telephones, or if the noises that you have been hearing are more violent, you should hunt for a loose contact in some of your instruments or wiring.

Of course, this crude "bump" test will not be helpful if your receiver is of the crystal type, without tubes; in such a set the chances of internally produced noises are fairly remote, though sometimes a shaking contact will cause them and, in any event, a bad connection will make the received signals weaker than they should be. The best way to test the contacts in a crystal set is to try to shake each of them with an insulating rod (like a closed fountain pen) while listening to signals; a bad connection will usually show up by making a noise or by stopping the signals when you move it.

If there are no loose contacts in your receiver, and you still hear irregular noises while the antenna is disconnected, you should look for the trouble in your "B" batteries (which may have become run down and noisy) or in your detector grid-leak (which may have become microphonic or may not be of the correct value for the tube you are using). Should the noises not appear when you allow the set to remain untouched, but if they show up when you adjust some particular element such as a tuning condenser, a coupler or a potentiometer, you may expect to find a "floating" or irregular bad contact in that instrument.

In the next article of this series I will describe some of the causes of interfering noise that lie outside of your receiving outfit, together with the simple tests that you may use to trace them to their sources and, in some instances at least, the best ways to eliminate them.

HOW TO SELECT A
Ready-made Receiver

1: *"I would really enjoy having a good radio set, but I don't know enough about the subject to be able to pick out the right kind of an outfit, and I'm afraid I wouldn't get a good one."*

2: *"I am going to wait until the development of radio sets has come to the point where the reception is perfect. I don't want to have to spend $200 or $300 for a set today and have to junk the whole outfit in six months, just because it is out of date."*

3: *"If I had to listen to the same kind of noises in my home that I hear coming out of some of these radio stores, I would soon be in an asylum. If that is radio, I don't want any of it."*

This article has been written expressly for the people who have been making—and probably believing—one or all of these remarks

THE TECHNICAL STAFF

IN the first place, anyone of ordinary intelligence can purchase a radio set that will suit his needs and give him good service—after he has read this article.

In the second place, radio reception *has* now progressed so far that the modern manufactured receiver really does give long-time satisfaction if properly installed.

In the third place, there are good radio stores and poor radio stores—and the larger and more reliable ones have booths where radio sets are demonstrated like phonographs. Do not think that when you hear radio signals, stepped up to terrific volume, by poor amplifiers constructed by incompetent electricians, that you are hearing as good reception as can be obtained on commercially-built sets designed by competent engineers of long standing. It is only too true that some of the smaller shops that carry a side line of radio apparatus do clutter up the air with awful noises that are projected out into the streets through the transoms over their doors.

But this should not deter anyone from getting a good radio outfit that will be a real enjoyment and a source of information as well as an education to all listeners, both young and old.

Let us now take up the various considerations that should be worked out before purchasing a radio receiver. The most important of these are:

1. Can an outdoor antenna be used? Will the landlord permit it? Is there space enough on the roof or to neighboring roofs, poles or trees for an outdoor antenna? If not, will an indoor or loop antenna be used?

2. Is a loudspeaker to be employed? Or are head telephones preferred, or both?

3. How much money is to be spent for the set?

4. Is the set to be used for local reception? Or is "distance" a requisite?

5. Is the set to be a permanent set up? Or must it be portable?

There is no straight formula for picking out just the type of receiver that will meet all needs, such as cost, sensitivity, portability, combined with perfect quality of reception.

For instance, it would be impossible to get a set that would cost only $15.00 and that would pick up stations 3,000 miles away on a loop antenna and reproduce music and speech, just as if it were in the same room.

However, a good choice can be made that will be best for you, if you will make a study of the following data that has been collected from the larger manufacturers of complete radio receiving sets.

A questionnaire was sent out by POPULAR RADIO to a list of firms asking them to answer various questions that were asked about their apparatus. The replies are summarized for your benefit on these pages. This data has been compiled in a convenient form for ready reference.

The reader who wants to buy a set should go over the specifications of these various receivers as they appear in the table; if he does the job carefully, he will be able to pick out just the right type of set to meet his needs—and one that will be certain to give him satisfaction.

The charts are arranged so that the reader may decide on a price that he wants to spend; he may then look up the sets which are listed at this price and find out if there are any sets that will serve his needs. If there are not, he will know that he will have to spend more money.

The table gives, first, the manufacturer's name, then the model or type number of the set. It tells you how many tubes are used in the set and the kind or kinds used. It tells you what type of circuit or tuning unit is employed, whether it is regenerative, radio frequency of a number of various kinds, whether a crystal detector or a vacuum-tube detector is employed. The distance ranges that can be obtained on headphones, and on the loudspeaker, are also given.

If the beginner will pick out the set, from the chart, which satisfies the five considerations given previously in this article, he will find by experience that he has made a wise choice and will begin to enjoy radio in his own home.

Ready Reference Table of Ready-made Receivers

MANUFACTURER'S NAME	Crosley Radio Corp.	Midwest Radio Co.	Sweeney Radio Co.	Penna Wireless Mfg. Co.
MODEL NUMBER OR NAME	Model 5	Model MW	Series 4 Model A	GT 2
NUMBER OF TUBES	2	4	4	3
TYPE OF TUNING	Regenerative	Tuned Radio	Tuned Radio	Regenerative
TYPE OF DETECTOR	Vacuum Tube	Vacuum Tube	Vacuum Tube	Vacuum Tube
RANGE ON PHONES	2,000 miles	2,000 miles	2,000 miles	3,000 miles
RANGE ON LOUDSPEAKER	500 miles	2,000 miles	1,500 miles	3,000 miles
COST COMPLETE	$45.00	$95.00	$115.00	$125.00
ANTENNA RECOMMENDED	Outdoor	Outdoor	Outdoor	Outdoor
KIND OF TUBES FOR R. F.	.....	UV 201A	UV 201A	.....
DETECTOR TUBE	WD11, UV199 or UV 201A	UV 200	UV 201A	C 300 or UV 200
AUDIO TUBES	WD11, UV199 or UV 201A	UV 201A	UV 201A	C 301A or UV 201A
TYPE OF "A" BATTERY	To suit tubes	6-80 storage	6-80 storage	6-120 storage
TYPE OF "B" BATTERY	To suit tubes	45 volts large size	67½ volts large size	45 volts large size
DETECTOR "B" VOLTAGE	To suit tubes	18 volts	45 volts	18 volts
WAVELENGTH RANGE	150 to 600 meters	200 to 600 meters	220 to 560 meters	175 to 650 meters
NUMBER OF TUNING CONTROLS	3	2	5	1
"A" BATTERY CURRENT USED	Depends on tubes	2 amps.	1 amp.	1½ amps.
"B" BATTERY CURRENT USED	Depends on tubes	12 mils	20 mils	6 mils
LOUDSPEAKER RECOMMENDED	Any standard	Any standard	Jewett	Manhattan

MANUFACTURER'S NAME	Cleartone Radio Co.	Chicago Radio Lab.	C. D. Tuska Company	Workrite Mfg. Co.
MODEL NUMBER OR NAME	Clear-o-dyne	4R	Superdyne Type 228	Neutro Grand
NUMBER OF TUBES	4	4	4	5
TYPE OF TUNING	Tuned Radio	Regenerative	Tuned Radio	Neutrodyne
TYPE OF DETECTOR	Vacuum Tube	Vacuum Tube	Vacuum Tube	Vacuum Tube
RANGE ON PHONES	1,500 miles	3,000 miles	3,000 miles	3,000 miles
RANGE ON LOUDSPEAKER	1,000 miles	3,000 miles	2,000 miles	2,000 miles
COST COMPLETE	$135.00	$170.00	$170.00	$175.00
ANTENNA RECOMMENDED	Outdoor	Outdoor	Short Indoor	Outdoor
KIND OF TUBES FOR R. F.	UV 201A or C301A	.....	UV 201A or C301A	UV 201A
DETECTOR TUBE	UV 200 or C 300	UV 201A or C 301A	UV 200 or C 300	UV 200
AUDIO TUBES	UV 201A or C 301A	UV 201A or C 301A	UV 201A or C 301A	UV 201A
TYPE OF "A" BATTERY	6–80 storage	6–100 storage	6–80 storage	6–100 storage
TYPE OF "B" BATTERY	90 volts large size	135 volts large size	90 volts large size	90 volts large size
DETECTOR "B" VOLTAGE	18 volts	45 volts	18 to 22 volts	18 volts
WAVELENGTH RANGE	250 to 600 meters	150 to 600 meters	220 to 565 meters	200 to 650 meters
NUMBER OF TUNING CONTROLS	2	3	2	3
"A" BATTERY CURRENT USED	1½ amps.	1 amp.	1¾ amps.	2 amps.
"B" BATTERY CURRENT USED	9 mils	5 mils	12 mils	15 mils
LOUDSPEAKER RECOMMENDED	Any standard	Baldwin	Any standard	Any standard

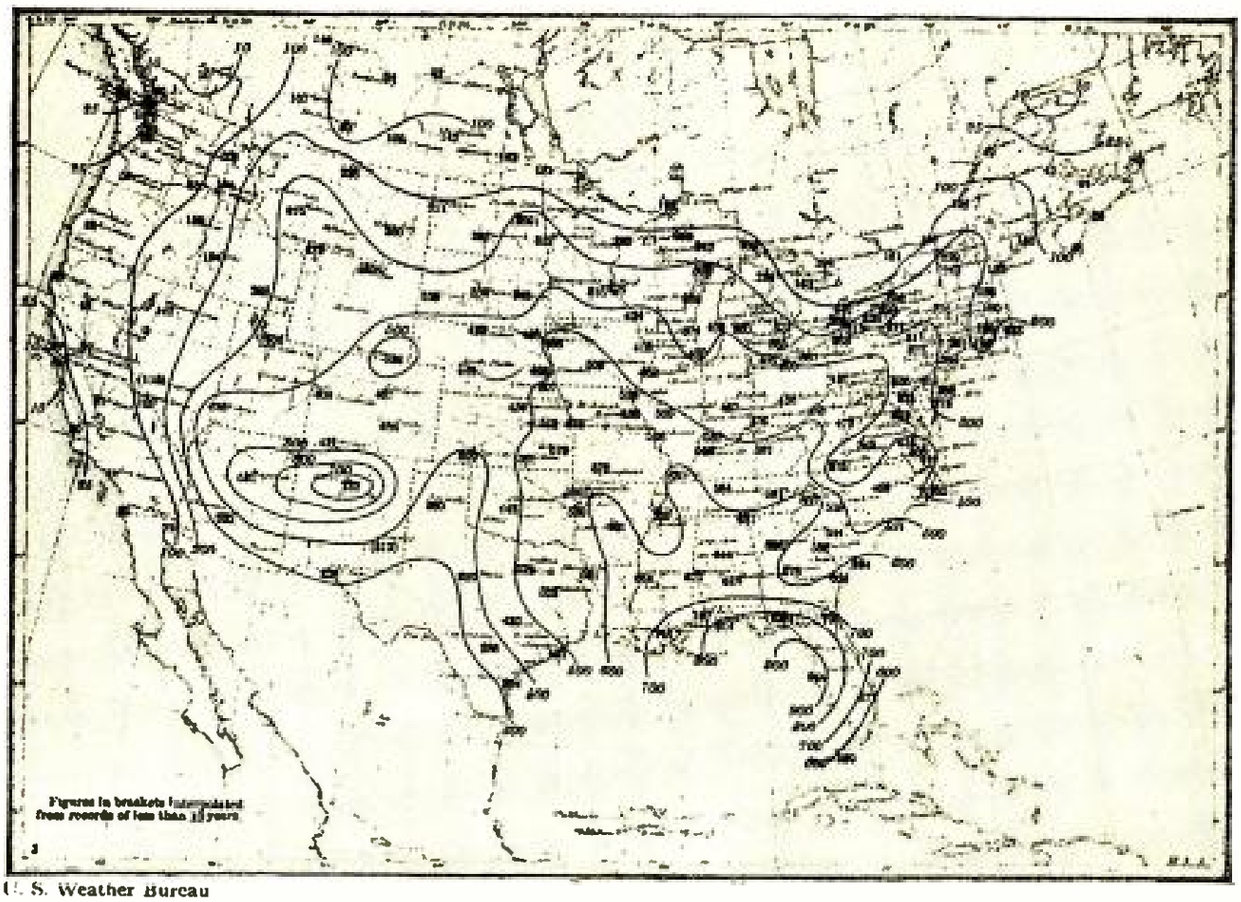
Ready Reference Table of Ready-made Receivers

MANUFACTURER'S NAME	Cleartone Radio Co.	Operadio Corporation	Garod Corporation	Westburr Incorporated
MODEL NUMBER OR NAME	Super Clear-o-dyne	Operadio 2	Type RAF	Westburr Six
NUMBER OF TUBES	5	6	4	6
TYPE OF TUNING	Tuned Radio	Transformer coupled	Neutrodyne	Transformer coupled R. F.
TYPE OF DETECTOR	Vacuum Tube	Vacuum Tube	Vacuum Tube	Vacuum Tube
RANGE ON PHONES	1,500 miles	2,000 miles	2,000 miles	1,000 miles
RANGE ON LOUDSPEAKER	1,000 miles	2,000 miles	1,500 miles	Local signals
COST COMPLETE	$180.00	$190.00*	$190.00	$195.00
ANTENNA RECOMMENDED	Outdoor	Loop	Outdoor	Loop
KIND OF TUBES FOR R. F.	UV 201A or C 301A	UV 199 or C 299	UV 201A or C 301A	UV 199
DETECTOR TUBE	UV 200 or C 300	UV 199 or C 299	UV 200 or C 300	UV 199
AUDIO TUBES	UV 201A or C 301A	UV 199 or C 299	UV 201A or C 301A	UV 199
TYPE OF "A" BATTERY	6–140 storage	4½ volts flashlight	6–100 storage	4½ volts flashlight
TYPE OF "B" BATTERY	90 volts large size	90 volts small size	90 volts large size	67½ volts small size
DETECTOR "B" VOLTAGE	18 volts	45 volts	22½ volts	45 volts
WAVELENGTH RANGE	250 to 600 meters	290 to 575 meters	230 to 560 meters	250 to 525 meters
NUMBER OF TUNING CONTROLS	3	2	3	3
"A" BATTERY CURRENT USED	1¾ amps.	.4 amp.	1¾ amps.	.4 amp.
"B" BATTERY CURRENT USED	15 mils	12 mils	14 mils	12 mils
LOUDSPEAKER RECOMMENDED	Any standard	Self-contained*	Any standard	Any standard
MANUFACTURER'S NAME	F. A. D. Andrea Inc.	Adams Morgan Co.	Henry Hyman & Co., Inc.	Moon Radio Corporation
MODEL NUMBER OR NAME	No. 160-A	Type RB-2	"Bestone" V-60	C-2 A
NUMBER OF TUBES	4	3	4	4
TYPE OF TUNING	Neutrodyne	Regenerative	Tuned Radio	Transformer coupled R. F.
TYPE OF DETECTOR	Vacuum Tube	Vacuum Tube	Vacuum Tube	Vacuum Tube
RANGE ON PHONES	3,000 miles	3,000 miles	3,000 miles	3,000 miles
RANGE ON LOUDSPEAKER	3,000 miles	2,000 miles	2,000 miles	2,000 miles
COST COMPLETE	$200.00	$200.00	$210.00	$210.00
ANTENNA RECOMMENDED	Outdoor	Outdoor	Outdoor	Ground alone
KIND OF TUBES FOR R. F.	UV 201A or C 301A	.....	UV 201A or C 301A	UV 201A or C 301A
DETECTOR TUBE	UV 200 or C 300	UV 200 or C 300	UV 200 or C 300	UV 200 or C 300
AUDIO TUBES	UV 201A or C 301A	UV 201A or C 301A	UV 201A or C 301A	UV 201A or C 301A
TYPE OF "A" BATTERY	6–100 storage	6–80 storage	6–100 storage	6–110 storage
TYPE OF "B" BATTERY	90 volts large size	67½ volts large size	135 volts large size	90 volts large size
DETECTOR "B" VOLTAGE	22½ volts	22½ volts	18 volts	18 volts
WAVELENGTH RANGE	200 to 600 meters	200 to 560 meters	280 to 550 meters	250 to 550 meters
NUMBER OF TUNING CONTROLS	3	3	2	2
"A" BATTERY CURRENT USED	1¾ amps.	1½ amps.	2 amps.	1¾ amps.
"B" BATTERY CURRENT USED	15 mils	8 mils	14 mils	14 mils
LOUDSPEAKER RECOMMENDED	Music Master	Any standard	Any standard	Natural-tone

Ready Reference Table of Ready-made Receivers

MANUFACTURER'S NAME	De Forest Radio Co.	Western Coil & Electric Co.	Amsco Products Co.	Chicago Radio Lab.
MODEL NUMBER OR NAME	Reflex	Radiodyne WC10 & WC11	Melco Supreme	3R
NUMBER OF TUBES	4	6	4	4
TYPE OF TUNING	Transformer coupled R. F.	Transformer coupled R. F.	Tuned Radio	Regenerative
TYPE OF DETECTOR	Crystal	Vacuum Tube	Vacuum Tube	Vacuum Tube
RANGE ON PHONES	3,000 miles	3,000 miles	3,000 miles	3,000 miles
RANGE ON LOUDSPEAKER	1,500 miles	3,000 miles	1,500 miles	3,000 miles
COST COMPLETE	$210.00	$211.00	$225.00	$244.85
ANTENNA RECOMMENDED	Loop	Outdoor	Outdoor	Outdoor
KIND OF TUBES FOR R. F.	De Forest	UV 201A or C 301A	UV 201A or DV 2	.....
DETECTOR TUBE	.....	UV 201A or C 301A	UV 201A or DV 2	UV 201A or C 301A
AUDIO TUBES	De Forest	UV 201A or C 301A	UV 201A or DV 2	UV 201A or C 301A
TYPE OF "A" BATTERY	6–120 storage	6–120 storage	6—80 storage	6–100 storage
TYPE OF "B" BATTERY	90 volts large size	90 volts large size	67½ volts large size	135 volts large size
DETECTOR "B" VOLTAGE	.....	16½ volts	67½ volts	45 volts
WAVELENGTH RANGE	222 to 600 meters	200 to 650 meters	200 to 600 meters	150 to 600 meters
NUMBER OF TUNING CONTROLS	2	2	3	3
"A" BATTERY CURRENT USED	1 amp.	1⅜ amps.	1 amp.	1 amp.
"B" BATTERY CURRENT USED	16 mils	18 mils	12 mils	5 mils
LOUDSPEAKER RECOMMENDED	Vernco	Any standard	Western Electric	Baldwin

MANUFACTURER'S NAME	Mu-Rad Lab., Inc.	Freed-Eismann	Pooley Furniture Co.	The Bristol Company
MODEL NUMBER OR NAME	MA-15	NR-5	No. 600	Model D
NUMBER OF TUBES	6	5	5	4
TYPE OF TUNING	Transformer coupled R. F.	Neutrodyne	Tuned Radio	Reflex
TYPE OF DETECTOR	Vacuum or Sodion Tube	Vacuum Tube	Vacuum or Sodion Tube	Vacuum Tube
RANGE ON PHONES	3,000 miles	3,000 miles	2,000 miles	3,000 miles
RANGE ON LOUDSPEAKER	3,000 miles	3,000 miles	1,500 miles	3,000 miles
COST COMPLETE	$260.00	$275.00	$275.00*	$300.00
ANTENNA RECOMMENDED	Loop	Outdoor	Outdoor	Outdoor
KIND OF TUBES FOR R. F.	C 301A or UV 201A	UV 201A or C 301A	UV 201A	UV 201A
DETECTOR TUBE	UV 200 or Sodion	UV 201A or C 301A	UV 201A or UV 200	UV 200
AUDIO TUBES	UV 201A or C 301A	UV 201A or C 301A	UV 201A	UV 201A
TYPE OF "A" BATTERY	6–90 storage	6–100 storage	6–100 storage	6–80 storage
TYPE OF "B" BATTERY	90 volts large size	90 volts large size	90 volts large size	90 volts large size
DETECTOR "B" VOLTAGE	20 volts	45 volts	22½–45 volts	18 volts
WAVELENGTH RANGE	270 to 600 meters	220 to 560 meters	220 to 560 meters	200 to 600 meters
NUMBER OF TUNING CONTROLS	1	3	3	1
"A" BATTERY CURRENT USED	2¼ amps.	1¼ amps.	1¼ to 2 amps.	1¾ amps.
"B" BATTERY CURRENT USED	22 mils	25 mils	15 mils	15 mils
LOUDSPEAKER RECOMMENDED	Mu-Rad Audiophone	Western Electric	Self-contained*	Audiophone Senior



U. S. Weather Bureau

THUNDERSTORM AREAS ARE SOURCES OF STATIC

FIGURE 1: *This map shows the total number of thunderstorms that occurred in different parts of the United States between 1904 and 1913. The two regions of most frequent thunderstorms, in the Gulf of Mexico and over Arizona and New Mexico, are also sources of much static.*

Tracking Static to Its Lair

One of the most significant investigations of static ever made has been in progress for over two years at the University of Wisconsin. In this exclusive article Dr. Terry, who is Associate Professor of Physics at that university and who has directed the static work, describes the methods used and some of the conclusions that have been reached. It is fundamental investigations of this kind which will lead presently to the understanding and control of this form of radio interference

By EARLE M. TERRY, Ph.D.

STATIC interference is generally divided into three major groups which are known respectively as "hisses," "crashes" and "grinders."

These three terms are self-explanatory; anyone who has had even a limited experience in radio listening will easily recognize them.

The "hisses" are due to an actual electric discharge from the antenna to the earth. This variety of static is more pronounced when a series tuning condenser is used. While it often sadly mars the reception of music, it is not of serious consequence in the reception of telegraphic signals.

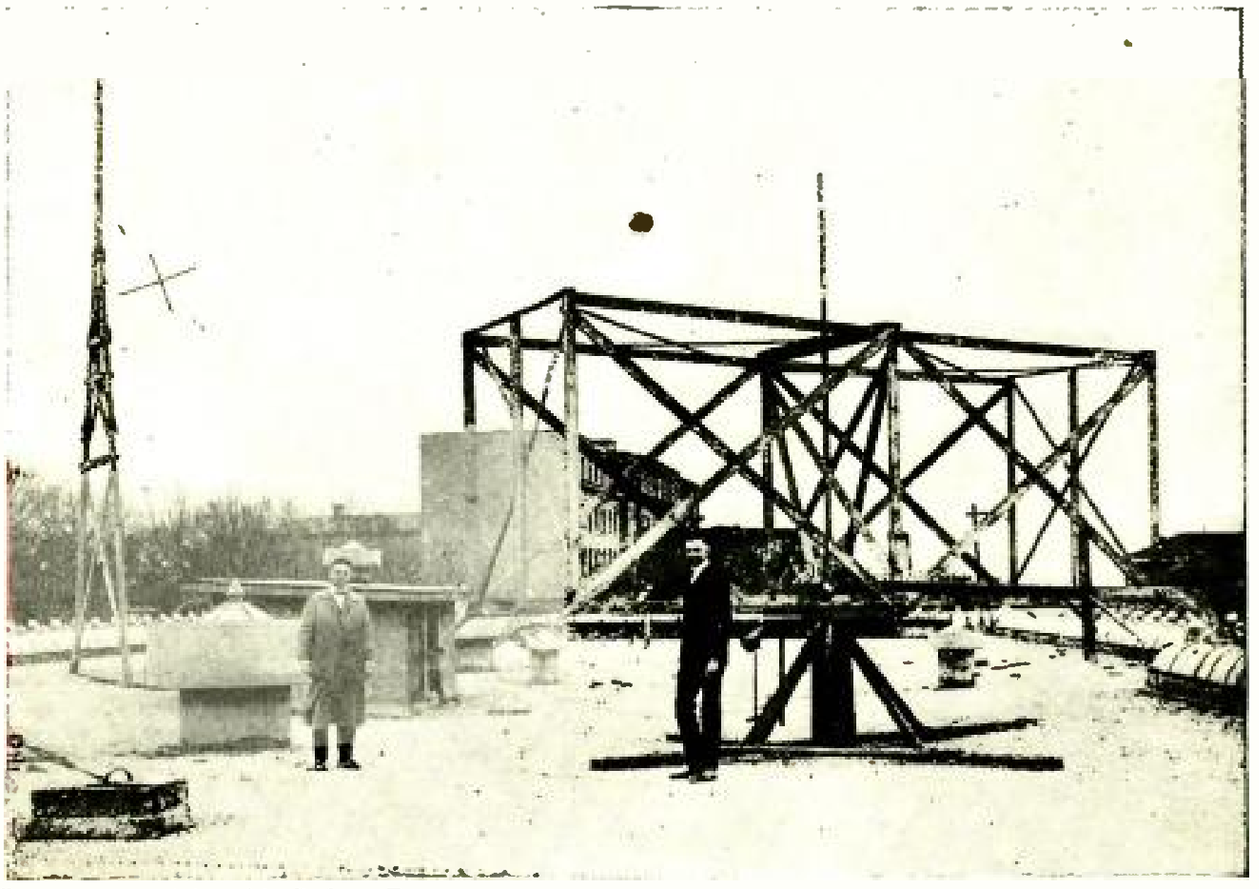
The "crashes" have been traced quite definitely to lightning discharges. While such crashes last they are often so strong as to obliterate completely the incoming signal, but because of their short duration they seldom interfere

seriously with radio communication.

The "grinder" type of interference is the most serious of all. This consists of a series of sustained crashes of varying intensity. It reminds one somewhat of the sound produced when sand that contains an occasional pebble is thrown against a window in a more or less broken stream. This form of static often rises to overwhelming intensity during the summer months. In the early days of transoceanic radio communication it frequently caused interruptions for hours at a time.

Experience shows that this grinder static is more severe near the tropics than in the temperate or frigid zones. In a given locality it varies in intensity from day to day. It is worse on warm days than on cool days. It also varies throughout the day; it is usually at a minimum between sunrise and noon and increases to a maximum just before sunset. During the evening and the early part of the night it remains practically constant and falls gradually to a minimum at sunrise.

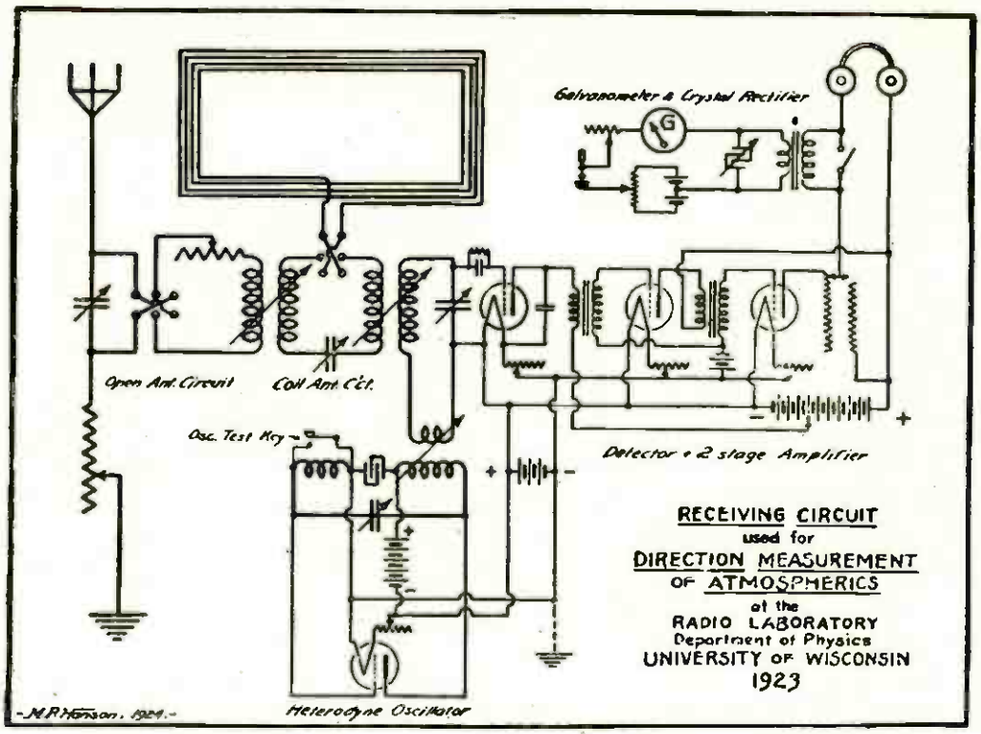
The origin of this type of static is not definitely known. In the early days of radio all forms of static were thought to be caused by lightning disturbances either between two clouds or between a cloud and the earth. In recent years, however, the belief is gaining ground that the grinder type is not due to ordinary lightning but to disturbances in regions of the atmosphere far above the clouds. It apparently has but little connection with the ordinary phenomena of meteorology, and electricity that is received from the sun probably plays an important part in it.



From a photograph loaned by Professor Terry

THE TWO ANTENNAS OF THE STATIC MEASURER

FIGURE 2: *The frame at the right carries the eighty-turn loop. The cage antenna may be discerned by its spreaders, attached to the mast at the left. Professor Terry stands at the left. The entire apparatus is on top of one of the university buildings.*



HOOK-UP FOR THE STATIC-MEASURING CIRCUITS

FIGURE 3: *In the upper right-hand corner notice the galvanometer circuit, supplementing the telephones for the measurement of intensity. The circuits are fully described in the article.*

One of the most elaborate attempts to overcome interference from the grinders type of static was that carried out by Weagant, then chief engineer of the Marconi Wireless Telephone Company of America. His method was based on the supposition that this static really does originate overhead, so that it will be propagated directly downward.

As the signal waves that one desires to receive travel parallel to the earth's surface, it would be possible, Weagant thought, to design receiving systems in which the vertical impulses of the static would neutralize each other, while the horizontal impulses due to the signal would reinforce each other.

Such systems were installed and actually did give marked improvement in ability to receive through static interference. For a time this plan was widely heralded as having solved the problem of static elimination. But subsequent investigations have shown that the static does not all come from above. The Weagant system does not eliminate it all. Furthermore, the large dimensions of the receiving loops required, together with the strays picked up by the long connecting lines, have prevented this system from coming into general use.

Another method for the elimination of static is one designed by Commander A. H. Taylor, Director of the Naval Aircraft Laboratory, Washington, D. C. This method takes advantage of the relative effectiveness of a loop and a buried wire in picking up static and signals. The loop and an insulated wire, the latter buried a short distance underground, are coupled to a receiving circuit in such a way that the electromotive forces that they induce in it are opposite.

It is then possible to adjust the coupling so that all of the static disturbances are neutralized. But the signal will be relatively stronger in the buried wire than in the loop and a portion of it will remain unneutralized. By suitable amplification this can be made of any desired strength.

Commander Taylor states that the ratio of improvement of this balanced receiver over the loop alone is more than 8 to 1. Six receivers of this type were installed at Belmar, New Jersey, in April, 1919, and were used for the navy's transatlantic reception for the remainder of the war.

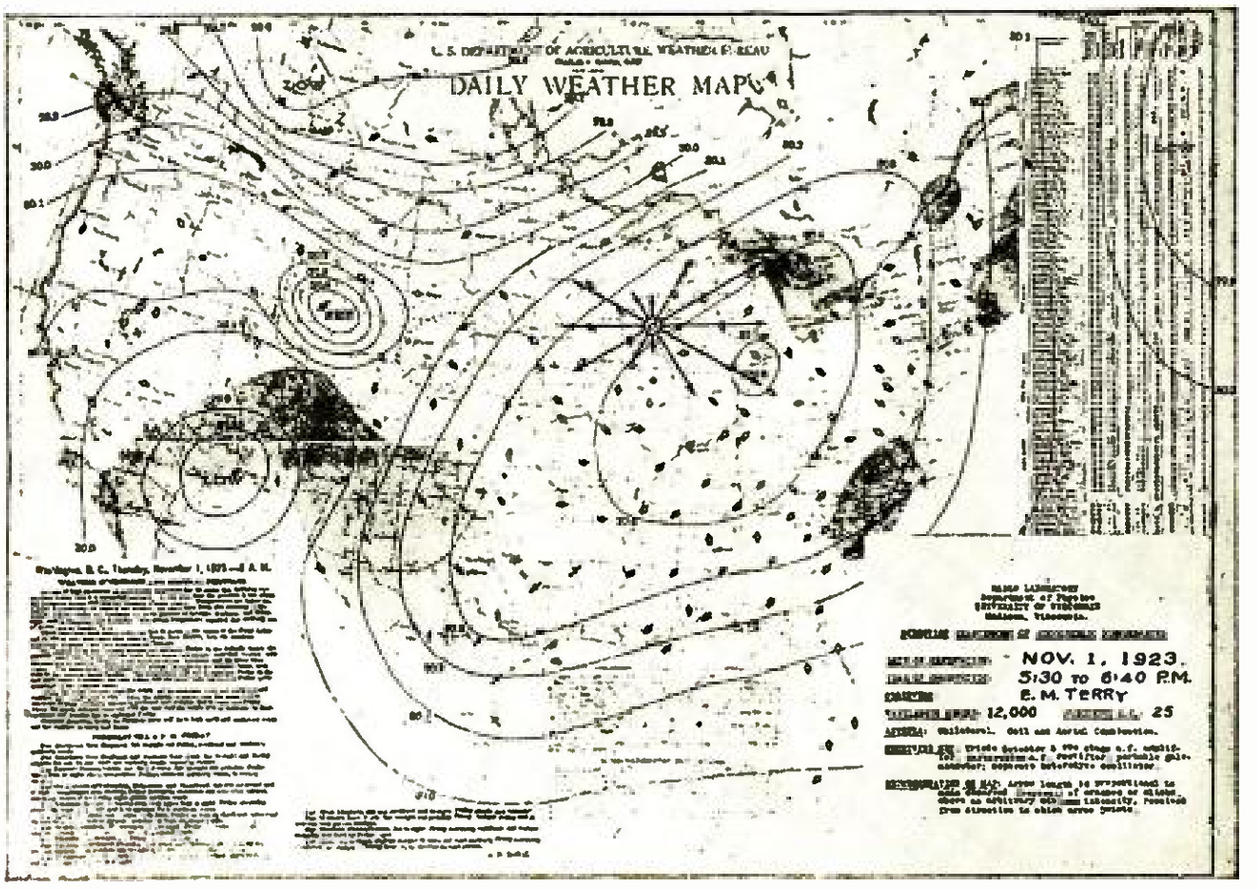
One of the most important contributions to the problem of static elimination is the recent discovery that the disturbances do not come from above, as Weagant believed, but that for the most part they originate in certain fairly well defined land areas.

In the United States, for example, there seem to be two such localities, one in the Gulf States and the other in Arizona and New Mexico. In Figure 1 is shown a map prepared by the United States Weather Bureau on which the total number of thunderstorms which occurred during the ten-year period from 1904 to 1913 has been recorded. Lines are drawn through the areas that have equal numbers of storms.

It is a striking fact that the preponderance of static comes from exactly those regions where thunderstorms are most prevalent.

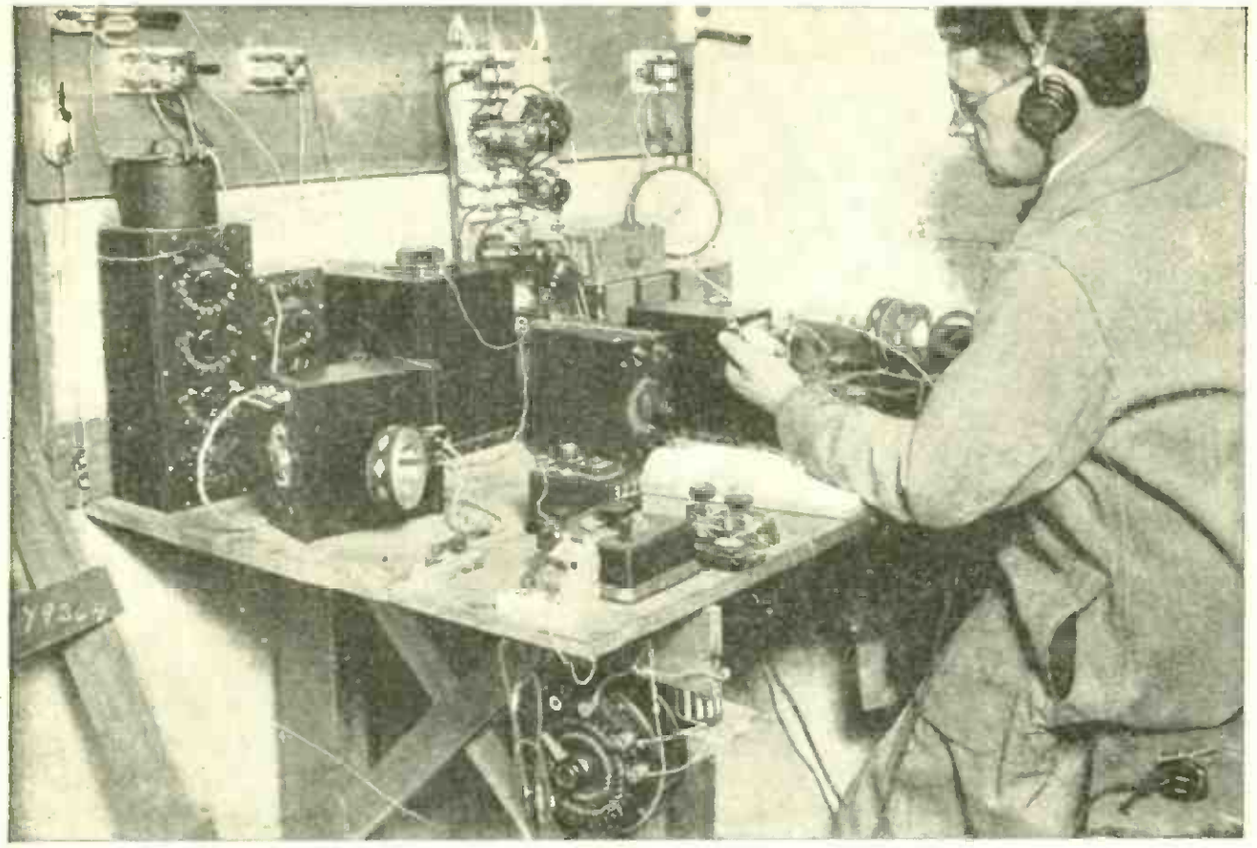
For this reason opinion is swinging back again to the idea that thunderstorms rather than the high-altitude electric disturbances are at the bottom of our difficulties from static.

Fortunately for transoceanic reception on both sides of the continent these major static sources lie nearly opposite to the stations that one wishes to receive and any receiving device possessing highly directive properties may be used to advantage. One of the most successful of these is the so-called wave antenna designed by Mr. H. H. Beverage



STATIC ON A DAY OF NO THUNDERSTORMS

FIGURE 4: *On November 1, 1923, there were no thunderstorms anywhere in the country. The arrows show the direction and intensity of static and indicate that it is coming mainly from regions of high barometric pressure, as located by the weather map.*



From a photograph loaned by Professor Terry

WHERE THE MEASUREMENTS ARE MADE

The receivers, meters and other instruments are placed inside the small house shown in Figure 2. In this view Professor Terry is seated at the receiver making a measurement.

of the Radio Corporation of America.

This consists of two long horizontal wires, suspended at equal heights a few feet above the ground and extending from the receiver in a direction opposite to the transmitting station. At each end is an ingenious coil arrangement which permits waves traveling in one direction to act upon the receiver, while neutralizing the effects of those going the opposite direction. By making the antenna somewhat longer than the wavelength to be received marked directive properties are secured.

At Radio Central, the powerful station of the Radio Corporation of America near New York, this method of reception has been in use for some time. The wires are seven miles in length and are suspended ten feet above the earth. As they are untuned, it is possible to couple this antenna to more than one tuned receiving circuit, thus permitting multiplex reception. A single pair of wires with its separate receiving circuits has handled all the business of the station for some time. The company reports very little interference with traffic even during the worst seasons of the year.

While observations along the two seaboards have already indicated clearly the preponderance of static from the areas mentioned, no systematic study has been made at points in the interior of the United States. During the past year the author and the staff of radio station WHA at Madison, Wisconsin, have begun this work.

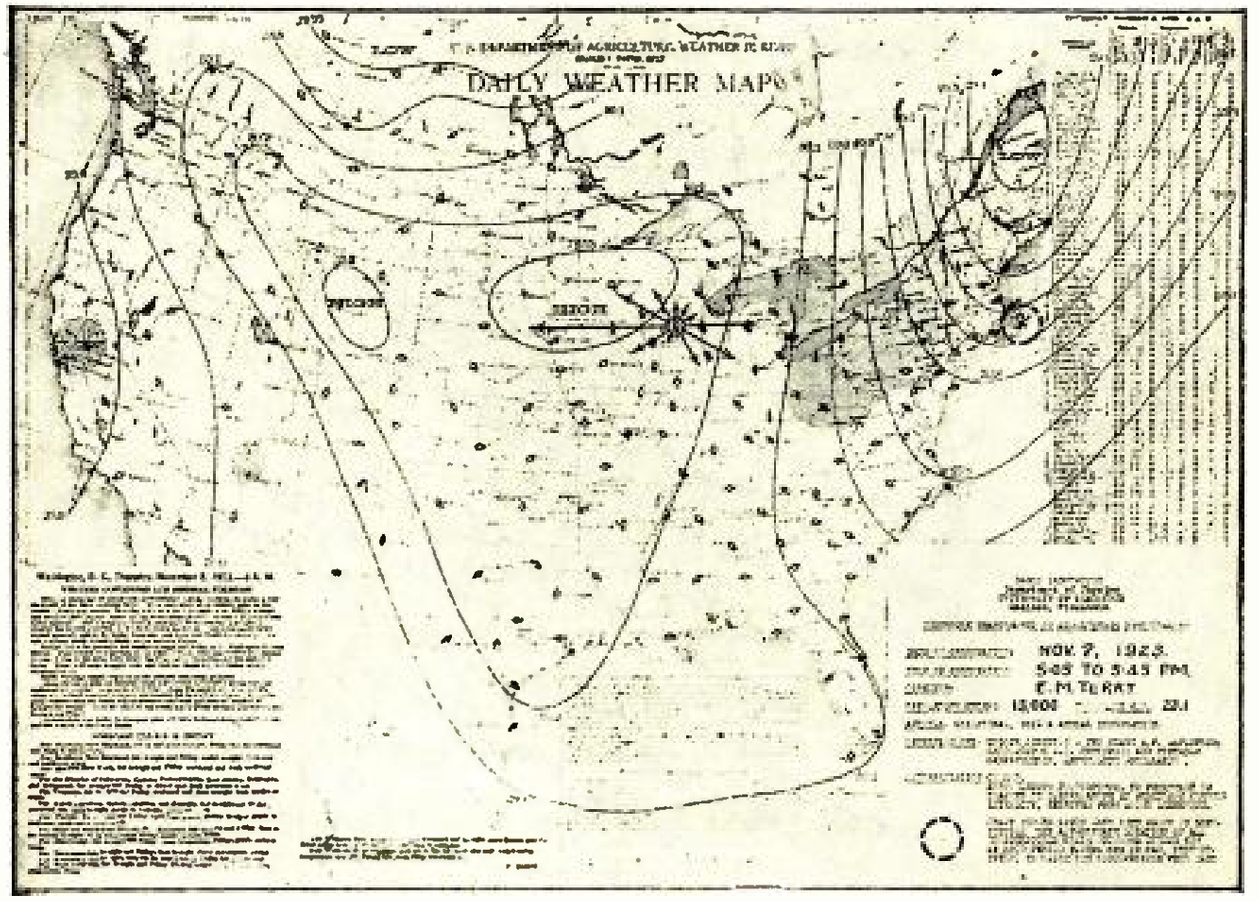
The receiving apparatus consists of a large rotatable coil and a small cage antenna located on the top of Sterling Hall, one of the buildings of the University of Wisconsin. Both coil and cage are coupled to the same receiving circuit. The cage receives equally well

from all directions, while the coil has bi-lateral properties. Moreover, the phase of the electromotive force induced in the coil reverses when the coil is turned through 180 degrees with regard to a given source.

The coupling of the coil and of the cage to the receiving circuit are each so adjusted that when the plane of the coil passes through a given transmitting station the intensities of the signals received by it and by the cage separately are the same. Then, if these two are combined, the total intensity in the receiver is twice that of either alone, while signals that come from the opposite direction are completely neutralized. The system thus has uni-directional receiving properties and, by rotating the coil, the system may be used to measure the intensity of the static that comes from all directions.

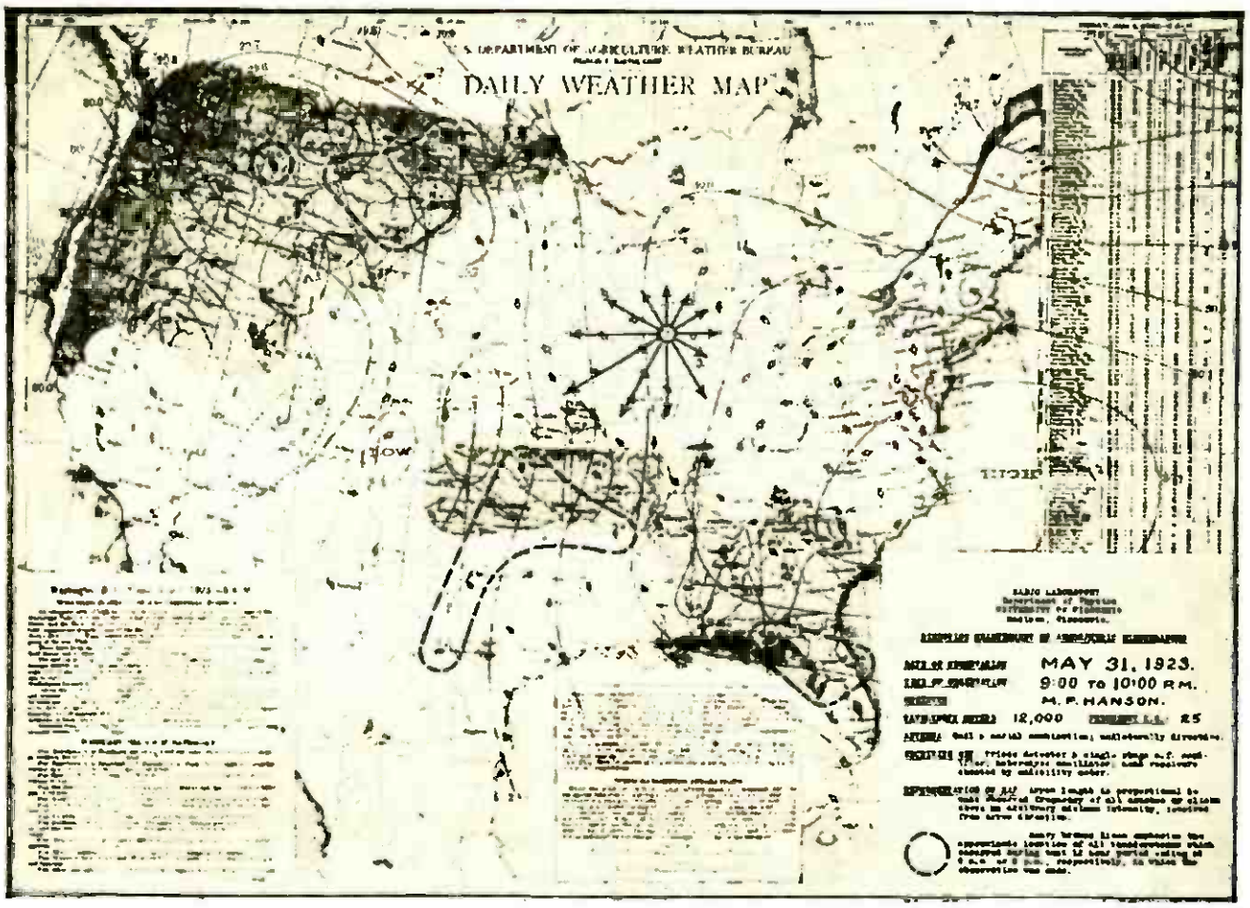
The two antennas—cage and coil—are shown in Figure 2. The coil (in the right front) consists of eighty turns of wire wound on a rotatable frame twenty feet long, eight feet high and six feet wide. The ends are connected to brushes which rest on slip rings which cannot be seen in the figure. The frame is carried on a ball bearing and is easily rotatable from the receiving set by an arrangement of rope and pulleys. A circular scale is mounted underneath the coil and is read by means of a telescope at the receiving set.

The cage antenna is supported on the mast shown at the left of the picture, which also carries one end of the broadcasting antenna for station WHA. The cage itself is a four-wire unit and is barely discernible by the spreaders, which may be seen about two-thirds of the way up the mast. The lower end is con-



ON THIS DAY A THUNDERSTORM CONTRIBUTED TO THE STATIC

FIGURE 5: *Of the two longest arrows, indicating the chief directions of static, one points to a thunderstorm, marked by the dotted circle over Cape Cod, the other to the high-pressure area in Wyoming.*



A DAY OF MANY THUNDERSTORMS

FIGURE 6: *Heavy thunderstorm areas are indicated by the regions inclosed in heavy dotted lines in the northwest, the southwest and over the northern corner of the Gulf of Mexico. The preponderance of static from these directions is shown clearly by the arrows.*

nected to the small house built to contain one of the ventilating fans for the building. The receiving equipment is located in this house.

The circuit which we are using is a modification of the one described by Dr. Austin in the Proceedings of the Institute of Radio Engineers for August, 1923. The method employed by Dr. Austin is this; the two antennas are adjusted so that their responses are equal. Then the loop is rotated slowly and the polarity of its terminals with the receiving circuit are quickly reversed while observations on static are being made. If the plane of the coil coincides with the direction from which static arrives, then for one position of a switch the response to static is a minimum, while for the reverse position it is zero. The coil is then rotated until no difference in the response to static is observed for the two positions of the switch. The static is then coming from the direction at right angles to the plane of the coil.

Our experience has been that the static in this locality is of such an irregular character that observations cannot be made in this simple manner. We have used, accordingly, the somewhat more elaborate circuit shown in the wiring diagram of Figure 3. The antenna at the left of the figure represents the cage with a parallel-connected tuned circuit. The loop is shown next toward the right with two variable inductances and a tuning condenser in series. Loosely coupled with this is a third tuned circuit to which is connected a detector tube and a two-stage audio-frequency amplifier of ordinary design.

At the lower part of the figure is shown a separate heterodyne oscillator, loosely coupled to the tuning circuit by a variable mutual inductance. In series with the phone is an audio-frequency transformer, the secondary of which contains a crystal rectifier and a pointer galvanometer.

Our procedure is first to tune the cage and the loop separately to some continuous-wave transmitting station. The two are then coupled together and the resistances are varied until, with the coil pointed toward the station, the response is a maximum for one position of the reversing switch and is zero for the other position. This adjustment is made by varying the antenna resistance next to ground.

This adjustment insures that the responses of the two antennas are equal. It does not indicate, however, that the decrements are equal. We make an attempt to equalize the decrements by throwing each receiver out of tune by the same amount, and then adjusting the resistance in the parallel circuit of the cage until for this detuned position the responses are equal. This, of course, necessitates readjusting the first resistance. The end of the loop which points toward the receiving station is then marked. As the loop is rotated, static disturbances heard in the phones will thus be arriving from the direction in which this marked end points.

Our schedule for taking observations consists in setting the loop in various positions around a circle with thirty degree spacing, and then counting the number of crashes received in a definite time, usually fifty seconds for each position. This process is repeated for five complete rotations of the loop and the results are averaged.

In the early part of the work it was often found difficult to distinguish between static crashes and tube noises, so the transformer with rectified secondary current was introduced in the phone circuit as an aid. Each crash registers on the galvanometer a deflection proportional to the strength of the disturbance. Small, irregular disturbances are eliminated by counting only those crashes which produce a galvanometer deflection greater than some arbitrarily chosen threshold value. We have found that by this combination of visual and aural methods we are able to obtain much more consistent results.

The results obtained are plotted on weather maps like those shown in Figures 4 to 6. Arrows are drawn for each of the thirty-degree angular positions and the lengths of these arrows are proportional to the average number of crashes counted in these directions. Each arrow is, in general, the average of five observations. To avoid prejudice of the observer, it is our custom to select these positions in a somewhat haphazard order and not consecutively. I believe that the personal equation has been effectively eliminated.

The results obtained thus far seem to indicate that there are several sources of static operating in the neighborhood of Madison, and that they change from day to day, although the greater part of the interference comes from the southeast. A comparison of the polar diagrams with the weather maps showed little correlation, except that in the latter part of the summer, after the thunderstorm season had passed, the direction of the static sources was found to coincide, in many cases, with the direction of regions of high barometric pressure. In the earlier part of the season this is not true; the static comes then from the thunderstorm areas.

It is my opinion that the older theory of static—that it is produced by thunderstorms and by the accompanying irregular discharges between clouds and the earth—is the correct one. Even for static of the grinder type this theory seems better in accord with the facts than are the more recent theories of high-altitude electric discharges, as proposed by Pickard, Weagant and others.

From photographs made for POPULAR RADIO

THE WRONG WAY

FIGURE 1: *This is the way the headbands should* NOT *fit. All the weight is carried on just two spots.*

THE RIGHT WAY

FIGURE 2: *Note how the bands conform to the shape of the head, so that the weight is properly distributed.*

How to Fit Your Headphones to Your Head

By ALFRED P. LANE

DO your headphones fit your head? After a couple of hours of listening in with a pair of headphones, the average man is apt to discover a variety of little discomforts that distract his attention from the program. His ears begin to feel the clamp and the bands suggest iron bars resting on the top of his skull.

So he removes or readjusts the offending phones and decides to get an amplifier and a loudspeaker—and to use the headphones for tuning purposes only.

Of course, a good loudspeaker plus a good amplifier will reproduce broadcast programs well enough to suit anyone. But the man who cannot afford such an outfit may take comfort in the fact that no loudspeaker outfit can give any better results than a plain, ordinary headset of a good make. And the headphones have another important advantage too—they give satisfyingly loud reproduction in the user's ears without disturbing others.

As headphones are of value even to the man with a *de luxe* outfit, the problem is to make the wearing of them a comfort and not a nuisance. About all that the manufacturer of headphones can be expected to do is to supply a sufficient number of adjustments so that the user will be able to get each phone located squarely against each ear.

All the good headphones now on the market are satisfactory in this respect. But it is impossible to turn out a standardized product that will properly fit every curve and angle with which nature endows various human craniums. You can't walk into a store and just ask for a hat and expect to get one that fits you unless you try on a number of sizes; even then, you will probably need to have it stretched one way or the other.

What makes an old hat feel so comfortable? Because the many hours of resting on your head have finally forced the material of the hat into a shape that fits your head all the way round without any tight and loose places. How can we get some of that old-hat feeling into the headphones?

In the first place, the springs in the bands are too strong. They are made that way so that no matter how narrow your head is, the phones will still rest tightly against your ears. The remedy for this trouble is obvious—simply bend the bands until the phones do not press so tightly. And this is just about as far as anybody goes in adjusting the bands.

Regardless of how carefully this adjustment is made, the phones may still be uncomfortable because the bands do not distribute the weight of the phones evenly on the head; in most cases they will press against just one pair of spots on the top of the crown, and after you have worn them for a while you will sense that the phones are too heavy. If you continue to wear them in this condition, you may get a headache—the same kind of headache that you get from a hat that presses against the head in only two spots.

Look at Figure 1 and note that the bands touch the wearer's head in only two spots right near the center of each band.

Now look at Figure 2 and see how the bands have been bent so that each one rests for almost its entire length snugly against the head.

The headphones in Figure 2 may be worn for hours without discomfort, simply because the bands distribute the weight *evenly* over a large area instead of concentrating it at just two points.

To get your headphones to fit as in Figure 2, bend each band, little by little, as shown in Figure 3, trying the phones on each time you bend one of the bands. When the phones are on the head, press against the bands and you can easily locate the spots that stand away from your head. Keep at it until you cannot find a spot on either band that does not touch.

After this is done, you can adjust the pressure of the phones against the ears to the point that seems most comfortable. In general, it will be found that the best pressure is just sufficient so that the phones will not fall off when you lean your head forward or backward as in looking down at a piece of paper on the table, or up at someone who is standing beside your chair.

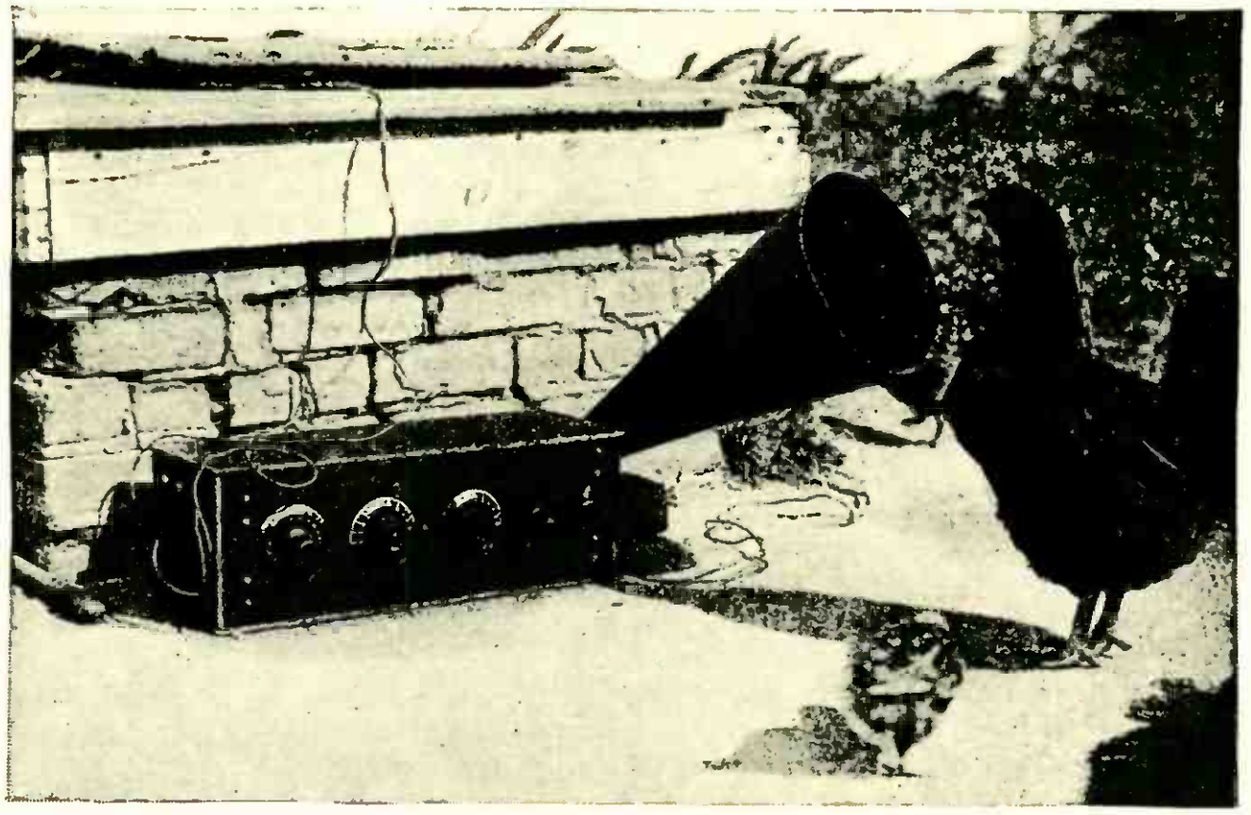
Fit your headphones to your head properly—and be surprised at the increased pleasure and comfort you get out of using them!

From a photograph made for POPULAR RADIO

BEND THE BANDS TO THE SHAPE OF YOUR SKULL

FIGURE 3: *It takes time to adjust the bands so that they touch all over your head evenly, but the increase in comfort is well worth the trouble.*

¶ *If, as the biologists tell us, electricity controls the protoplasmic cells of our bodies, it is possible, if not probable, that radio waves influence them—and us.*



DO BIRDS PERCEIVE RADIO WAVES THAT HUMAN BEINGS DO NOT?
Many indications point to the possibility that birds and other animals sometimes perceive vibrations that human senses are unable to detect at all. The great Japanese geologist, Omori, proved that pheasants can detect earthquake shocks so slight that men and women do not feel them.

Do Radio Waves Affect Living Creatures?

Scientists tell us that life is electrical. The tiny protoplasmic cells which make up all living creatures—including the human body—are fed, operated and regulated by electrical signals. In this article the author describes some of the remarkable recent experiments on these subjects and explains how the electromagnetic waves used in radio may affect these inmost secrets of life

By E. E. FREE, Ph.D.

IF radio waves affect the human body at all it is improbable that their action is on the brain or the nerves. It is much more likely to be on the digestion.

I do not mean the preliminary kind of digestion that takes place in the stomach and the other so-called digestive organs. This is not really going on inside the body at all. The digestive tract is really outside the body proper; the lining of the stomach is a variety of skin.

But there is a much more intimate and internal kind of digestion—or rather

a kind of *nutrition*—that is going on all the time inside every tissue of the body. This is the absorption by the single living cells of the food materials that are carried to them by the blood.

It is upon this less obvious but much more fundamental kind of digestion that the radio waves are most likely to have their biologic effects.

That the waves do have some kind of effect on the body has been a common idea ever since the phenomena of radio were discovered. Indeed, even before there was any knowledge of radio, many physicians expressed fears that the increasing use of electricity in modern life might increase nervous disorders or might work some other unexpected damage on mankind.

The fundamental basis of life is known to be intimately associated with electricity. Matter itself is electric; it is composed of positive nuclei and of negative electrons. That is the conclusion from modern theories of atoms.

Living matter shares this essential electric nature with all other kinds of matter. Furthermore, most of the normal functions of the body, if not all of them, are controlled and modified by electric changes. Nerve action is electric; the carriage of oxygen by the blood is an electrochemical process; sight and hearing involve, almost certainly, essential elements of electric charges and currents.

A distinguished American surgeon, Dr. George W. Crile of Cleveland, Ohio, reported last year to the International Congress of Surgery in London his

Gilliams

TESTING THE EFFECT OF ELECTRIC CURRENTS ON LIVING PLANTS

The treatment of growing plants with mild electric currents, either alternating or direct, may cause substantial increases in the rate of growth and in the yields of flowers, plant stems or seed, according to the Electroculture Commission of the British Government. The electricity is supposed to operate by affecting the absorption of food materials in the living cells in the plant roots or in other parts of the plant body.

conclusion that *all* important functions of the body were really no more than electric changes. Electricity controlled, he said, the difference between health and disorder, between life and death.

There is no dispute about this. The human body is really a delicate and complicated electrical machine; a machine far more sensitive than the most perfect radio receiver ever built. There would be no surprise, therefore, about a conclusion that the radio waves which now pulse so mightily and pervasively through the ether all around us were modifying in some fashion these mechanisms that we call men and women.

The question for the scientist is merely one of fact. Do the radio waves, in fact, have any perceptible influence on the human body?

The obvious and straightforward way to answer this question would be by direct experiment. Let us try it, you say, and see just what the radio waves do do.

Unfortunately this is more easily suggested than accomplished. The human body is not only a complicated machine; it is to a considerable degree a self-regulating one. It is subject to variations of its own causing. For example, suppose you sat some day for an hour or two with your head in a powerful radio-frequency field and suppose you acquired a fit of depression. That would not mean, necessarily, that the radio waves had depressed you. The trouble might have been some depressing thought that occurred to you, or some wrong food that you had for lunch or even the mere mental effect of sitting still for the time needed for the experiment when you would rather have been off playing golf.

When one sets out to experiment in any fashion whatsoever on the human body one undertakes a task of extraordinary difficulty. The thing you are experimenting with often takes a hand in the experiment. It is as though one of the condensers of your experimental hook-up suddenly began to vary all by itself because of some obscure intention of its own.

Furthermore, it is considered improper to experiment upon humanity, even upon yourself, in such fashion as might conceivably prove dangerous to life or to reason. This precludes many experiments that might be instructive if we could push them to the bitter end.

And so, on this really very important question of whether the prevalence of radio waves nowadays is disturbing the bodily organization of men or is upsetting their nervous systems or their mentality, we are reduced to making such inferences as we can draw from the known nature of our bodies or from experiments on lower varieties of living creatures.

The lower creatures that we can experiment with most easily are the vegetable ones, the growing plants. A number of experiments have been made on plants with radio-frequency waves and currents. Also some ingenious and instructive experiments have been made on the fundamental chemistry and electrochemistry of vegetable protoplasm. It is these fundamental experiments that lead me to the conclusion with which I began this article; the conclusion that if radio waves have any effect on the human body it is much more likely to be an effect on the nutrition of the living cells than on any secondary thing like the action of the nerves or of the brain.

All living creatures, ourselves included, are built up out of little balls or droplets of the same material, the material that scientists call protoplasm. Each tiny droplet is called a living cell. Inside each cell is the slightly cloudy, whitish jelly that is the protoplasm itself. Under the microscope it looks a good deal like uncooked white of egg.

This remarkable material is the seat and substance of life. How it works we do not know; the details of its chemical and physical constitution we do not know. But we do know that—to us, at

From a photograph made for POPULAR RADIO by Brown Brothers

HOW HIGH-FREQUENCY ELECTRIC FIELDS ARE APPLIED TO THE HUMAN BODY

The cabinet at the rear contains transformers and a rotary spark gap, operating to produce a powerful high-frequency current. The leather cover on top of the patient contains a metallic screen connected to one of the terminals of the oscillator; the other terminal is connected to a similar screen inside the upholstery of the couch. Thus the body of the patient is between two plates of a high-frequency condenser. This apparatus was designed by Mr. S. N. Baruch of New York City.

least—it is the most important substance in the world. It is the substance of ourselves.

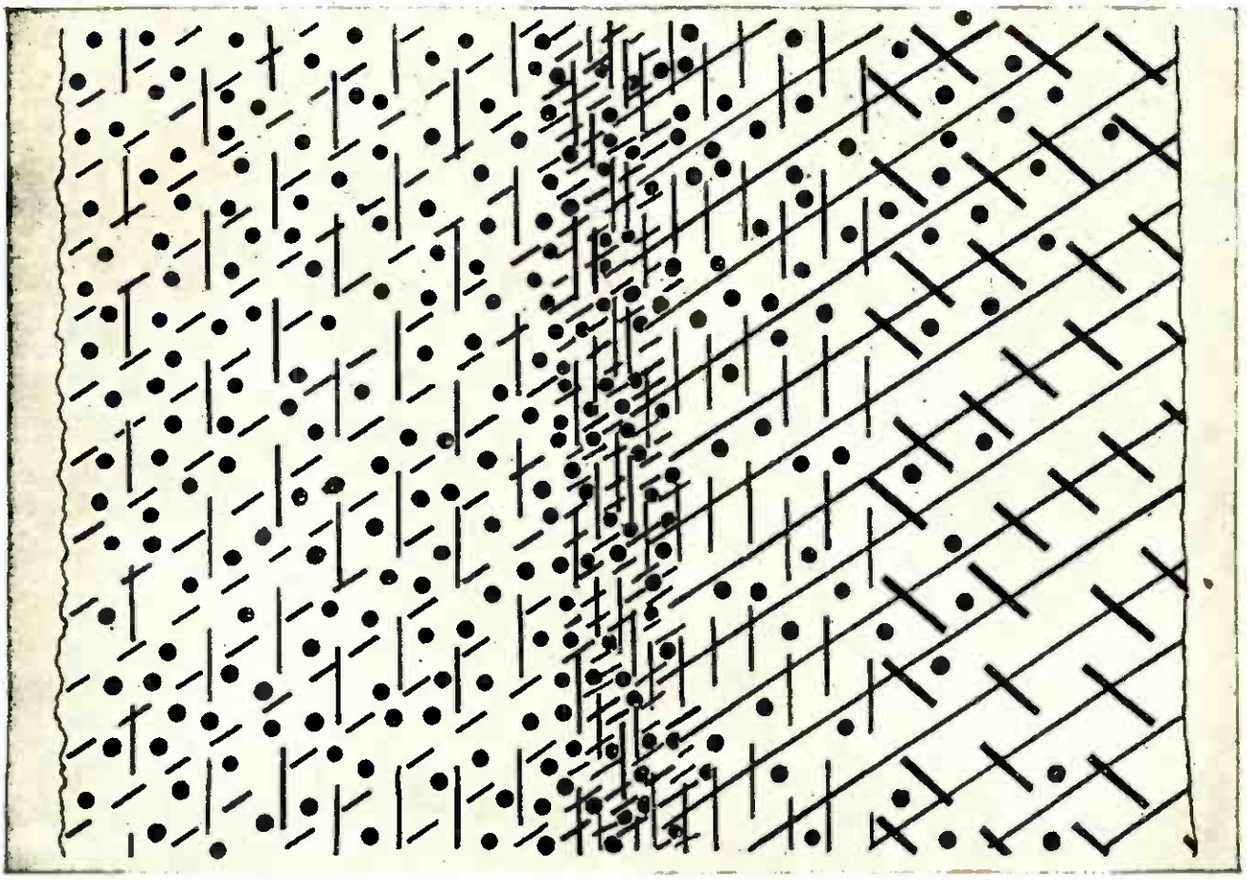
We know, too, that this protoplasm is essentially electric in its behavior. At the last meeting of the American Philosophical Society Dr. D. T. MacDougal, one of the most distinguished American biologists, described a long series of experiments with his "artificial plant cell."

What Dr. MacDougal has done constitutes, in my opinion, one of the most important steps ever taken in the search for the great secret of life.

First, he studied real protoplasm very carefully. He examined its chemical nature and its physical behavior under a great number of conditions. Then, he set out to imitate it. He took non-living materials, the nature of which he knew perfectly, and he put these materials together in such a way, he thought, as might simulate more or less perfectly the nature of the real, living protoplasm of plant or animal bodies.

He succeeded. He has built himself an artificial piece of apparatus which resembles very closely in its behavior the behavior of a real living cell, like, for example, the cells in the rootlets of a tiny, growing wheat plant.

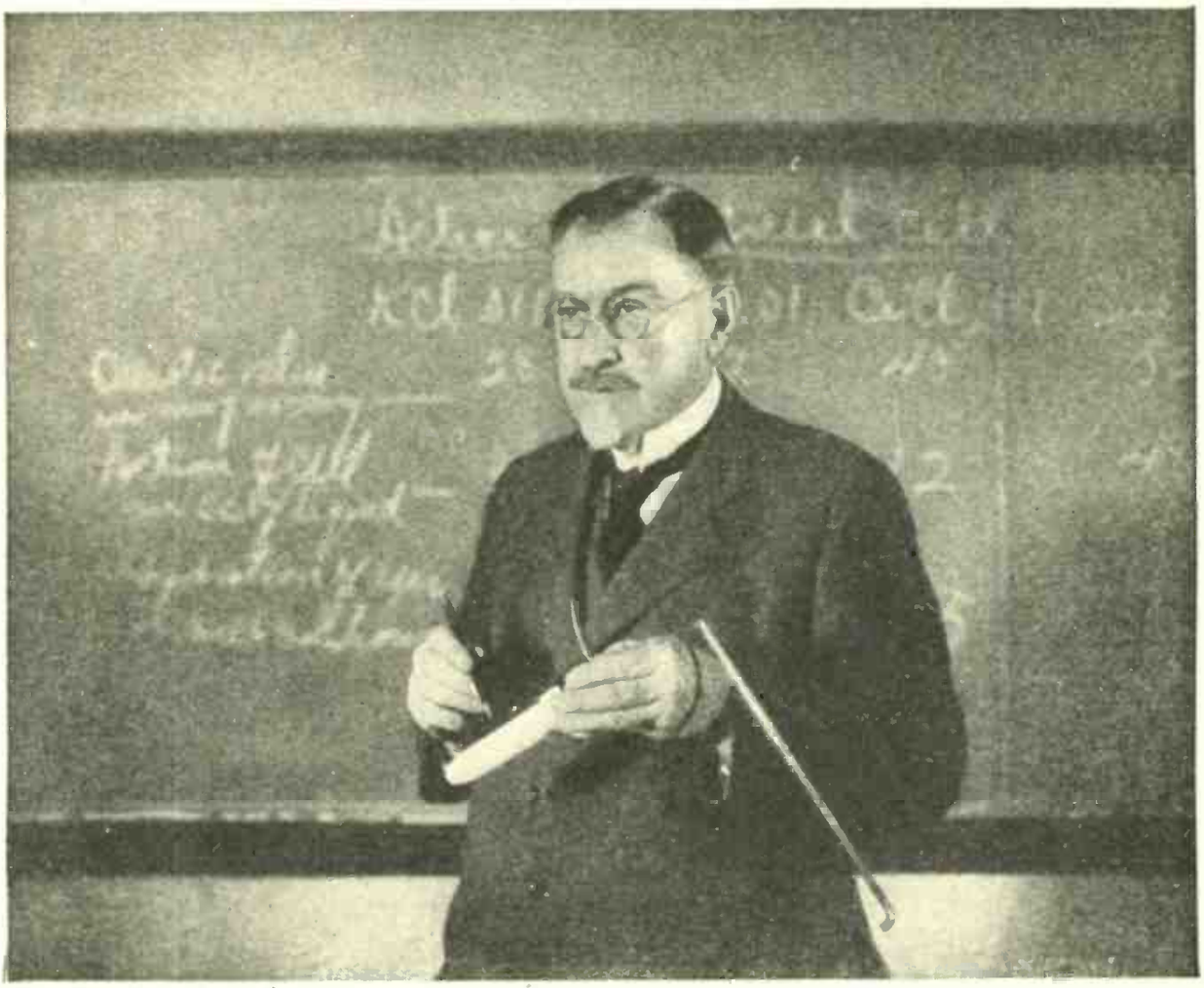
Of course, he has not created life. He was not trying to do that. The object was merely to construct a known and understandable apparatus that would reproduce what the living cells of plant



From a diagram loaned by Dr. D. T. MacDougal

THE TREMENDOUS COMPLEXITY OF A LIVING CELL

This diagram (exhibited by Dr. D. T. MacDougal before the American Philosophical Society) shows his conclusions concerning the different chemical substances which make up the surface layer of a living cell plant. The long slanting lines indicate fibers of the woody material called cellulose; the short slanting lines indicate glue-like materials called pectins (slanting downward to the right) and mucilages (downward to the left). The vertical lines indicate the meat-like substances called proteins. The round dots indicate fatty materials. All these substances, with the possible exception of the cellulose, are affected by electric charges. This is only the outer wall of the cell; still more complex materials exist inside the cell body.



Carpenter-Goldman Laboratories

THE SCIENTIST WHO DUPLICATES THE BEHAVIOR OF LIVING MATTER

This picture, taken during Dr. MacDougal's lectures at Columbia University last year, shows in the doctor's hand the "artificial plant cell" with which his remarkable experiments were carried out. The form of the cell has been improved subsequently but it still resembles the one shown here.

roots are known to do. This might enable us, the doctor believed, to guess more accurately at what the real root cells are like and at how they accomplish their jobs.

It did enable us to do this. And the answer, as before, comes back to electricity.

The essential duty of a plant root is to take up the food materials of the plant from the soil. That is, it is an organ of *absorption;* it absorbs the food. Now these food materials of plants are mainly the atoms of certain chemical elements; potassium, for example, commonly known as "potash." This potash is one of the things used in artificial fertilizers.

And so, one property of the protoplasm in plant roots that is a very important property for the plant is the ability to absorb potassium atoms out of the soil, while rejecting the atoms of other elements, as, for example, the atoms of sodium and calcium which are always present at the same time. The protoplasm is not only an absorber, it is a *selective* absorber.

At the door of the tiny living cell there stands some kind of a watchman. When an atom of potassium comes along the watchman lets this atom in. But, when an atom of some other element that the plant does not need tries for admittance, the watchman is ada-

mant. No useless atoms can come in.

This ability to absorb what it needs and to reject what it does not need is so important to the whole world of living matter that this was one of the first things that Dr. MacDougal set out to study with his artificial plant cell. He found that the cell did duplicate to a considerable degree the behavior of the real root. This non-living device, with no real protoplasm about it at all, absorbed the same things that protoplasm absorbed and rejected the things that protoplasm rejected.

This disposed, of course, of any idea that the selective absorbing power of protoplasm was some mysterious "living" function. The secret was merely an electric action. In solution in water the atoms of potassium, as of most other substances, are electrically charged. These charges affect the absorption or non-absorption of the atoms.

The details, of course, are quite complicated. Many of them have not yet been worked out to Dr. MacDougal's satisfaction. But the main meaning of the investigation is already quite plain. It is, that electricity controls the absorption of food atoms by the roots of plants. The watchman that stands at the door of each little living cell asks the approaching atoms only one question: "What kind of electricity have you got and how much?"

Now this work with plant roots and artificial cells is not so far away from the human body and from radio as you might imagine. The cells of our own body have to absorb things just as the plant cells do. Even the element potassium, the same one that the plants need, is a constituent of human blood and is passing back and forth all the time between the blood fluid and the various living cells of our body.

Consider, for example, a single, living cell in the muscle of your arm. This cell is a tiny elongated fiber. It has the power to contract. The contraction of all the millions of fibers in your arm muscles is what shortens the muscle and moves your arm.

And this tiny muscle fiber, like all other living cells, has to be fed. Like the living cell in the plant root it must absorb the potassium atoms and whatever other atoms it needs from the liquid that surrounds it. In our body this liquid is the blood.

And so, there exists, you see, inside this body of ours exactly the same mechanism that is so important in plant roots and that has been duplicated, more or less perfectly, by Dr. MacDougal's artificial cell. This is the mechanism of selective absorption: the ability of a cell to take up what it needs and to reject what it does not need.

Nor can there be the slightest doubt that this mechanism in our body cells, just as in the plant cells and in Dr. MacDougal's artificial one, is an electric mechanism. Indeed, it is possible to attach a delicate galvanometer to a muscle and to show that when the muscle contracts a pulse of electricity is produced. Conversely, a pulse of electricity of the right kind and amount will make the muscle contract. That is what happens when you get an electric shock. Your muscles contract suddenly and you give an involuntary jerk.

All living cells, then, including the cells of our muscles and blood and heart and brain, are controlled by electricity. The mechanism of this control is extremely delicate. The tiny quantity of electricity that is carried by a single atom is sufficient to open or shut the door of the cell against that atom and its companions.

It is not only probable but almost certain that Dr. Crile is right in ascribing most of the disorders of health to some derangement of this electric mechanism for cell control. The damage that can be worked by a bad battery in your radio receiver is as nothing compared with the damage that a small electric derangement can cause in some organ of your body.

Gilliams

ONE KIND OF ETHER WAVES THAT PERCEPTIBLY AFFECT PLANTS

Light consists of ether waves, like radio waves, but shorter, and light is the very life-blood of the plant kingdom. In the recent greenhouse experiments shown here the rate of growth of the plants was more than doubled by exposing them to electric light between 8 P.M. *and 1* A.M. *each night.*

Now radio waves are extremely good at causing electric changes. There is no need to prove this to a radio fan. And, if powerful radio waves are coursing through your body, it is quite probable that they will have some effect on this fundamental process of the absorption of food materials and of other things by the living cells of muscle, of blood, and of the various organs.

The surprising thing, indeed, is that the waves do not produce more marked effects; effects which would have been unmistakable long ago. The reason is, probably, that the electric mechanism that regulates cell absorption possesses a good deal of automatic stability. There has been invented, you know, an automatic stabilizer for airplanes. A man can crawl out on the wing of the plane

clear to its tip and the ship will still keep an even keel. The stabilizer does it.

And, what man can do, Nature usually can do still better. There is probably something about that imaginary watchman who stands at the door of each tiny cell that prevents his being upset by radio waves that come along and change the electric conditions around him.

But that these conditions *are* changed somewhat and that the watchman *is* affected, at least a little, is indicated by the experimental work on the effect of electric currents and waves in increasing the growth of plants. There exists in England an official governmental committee on what is called electroculture, which is the possibility of using electricity to increase the growth of crop plants much as we now use fertilizers.

The work of this committee, directed mainly by the distinguished plant physiologist, Dr. V. H. Blackman, as well as much work that has been done elsewhere in the world on the same problem, indicates that there undoubtedly occurs under some conditions a noticeable increase in the growth of the electrified plants. As yet, this effect is erratic. We do not know enough about it to make it controllable or useful practically.

But from our present viewpoint the important thing is this. Electric changes do affect plant protoplasm practically, just as the theory of the thing and the operation of Dr. MacDougal's artificial cell agree in indicating what these changes ought to do.

It is very probable that similar effects occur inside the body of man. High-frequency electricity has been employed by physicians to cure various bodily ills, especially hardening of the arteries and high blood pressure. The results do not seem to be very conclusive. But it is difficult to secure conclusive results on a machine so variable and complicated as we are. That will come in time.

What all this means seems to me to be this. It will be a mistake to seek a direct effect of radio waves on thought processes or even on the action of the nerves. Such effects may occur but they are likely to be secondary.

The primary effect, the first and most important thing that electric changes of any kind—including radio waves—are likely to do to living matter, is to alter its nutrition or, as I said before, its "digestion." We remember, of course, that the kind of digestion referred to is the absorption of food materials by each little living cell; not the grosser, external kind of digestion that occurs in the stomach and its accessory organs.

If we want to investigate the effects of radio waves on living matter the best way to do so is with fundamental experiments on simple mechanisms like single, living cells or like the cells of plant roots; better still, probably, on devices like Dr. MacDougal's artificial cell.

And, if I were to look nowadays for effects of radio waves on the bodily aspects of humanity, I would not bother with any supposed nervousnesses or brain disorders or mental delusions. I would look instead for disturbances of the internal bodily nutrition. I would scrutinize such things as loss or gain of weight, as the amount and quality of the blood—evidenced, for example, in rosiness or paleness of cheeks—as improvement or decrease of muscular strength.

If radio waves bother us (or improve us) at all they will do so, I believe, by altering the feeding habits of the little cells of which our bodies are composed; not by upsetting our brains.

Traffic Regulation by Radio

THE *enormous increase in vehicles in American cities during the past two or three years has presented a new problem to the city authorities. How radio may be used to solve it will be told in a coming issue of* POPULAR RADIO.

From a photograph made for POPULAR RADIO

HOW THE DETECTOR-AMPLIFIER IS HOOKED UP

Dr. Bickelhaupt has obtained excellent results with the single-layer coils on amateur and the shorter broadcasting wavelengths. Note how he connects the detector-amplifier with the multi-wave tuner which he described in the September number of POPULAR RADIO.

HOW TO BUILD A DETECTOR-AMPLIFIER

PART II

Here is an exceptionally interesting piece of radio apparatus that is equally useful for regular reception and for experimental work on tuning circuits. It is easy to build and may be used with any of the ready-made tuning units on the market or with the multi-wave tuner described in POPULAR RADIO for September

By B. S. BICKELHAUPT, M.D. (2CBA)

COST OF PARTS: *About $30.00*

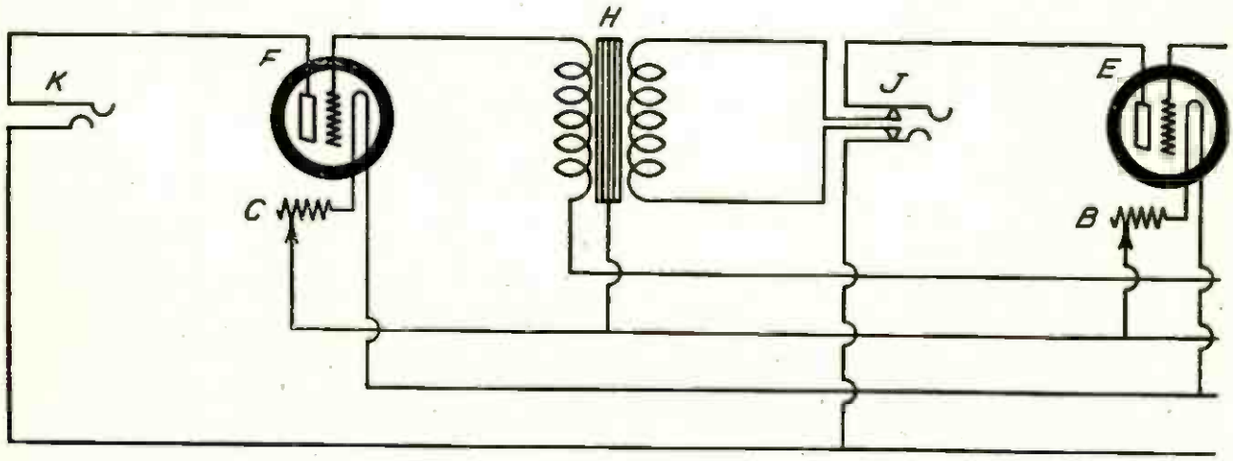
HERE ARE THE ITEMS YOU WILL NEED—

A—Pacent rheostat, 6 ohms;
B and C—Pacent rheostats, 30 ohms;
D, E and F—Na-ald standard vacuum-tube sockets, No. 400;
G and H—Modern transformers, 4 to 1 ratio;
I and J—Federal jacks, double-circuit;
K—Federal jack, single-circuit;
L—Dubilier mica fixed condenser, .00025 mfd., with grid-leak clip;
M—Daven tubular grid-leak, 3 megohms;
N—brass right-angle brackets;
O—composition panel, 7 by 15 inches;
P—hardwood baseboard, ½ by 7 by 14¼ inches;
Q—standard 7 x 15 inch cabinet;
10 Eby binding posts, bus-wire, screws, etc.

REGARDLESS of the type of tuning circuit the radio fan uses, his complete outfit almost invariably includes a detector and some form of amplifier operating at audio frequencies. The tendency of the amateur set builder these days is to make the whole radio receiver a complete unit in one cabinet, but there is much to recommend the practice of arranging the detector and amplifier

THE ELECTRICAL WIRING DIAGRAM

FIGURE 1: *This drawing shows the correct way to hook up the various instruments and parts in the circuit so that they will all function properly. Notice that the diagram is drawn from* RIGHT *to* LEFT, *so that the wiring is shown exactly as it goes into the detector-amplifier.*



circuits in a cabinet separate from the tuner. For the man who is doing any considerable amount of experimental work, this construction is particularly good because it permits all kinds of tests to be made on the tuning unit without disturbing the detector-tube wiring or the audio amplifier.

If the experimenter desires to try out some other form of tuning circuit, the instruments that comprise the circuit to be tested need only be hooked up on a board, connections made to the four binding posts of the detector and two-stage amplifier, and the test conducted with the assurance that there can be nothing wrong with the part of the receiver that is in the cabinet.

In this article will be described a three-tube cabinet unit with the first tube as a detector and the other two tubes giving two stages of transformer-coupled, audio-frequency amplification.

The arrangement of the binding posts is such that the multi-wave tuner described in last month's article can be connected to the detector and two-stage amplifier with short pieces of bus-wire between the posts that come opposite each other when the two cabinets are set side by side.

The grid condenser and grid-leak are mounted with only a half-inch connecting lead to the grid terminal of the detector-tube socket and the grid-leak is of the tubular type, held by clips, so that other leaks of different values of resistance can be substituted.

The transformers are mounted with the cores parallel to each other, as this helps in making a neat wiring job and there is little coupling between them, because both are shielded. If some of the other styles of transformers are used, it would probably be desirable to set them with the cores at right angles.

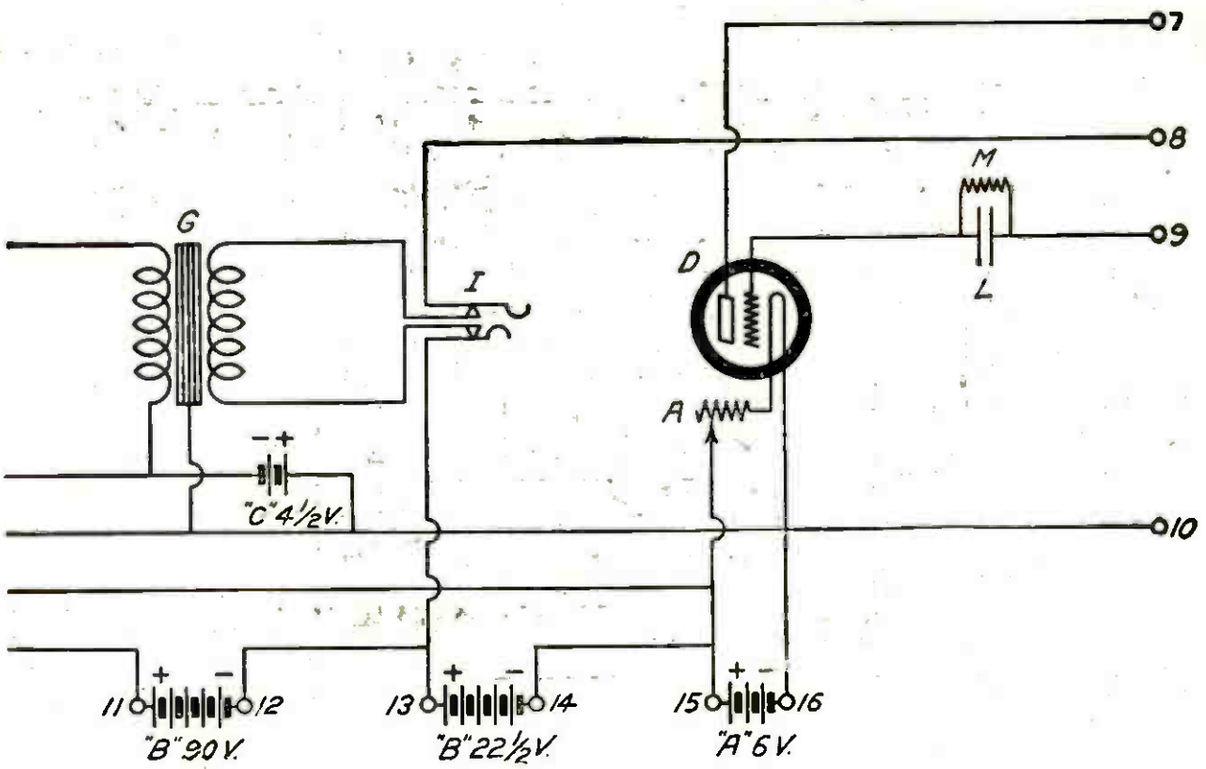
Note the provision for the "C" battery *within* the set. This is a good idea, because it saves two binding posts and simplifies the wiring.

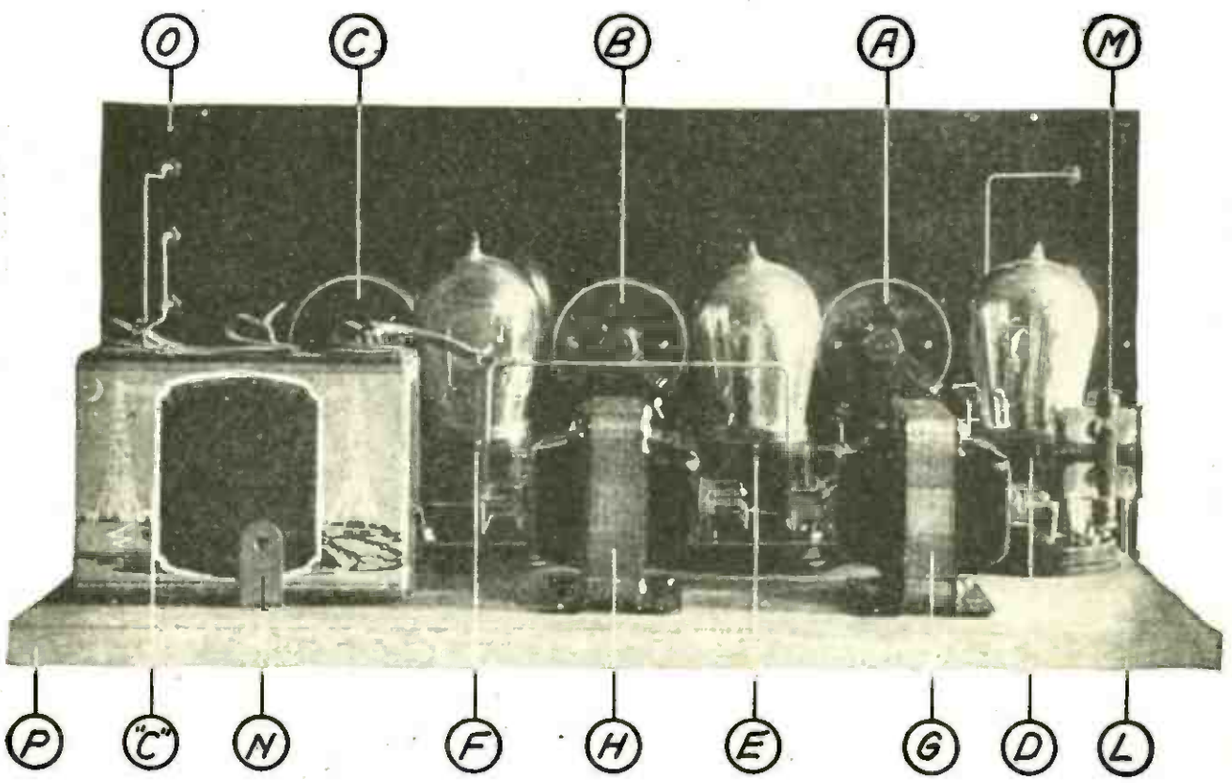
The electrical wiring diagram is shown in Figure 1.

The Parts Used in Building the Amplifier

In all the diagrams in this article each part bears a designating letter. In this way the prospective builder of the amplifier may easily determine how to mount the instruments in the correct places and connect them properly in the electric circuit. The same designating letters are used in the text and in the list of parts at the beginning of the article.

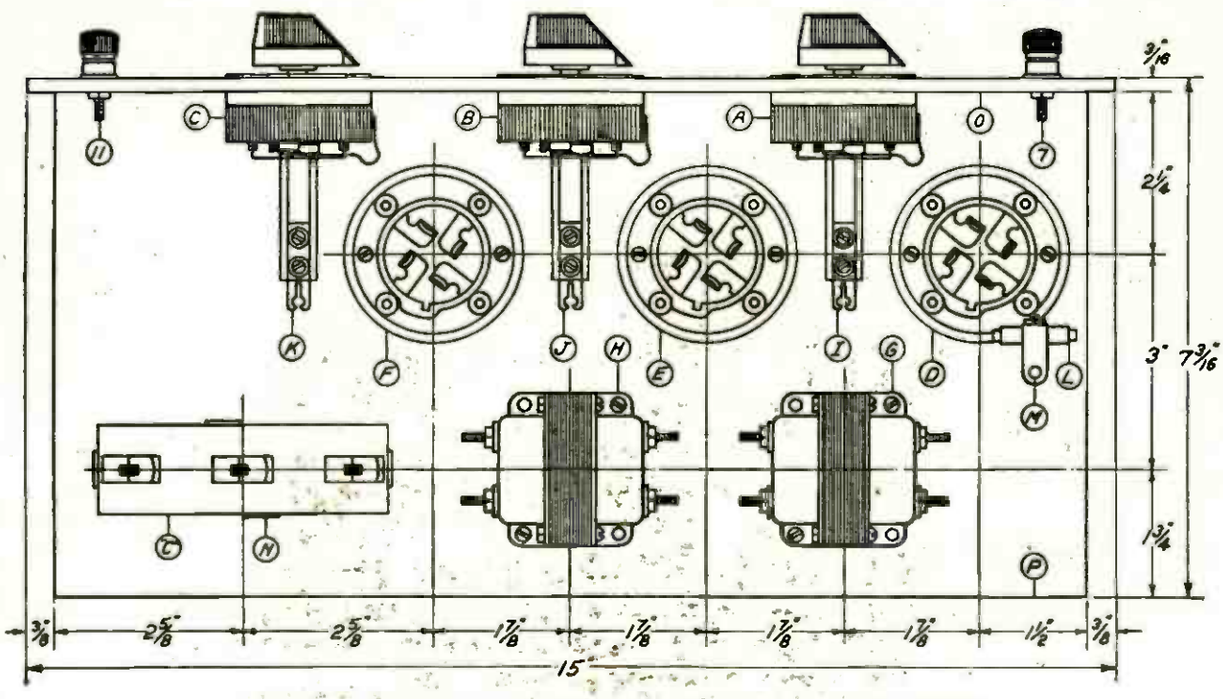
¶ *The list of parts there given includes the exact instruments used in the set from which these specifications were made up; however, there are many other reliable makes of instruments which may be used in the set with equally good results.*





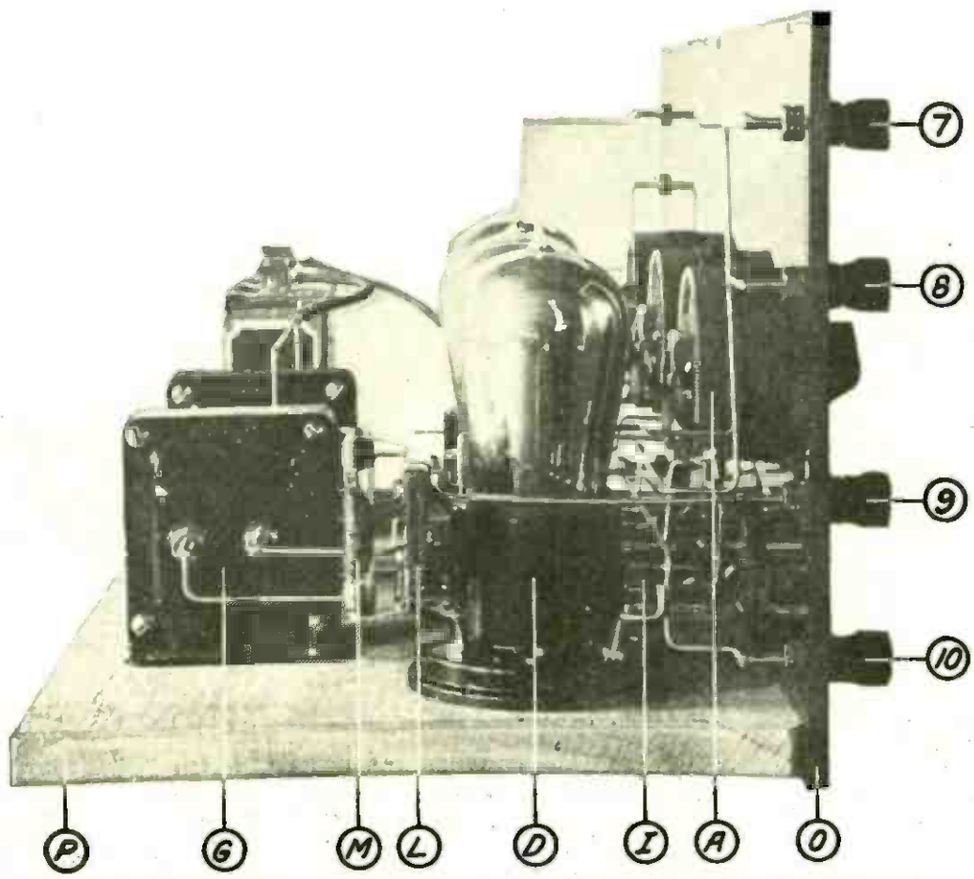
VIEW OF THE DETECTOR-AMPLIFIER FROM THE REAR

FIGURE 2: *This illustration shows the arrangement of the instruments on the panel and the base. The exact locations of the instruments are given in Figures 3 and 6.*



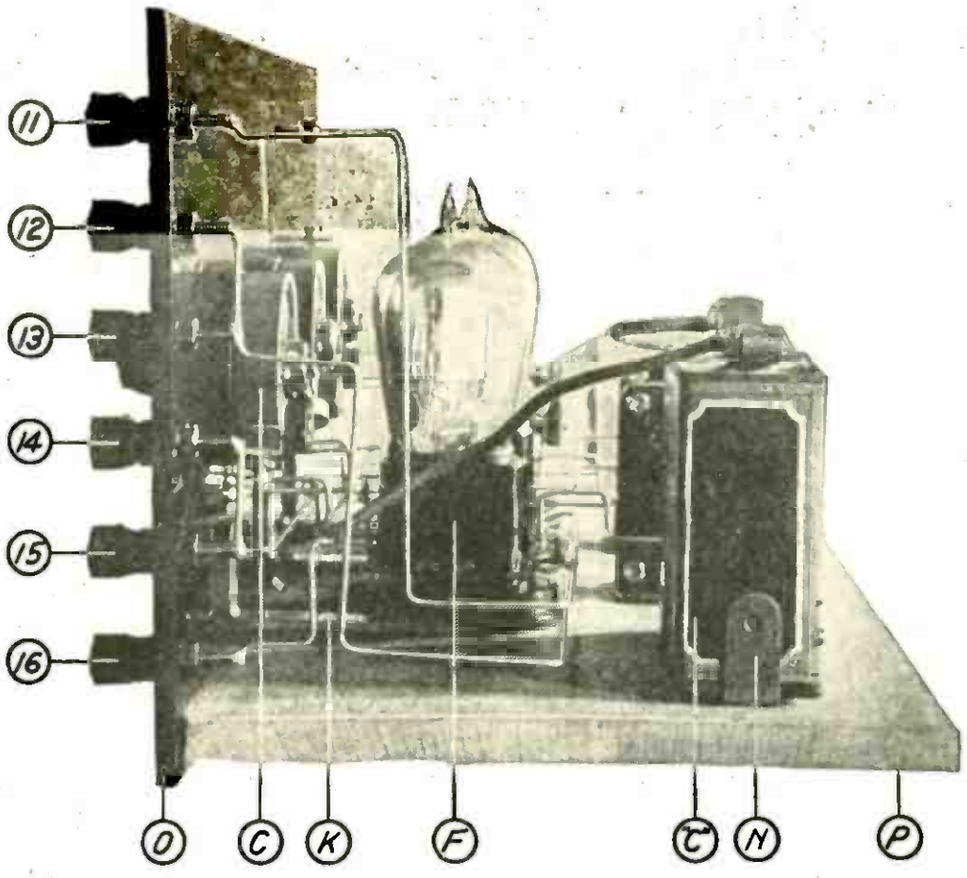
THE WORKING DRAWING FOR CONSTRUCTION

FIGURE 3: *Here are shown the exact positions for the various instruments. All the parts are designated by letters which reappear in the text and in the list of parts.*



THE DETECTOR-AMPLIFIER, AS SEEN FROM THE LEFT

FIGURE 4: *This illustration shows the detector-tube socket, the grid condenser on which are mounted clips for the grid-leak, and the binding posts to connect the detector-amplifier to the tuning unit.*



THE DETECTOR-AMPLIFIER, AS SEEN FROM THE RIGHT

FIGURE 5: *Here is shown the "C" battery, the rheostat and the socket for the tube that gives the second stage of amplification. Note the flexible wires that connect the "C" battery. They make it easy to change the "C" voltage quickly and to replace the "C" battery without resoldering the wires.*

If instruments other than the ones listed are used, it will necessitate only the use of different spacing of the holes drilled in the panel for mounting them.

How to Construct the Detector-amplifier

After procuring all the instruments and materials for building the detector-amplifier unit, the amateur should set about preparing the panel (shown in Figures 2, 3, 4, 5 and 6).

First of all, the panel should be cut to the correct size, 7 by 15 inches.

Then, the edges should be squared up smoothly with a file. The centers for boring the holes (which are necessary for mounting the instruments) should be laid out on the panel, as shown in Figure 6.

The holes outlined here with a double circle should be countersunk, so that the flat-head machine screws used for fastening the instruments will be flush with the panel. All the rest of the holes in this panel are straight drill holes. Sizes for the diameter of these holes have not been given, but the builder will readily decide what size hole is necessary by measuring the size of the screws and shafts of instruments that go through the holes.

When the panel is drilled, it may be given a dull finish by rubbing lengthwise with smooth sandpaper until the surface is smooth, then the same process should be repeated except that light machine oil should be applied during the rubbing. The panel should then be rubbed dry with a piece of cheese-cloth, and a dull permanent finish will be the result. Or the panel may be left with its original shiny-black finish, if care is exercised so that it is not scratched during drilling.

After the panel has been made ready, the baseboard should be cut to size and finished with sandpaper to remove the sharp edges. Now, mount the panel on the baseboard with the three screws at the bottom of the panel.

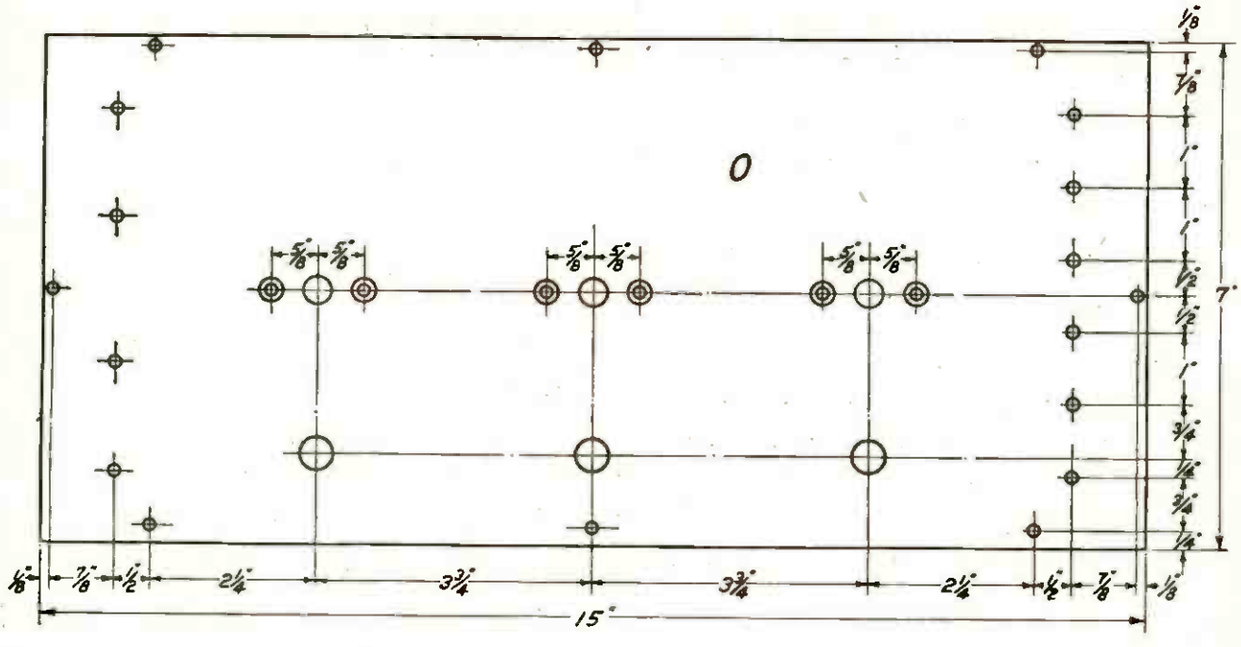
Next, the three rheostats, A, B and C, should be fastened to the panel O, in their respective places with the 5-ohm rheostat at the right end (as seen from the rear). The binding posts can now be screwed up tight and the three jacks, I, J and K, attached to the panel, taking care to place the single-circuit jack K at the left (as seen from the rear). This completes the work on the panel. Now screw the sockets D, E and F, and the transformers G and H, to the baseboard, as shown in Figure 3, being careful to place the transformers with the terminals marked "PRI" to the right (as seen from the rear). The mechanical work is now complete with the exception of fastening the brass right-angle brackets, which hold the "C" battery to the baseboard.

How to Wire the Detector-amplifier

Wiring this set is easy, as there is plenty of room to work, but it is advisable to study the wiring diagram, Figure 1, with the set in front of you and plan out the simplest and shortest way to run each connection. It will be found best to wire up the filament-lighting circuit first. The longest connections should be made first in order to avoid having to bend a number of kinks in any wire except the short ones. Binding posts 10, 15 and 16, the center and left terminals (as seen from the rear) on the three rheostats and the terminals on the sockets nearest the panel constitute the filament circuit. Now, connect up the grid circuit which runs from binding post 9 to the grid condenser and from the other side of the grid condenser to the socket. This part of the wiring is particularly important and it is well to note how the connections should be made, as shown in Figure 4. Next, comes the plate circuit, consisting of binding posts 7 and 8, the plate terminal of socket D, jack I, the primary terminals of transformer G and binding post 13. The wire running from the lower terminal of jack I to binding post 13 can be continued on and connected to binding post 12 also. Now, connect the grid terminal of socket E to terminal marked "G" on transformer G. The terminal on the secondary side of transformer G, which is nearest the panel, should be connected to the same terminal on transformer H and a piece of flexible wire soldered on to this wire which can be clipped on to the negative terminal of the "C" battery. Another piece of flexible wire from the filament connection near binding post 16 and clipped on to the positive terminal of the "C" battery completes the secondary circuit of the transformer G. Next, connect up the primary circuit of transformer H, consisting of the plate terminal of socket E, jack J and the primary terminals of the transformer. Binding post 11 can now be connected to the bottom terminal of jacks J and K. This leaves two more wires—the one that connects the grid terminal of socket F to the grid terminal of transformer H and the wire that goes from the plate terminal of the same socket to the upper terminal of jack K.

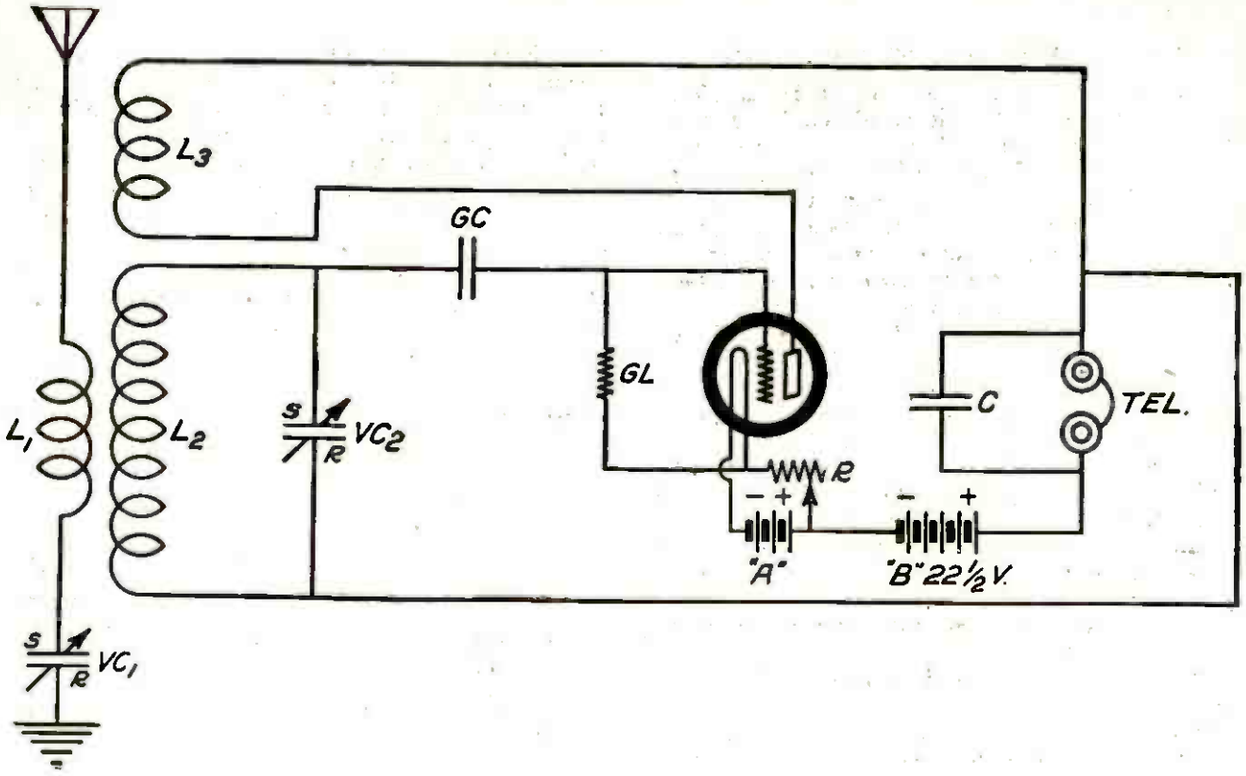
While this detector-amplifier can be used with any tuner, it is designed to match up with the multi-wave tuner described in last month's article. The photograph on page 361 shows the way to connect up the two units. The antenna and ground wires are connected to the two binding posts at the left of the tuner (as seen in photograph on page 361), the two units are connected by straight pieces of bus-wire between the four terminals that come opposite each other, and the batteries are connected to the six terminals at the right of the detector-amplifier. (See the wiring diagram in Figure 1.)

The detector amplifier will give best results with a UV-200 or C-300 in the detector socket and UV-201-a or C-301-a tubes in the other two sockets.



THE DRILLING PLAN FOR THE PANEL

FIGURE 6: *This drawing shows where to drill the holes for mounting the instruments. The holes outlined with a double circle should be countersunk so that the heads of the screws will be flush with the surface of the panel.*



THREE-CIRCUIT TUNER FOR SHORT-WAVE RECEPTION

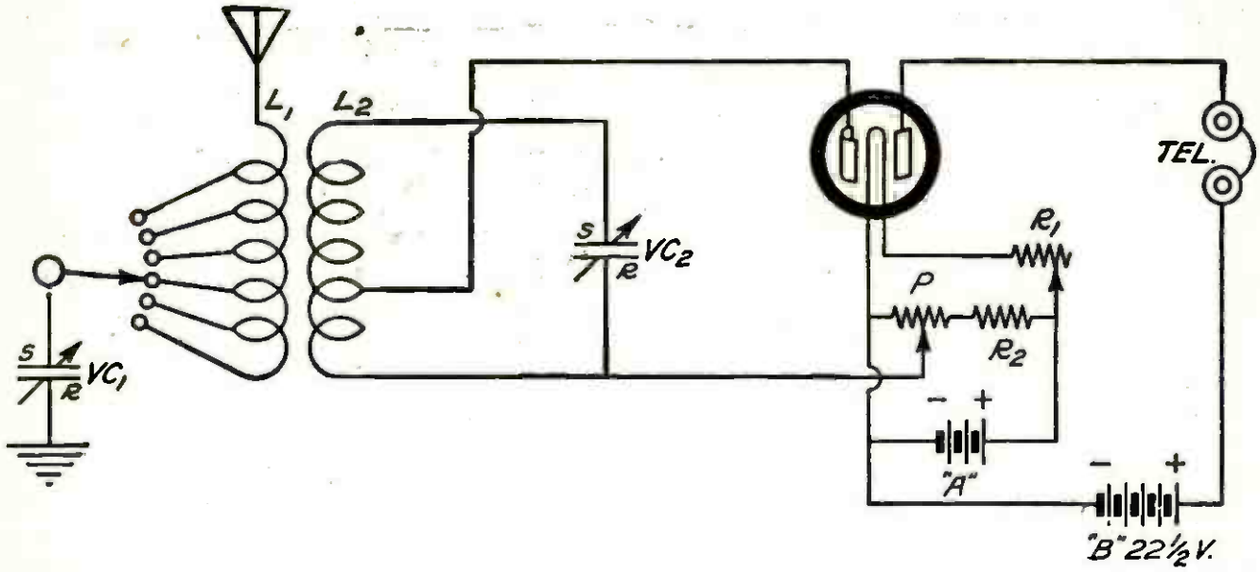
Cost of parts: Not more than $27.00.
Selectivity: Very good.
Operation: Not very hard to tune when the operator has worked with the set for a week or so.
Construction: Not difficult to make.*
Approximate range: 500 miles for telephony; 1,000 miles for CW reception.
Outstanding features: For work below 200 meters. For short-wave broadcast reception and amateur CW reception.

*(See POPULAR RADIO, August, 1924, page 183, for constructional details.)

100 BEST HOOK-UPS

INSTALLMENT NO. 11

THIS last installment of the series includes a number of receiving circuits that are particularly interesting both to the amateur who wants to do experimental work as well as to the radio fan who is looking for a circuit that will suit his own requirements. The range given in each case is only approximate, as no receiving set will give *exactly* the same results when used in two different locations. A relatively simple outfit in a good location may often receive at much longer ranges than the most sensitive set made if the latter is located where natural conditions are bad for the reception of radio waves.

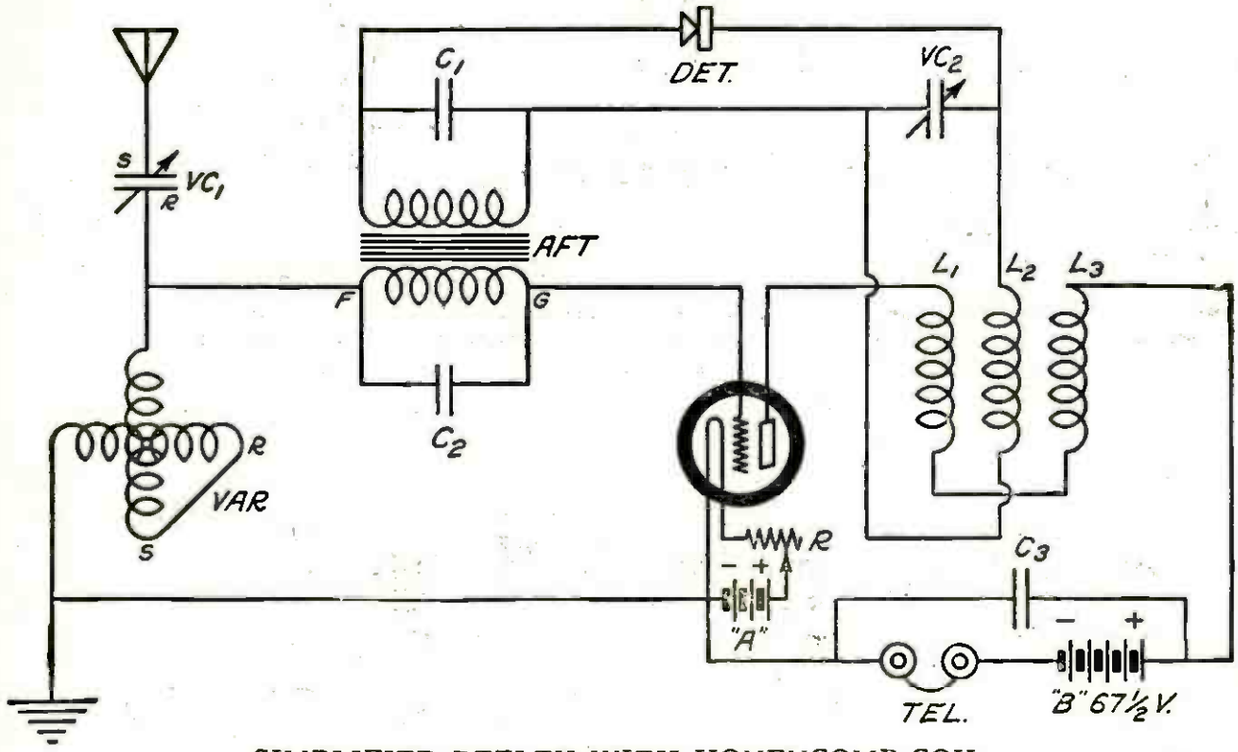


NON-REGENERATIVE CIRCUIT FOR THE SODION TUBE

Cost of parts: Not more than $26.00.
Selectivity: Good.
Operation: Fairly simple.
Construction: Simple to make.*

Approximate range: 500 miles.
Outstanding features: Cannot radiate. Maximum sensitivity without regeneration. Good reproduction of voice and music.

(See POPULAR RADIO, June, 1924, page 607, for constructional details.)

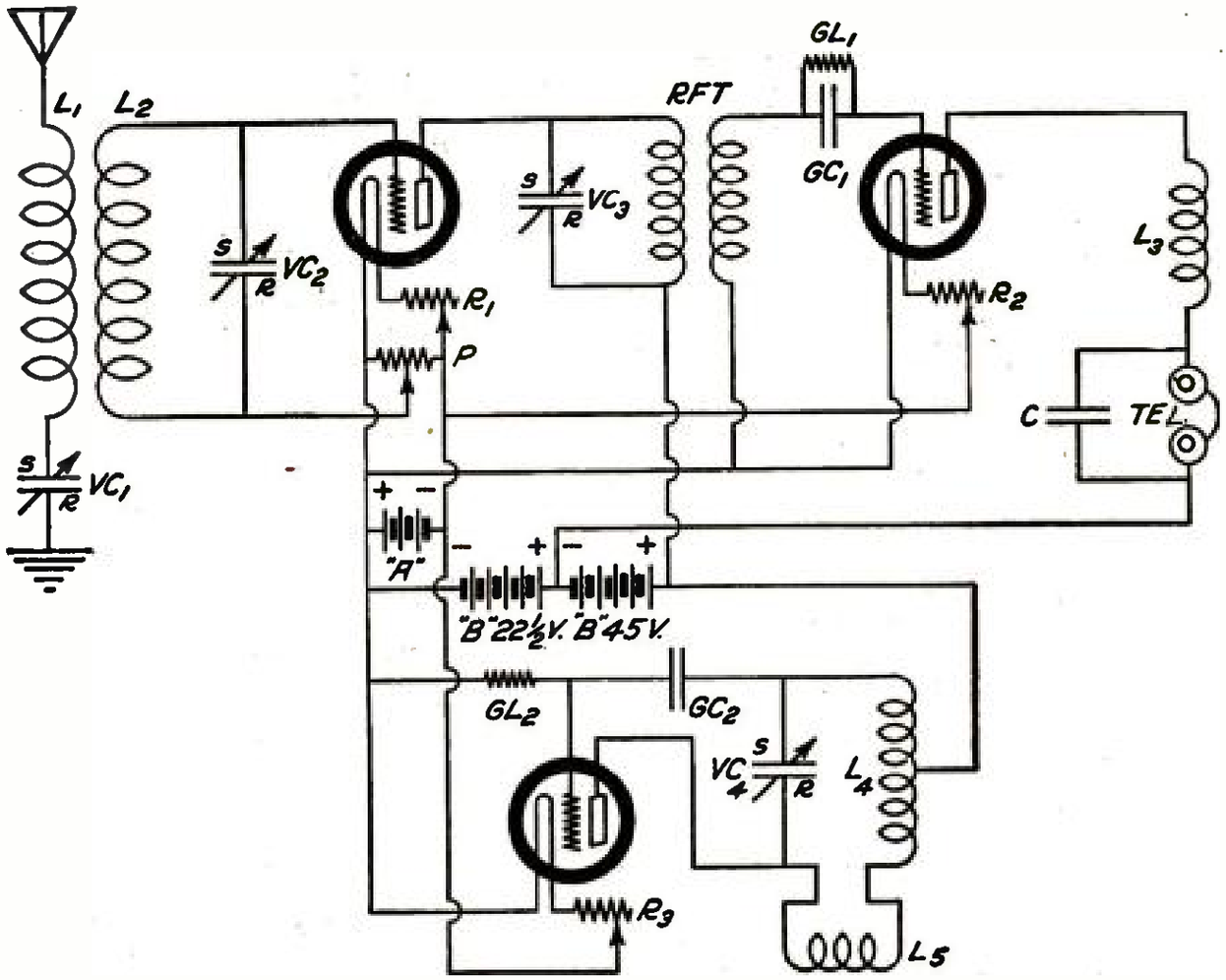


SIMPLIFIED REFLEX WITH HONEYCOMB-COIL, RADIO-FREQUENCY COUPLING

Cost of parts: Not more than $45.00.
Selectivity: Fair.
Operation: Rather difficult.
Construction: Some experience in making sets should be had before attempting construction.*

Approximate range: 1,000 miles.
Outstanding features: Will operate a loudspeaker on local stations. Incorporates one stage of radio-frequency amplification and one of audio with only one tube.

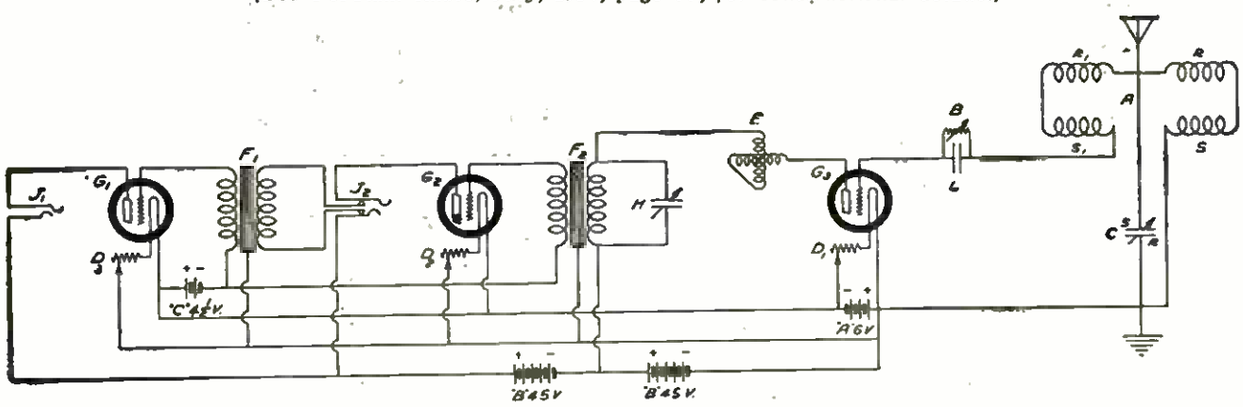
(See POPULAR RADIO, July, 1924, page 105, for constructional details.)



ONE STAGE OF TUNED-RADIO-FREQUENCY, VACUUM-TUBE DETECTOR, WITH SEPARATE HETERODYNE FOR CW RECEPTION

Cost of parts: Not more than $50.00.
Selectivity: Excellent.
Operation: Difficult to tune.
Construction: Only the experienced radio experimenter should try to build this receiver.*
Approximate range: 1,500 to 2,000 miles for CW.
Outstanding feature: Excellent for reception of continuous-wave telegraphy.

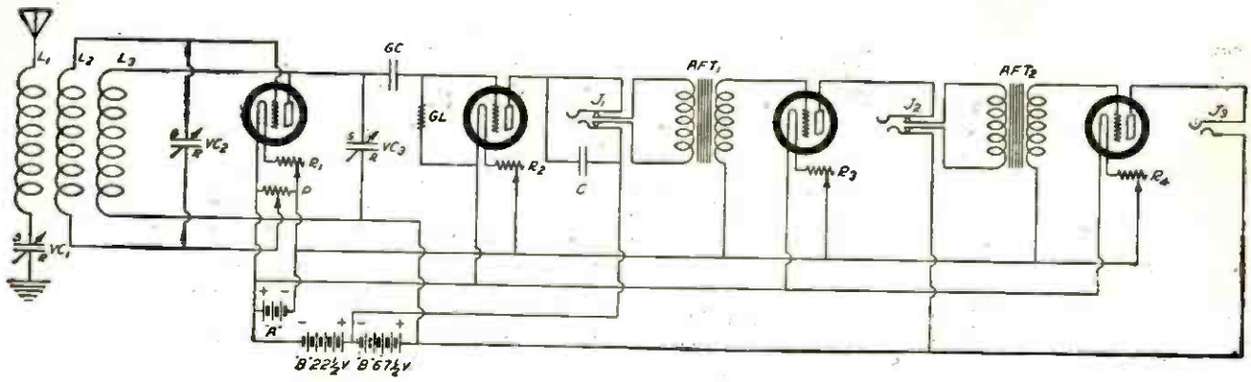
(See POPULAR RADIO, July, 1924, page 77, for constructional details.)



THE TOBIAS CIRCUIT FOR RECEPTION WITH AN INDOOR ANTENNA

Cost of parts: Not more than $55.00.
Selectivity: Excellent, if used on a short antenna.
Operation: Not hard to tune, once the mode of adjustment has been thoroughly learned.
Construction: No more complicated than other types of regenerative circuits.*
Approximate range: 1,200 miles.
Outstanding feature: Operates on a short indoor antenna with results about equal to the ordinary regenerative receiver used on an outdoor one.

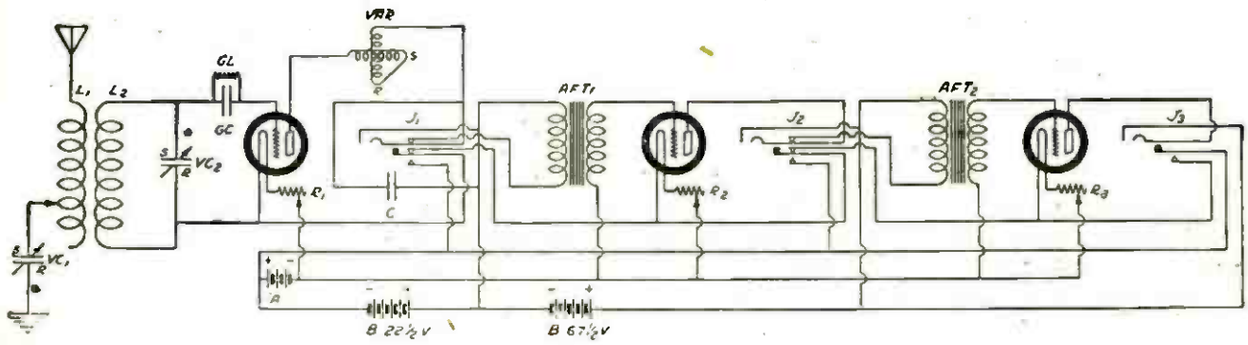
(See POPULAR RADIO, June, 1924, page 567, for constructional details.)



ONE STAGE OF TUNED-RADIO-FREQUENCY AMPLIFICATION, VACUUM-TUBE DETECTOR AND TWO STAGES OF AUDIO-FREQUENCY AMPLIFICATION EMPLOYING HONEYCOMB COILS FOR TUNING

Cost of parts: Not more than $46.00.
Selectivity: Good.
Operation: Fairly complicated.
Construction: Not easy to build.*
Approximate range: 2,400 miles.
Outstanding features: With few additions, this set can be made from the standard triple-coil hook-up. It is good on distance reception.

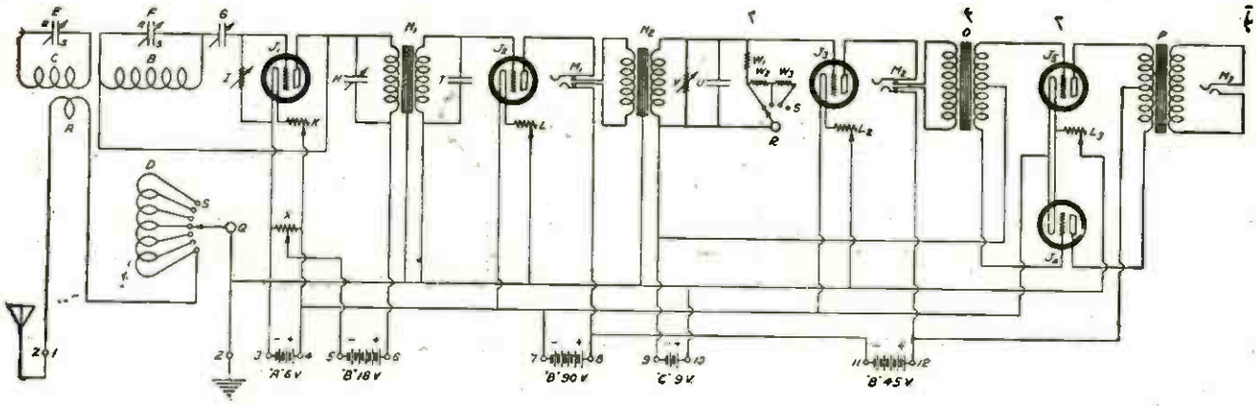
*(See POPULAR RADIO, *July, 1924, pages 78-9, for constructional details.)*



REGENERATIVE RECEIVER WITH TWO STAGES OF AUDIO-FREQUENCY AMPLIFICATION, EQUIPPED WITH AUTOMATIC FILAMENT-LIGHTING JACKS

Cost of parts: Not more than $45.00.
Selectivity: Excellent.
Operation: Simple. The primary and secondary condensers control tuning, with the variocoupler for coupling control and the plate variometer for effecting regeneration. By merely inserting the telephone plug into the stage desired the filaments used are automatically turned on and off.
Construction: Some care is necessary in laying out the circuit and in wiring up the filament circuit.*
Approximate range: 1,200 to 1,500 miles.
Outstanding features: Selectivity. Automatic filament control.

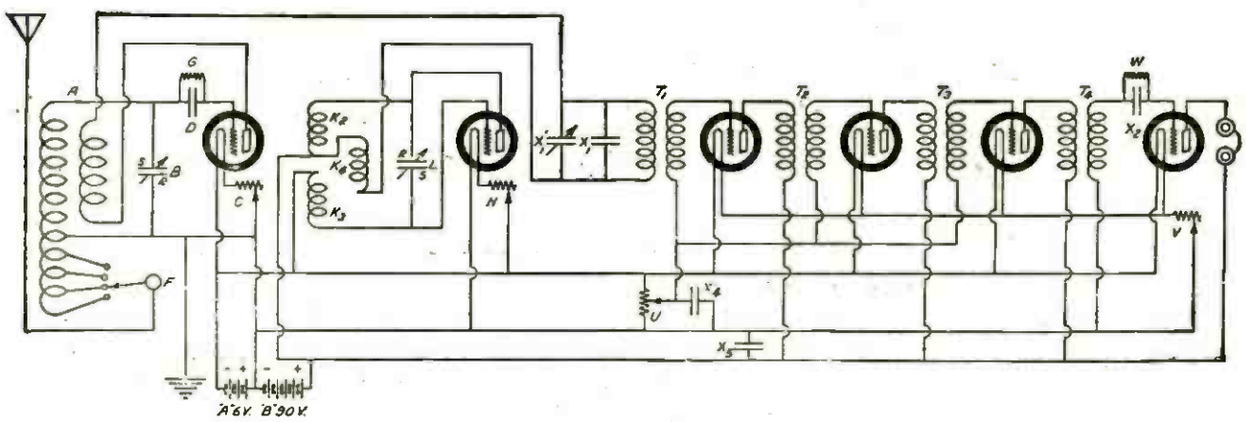
*(See POPULAR RADIO, *July, 1924, pages 80-1, for constructional details.)*



THE FOUR-CIRCUIT TUNER WITH TWO STAGES OF STRAIGHT TRANSFORMER-COUPLED AMPLIFICATION, AND ONE STAGE OF PUSH-PULL AMPLIFICATION

Cost of parts: Not more than $90.00.
Selectivity: Excellent.
Operation: Simple to tune.
Construction: Some experience in wiring up the circuit is necessary.*
Approximate range: 3,400 miles.
Outstanding features: Selectivity. Ease of tuning. Good reproduction.

*(See POPULAR RADIO, *January, 1924, page 23, for constructional details.)*

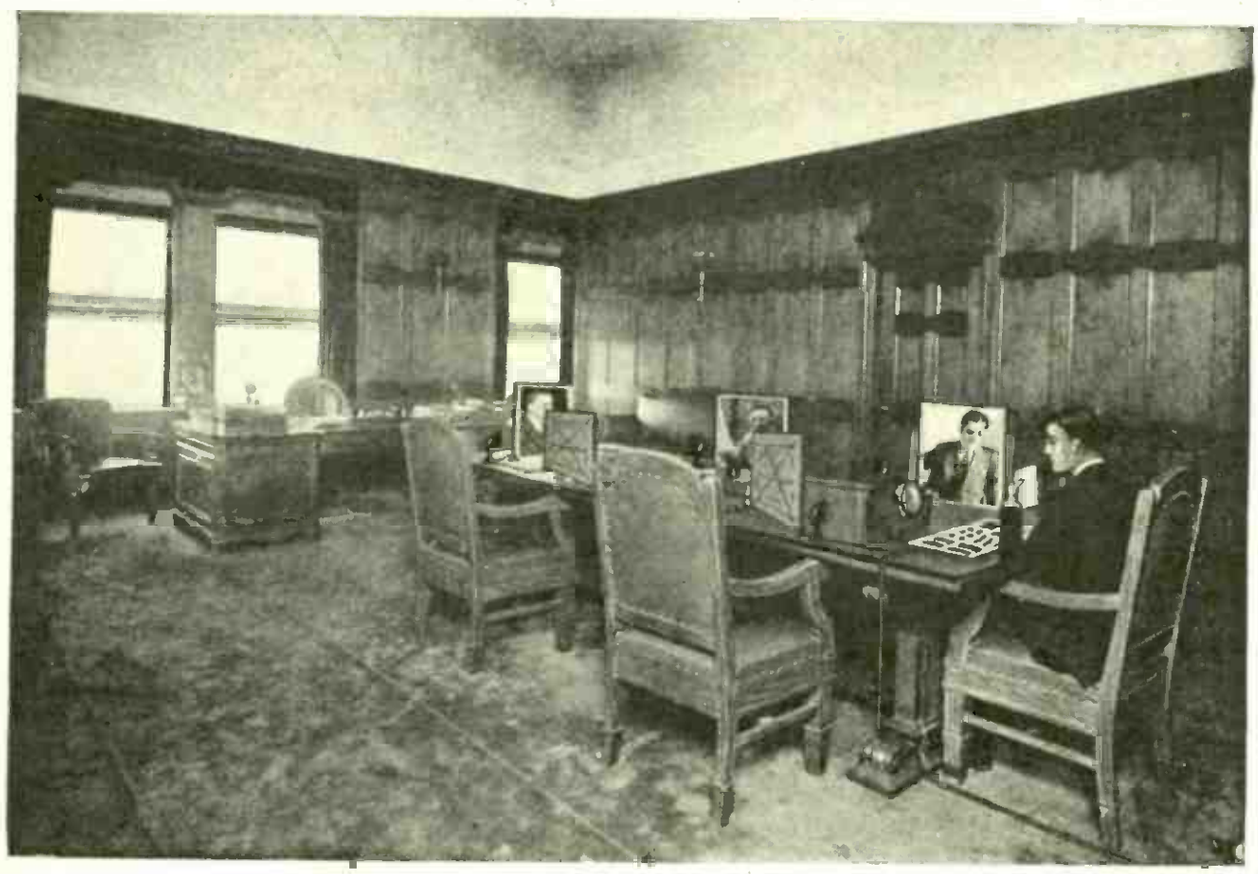


A SUPER-HETERODYNE CIRCUIT FOR AIR-CORE INTERMEDIATE-WAVE TRANSFORMERS

Cost of parts: Not more than $80.00.
Selectivity: Very good.
Operation: Not difficult to tune, when the mode of operation is learned.
Construction: Rather complicated.*
Approximate range: 3,400 miles.
Outstanding features: Easier to tune than most complicated circuits. Good distance and selectivity.

*(See POPULAR RADIO, *September, November and December, 1923, issues, for constructional details.)*

¶ The fourth of a series of articles that anticipate some of the startling effects that radio may have on our everyday life.



A POSSIBLE "BUSINESS CONFERENCE" IN 1935

Will radio vision give us this kind of a director's meeting? One man in the director's room works the controls; the others attend the meeting from wherever they happen to be, appearing by way of the radio-vision screens and the loudspeaker.

Will Radio Write Our Letters?

A possible use of transmitting and receiving apparatus in the business offices of tomorrow

By THOMAS ELWAY

AFTER all the multitude of changes that radio has brought into the daily life of the country what changes will it bring in the future of the average business office?

The real business of the world is done during working hours. The most important activity of most of us is what we do in the offices or factories that we manage or where we are employed. Radio will not have found its total utility to mankind until it has been fitted into its place in our work-a-day hours.

The possible use that everyone thinks of first of all is the use of radio devices in the great business of correspondence.

Although few business men realize it, the writing, reading, filing and handling of letters absorbs, so the experts estimate, more than sixty percent of the "overhead" commonly charged against business operations.

Nobody knows how many millions of

letters are needed every day to do the business of these United States. The entire typewriter industry is founded on nothing else. The increasing employment of women in business has no other cause than the fact that we need to write so many letters and that women do this, we find, both better and cheaper than men.

If a detached philosopher off somewhere on another star set himself the task of studying the development of that complicated merchandising activity that we call business, he would conclude, I think, that its growth since the very earliest of historic times included but two outstanding developments; financial credit and business correspondence.

Business, as we know it, was invented by the merchants of ancient Babylon; the first class of professional traders in the world. These forgotten geniuses invented both of these chief attributes of business. They devised credit by the invention of mortgages on land and on stored goods—what we would call today "warehouse receipts." Also they began business correspondence.

But this Babylonian business, while it displayed all the essentials of modern business forms and customs—even the bank check and purchase on the installment plan are Babylonian devices—was subject to a tremendous frictional drag. It carried around a load of clay.

The clay came on the letters. Indeed, the clay *was* the letters. The only kind of writing material that the Babylonians had was soft clay made into little flattish lumps or "bricks." When a Babylonian merchant wanted to write down a contract or to send a letter he took a piece of clay, patted it flat with his hands and made some marks on it with a sharp, pointed bit of bone. That was the Babylonian writing; slow, laborious, expensive, difficult to carry around and to store, but the best that the times had developed.

Even with this handicap the Babylonian merchants became millionaires. It is interesting to speculate what they might have done for—and to—the world if someone among them had invented pens, paper and ink!

After Babylon fell there was a long eclipse of what we call commerce. When it revived, in the hands of the great Italian merchants of the Middle Ages, it had pens and ink to work with. The increase of speed was remarkable—and speed in business is but another name for multiplication of capital and of the earning power of human time.

In modern times we have seen the still greater speeding up that has resulted from the series of inventions headed by the typewriter, the railway mail service and the electric telegraph. One business man today, assisted as he is by these scientific inventions, can accomplish hundreds of times as much work in a day as his Babylonian predecessor could get through in the same period. That is one reason why the worst paid servant of modern business lives far better than even the king could live in Babylonia.

But need we stop here? Is it not possible that the resources of modern science, properly applied, will enable us still further to decrease the work and shorten the time that business operations demand? The answer to both questions may be optimistic.

Let us take, for example, the writing, sending, filing and answering of letters.

To do this now requires, in general, three acts of translation. *First,* you dictate a letter to your stenographer; that is, she translates your speech into pothooks on her notebook. *Second,* she translates the pothooks, which she calls her notes, into written words on a sheet of paper; that is, into the "letter." *Finally,* when this letter has been sent and received, after being handled by scores of people, the recipient translates it again; namely, from written words into ideas, or sometimes actually into speech.

This, when we come to think of it,

is really an unbelievably costly sequence of operations. The message that we want to send begins as speech; it ends (or may end) as speech. The intermediate translations into writing are necessary, at present, for two reasons: first in order to send it cheaply to a distance; second, in order to provide a record.

Radio offers a good hope of making all these intermediate steps unnecessary. When directive radio beams have been perfected and when secret systems of multiple modulation similar to the famous Hammond system have been fully applied (both of which developments are clearly in sight to radio engineers) the cost of point-to-point speech communication will be a small fraction of the cost that is inevitable so long as the present expensive and troublesome equipment of telephone wires is in use.

Morris Rosenfeld

WHERE RADIO HAS ALREADY ENTERED BUSINESS

In the gathering and distribution of news, radio devices already permit the sending of hundreds of words by machines like these.

Courtesy of the Theatre Guild, N. Y.

WE WILL ACTUALLY SEE THE PERSON AT THE OTHER END OF THE "WIRELESS"

This phenomena, which science has now made a possibility, was anticipated by Bernard Shaw, the Irish dramatist, in his play "Back to Methuselah," from which the above scene was taken.

It will be cheap and easy, then, to communicate your desires to a distant correspondent and to obtain his reply. Even at the present high cost of the service, business men are making more and more use of the long-distance telephone in this way. Locally, inside a single city, the telephone has already superseded a large fraction of the correspondence that would have been necessary for modern business if we did not have this electric marvel.

There remains, however, the matter of a record. A telephone conversation is not recorded and this is considered, in many cases, a vital business defect. But here, too, radio has a solution to offer.

By virtue of well-known radio devices it is now possible to amplify speech to almost any extent. This means that an ordinary conversation carried on while you are seated comfortably at your desk may be amplified sufficiently to be recorded on any one of several varieties of phonograph. For example, the method of recording speech on rolls of soft iron wire, invented years ago by the famous Danish engineer, Poulsen, has been made really practicable by the invention of audio-frequency amplifiers, both for recording the message on the wire and for getting it off again afterward.

There is now no reason, therefore, why you cannot conduct a conference by long-distance telephone with any number of people and have a perfect record of this conversation, including both ends of it. All that is necessary is to install the proper amplifiers and recorders in connection with your telephone lines.

The filing room of the future business office may hold, not tons of paper, but miles of fine iron wire. When you want a record you will not ask for a carbon. Instead you will say, "Miss Smith, get me the roll of that conversation with London last Saturday."

This is no more improbable than it would have seemed to a Babylonian merchant if you had told him even about pens and paper, to say nothing of typewriters.

And when radio vision is perfected—a matter which is likely to happen, the engineers agree, within a comparatively few years—we can add the visual impression to the aural one. The board of directors of a great corporation can meet about the directors table, see each others' expressions, hear each other talk; although one of them is in London, one in China, one on vacation in the Canadian woods and the balance scattered in other cities throughout the world or on ships at sea. Indeed this is so sure a possibility that even literature has discovered it. It forms the turning point of one of the scenes of Shaw's play "Back to Methuselah."

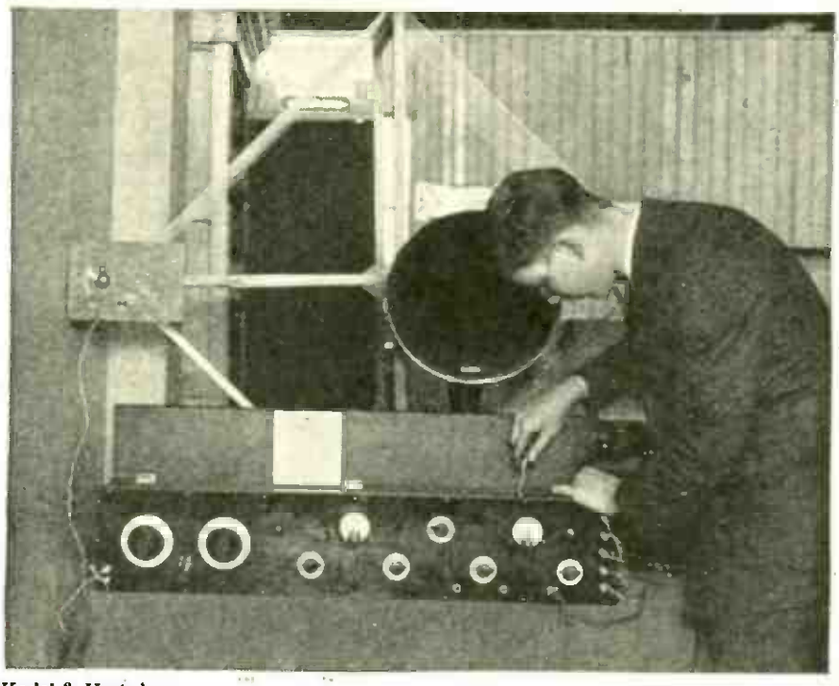
Such developments would eliminate altogether the need of written words in business correspondence. There would be no longer any need of translation into stenographic pothooks, then into typed letters and finally back into speech again. But if someone wished, for any reason, to put messages into writing it is probable that this, too, could be done by electric devices.

The scientists of the telephone industry have succeeded already in analyzing the sounds of speech so that the individual letters are recognizable from their pictures on an oscillograph. It would be possible, I imagine to construct a radio-typewriter that would set down a letter "a" on paper whenever you spoke this vowel into the machine. To set down words would be, of course, more difficult but I feel sure that it is not beyond the ultimate resources of radio science to give us a machine into which you could talk a letter as you talk to your stenographer, the machine setting down this letter in written words.

Twenty years from now, possibly even ten years from now, the executive office of a great corporation may look like the control room of a present-day power house. On the walls will be the screens for radio vision. An assortment of microphones will connect with the various circuits for distant communication, for recording, for issuing instructions to the few remaining employees. Buttons or switches will operate the dozens of radio-controlled devices that bring desired rolls of iron wire from the files, that admit or exclude visitors, that acknowledge or refuse radio calls.

At the center of it all sits a brain. The chief engineer of an ocean liner sits comfortably at a desk carrying a few valves and instruments and push buttons. He controls engines that do more than a hundred thousand galley slaves.

Why not run our business offices the same way?



Kadel & Herbert

CORRECT ADJUSTMENT IMPROVES ANY RADIO RECEIVER

Careful attention to small details in the construction and maintenance of his eight-tube super-heterodyne receiver enabled Frank P. Foley of New York City to tune in station 5SC, located in Glasgow, Scotland.

Tips for the Broadcast Listener

By Y. Z. MUTS

How to Test Condensers: When the stator and rotor plates touch, a short circuit occurs. Few realize what a source of considerable annoyance this is. The best way to determine whether the plates in a variable condenser touch each other is by connecting a battery and buzzer in series with the condenser. Should the buzzer operate while revolving the rotary plates, the plates are touching; a spark will also be seen at such points and thus the trouble may be remedied. Another method to be used in locating the trouble is using a pair of phones and "B" battery connected with each other in the same manner as the buzzer.

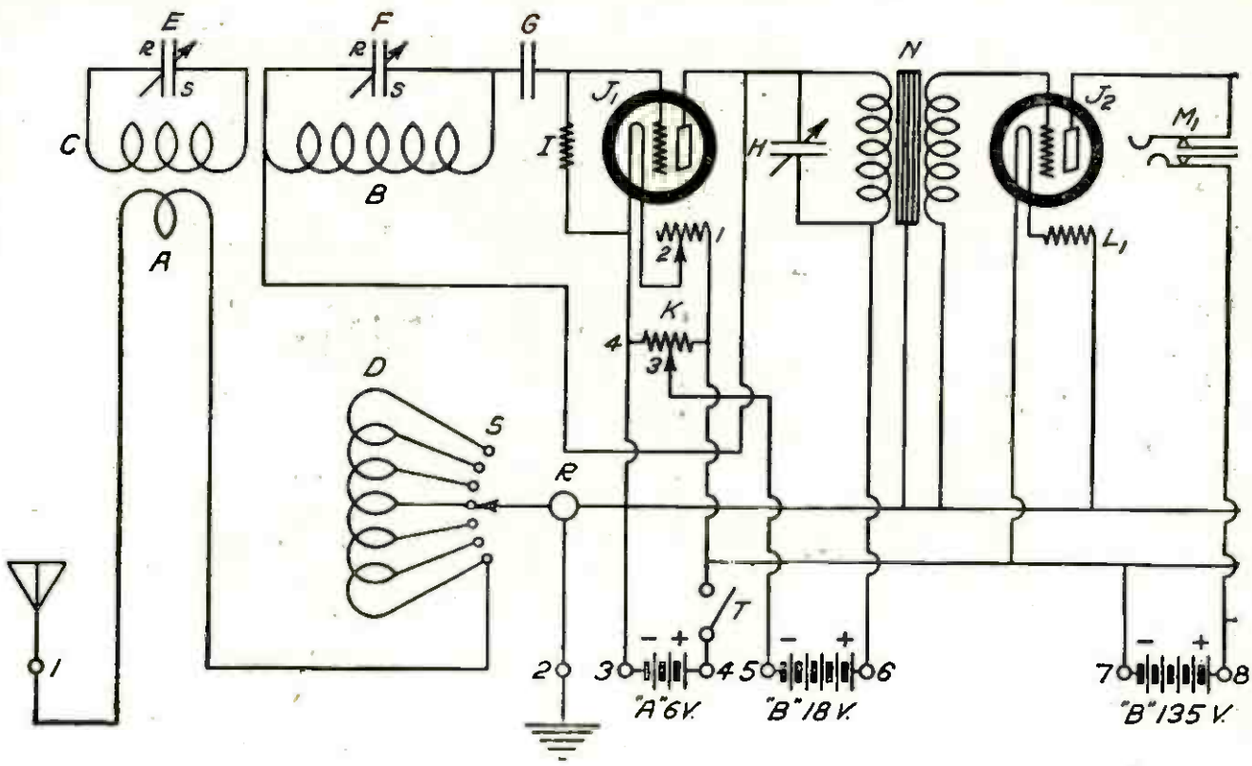
Bad Business: When soldering connections on a receiving set, don't allow the soldering flux to bubble and drop from a joint onto the windings of tuning coils or inductances in the set. The flux will destroy the insulation between the turns and this has often been the cause of the inefficient operation of an otherwise efficient receiver.

When Speaker Howls: Should you be bothered by a continual howl in the loudspeaker, you will find that the noise is generally caused because the loudspeaker is too close to the receiving set, or it is resting on the cabinet and the vibrations start the tubes "ringing." To overcome the disturbance move the loudspeaker a foot or more away from the receiving set.

Ground Transformer Cores: It is a good thing to ground the iron cores of the audio-frequency transformers. But use of a ground separate from that which is used for the receiver itself is advised.

The Causes of "Short Circuits": A wire running from one terminal of a battery to the other gives the current a path of low resistance and is what is called a "short circuit." This is harmful to any battery, and if the wire is left on for more than a second it may ruin the battery. Such heavy current discharged from a storage battery may cause enough heat to warp the plates and that means the end of the battery. In taking dry cells home from the store be careful not to let any metal connect the two terminals. If you are careless, you may think the store cheated you.

The Cost of Sloppy Wiring: If you hope to get the best results from your set you will take as much pains in soldering and bending all the little wires as you did in mounting the various dials and knobs on the panel. You will be surprised to know what an important factor a neatly wired receiver is, when you tire of it and wish to sell it. Under no conditions have the wires running this way and that, over and under in a crazy-pattern style. If you stop and consider all the trouble that this unnecessary carelessness causes, you will avoid doing sloppy work. A regenerative type of receiver is greatly affected by criss-crossed wires.



HOW TO BUILD THE

FOUR-CIRCUIT TUNER

WITH A RESISTANCE-COUPLED AMPLIFIER

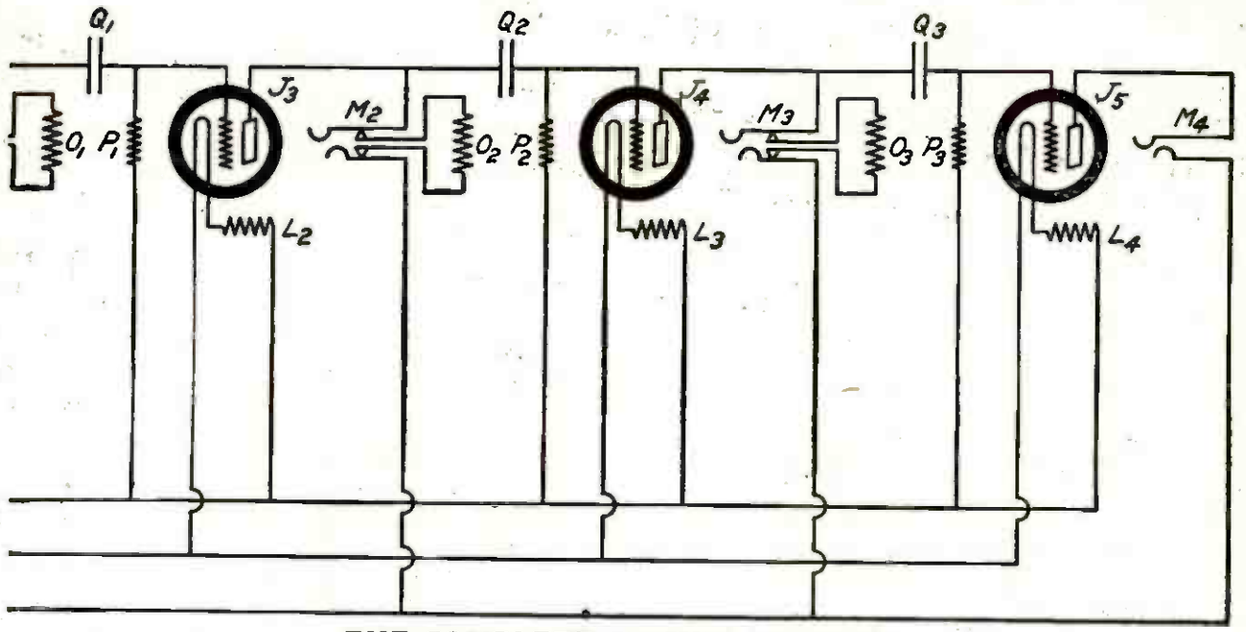
In this latest development, on which the Laboratory has been working for the last eight months, is incorporated the best-known methods for obtaining perfect reproduction as well as some of the newest though little-known methods for reducing losses in the radio-frequency circuits. For enjoyable rendition, ease of tuning and selectivity, this improved set is unsurpassed as a broadcast receptor.—EDITOR

By LAURENCE M. COCKADAY, R.E.

COST OF PARTS: *About $55.00*
RECEIVING RANGE: *Up to 3,500 miles*

HERE ARE THE ITEMS YOU WILL NEED—

A, B, C, D—Precision Cockaday coil-set for 4-circuit tuner;
E—Cardwell variable condenser, .0005 mfd., with Accuratune micrometer control dial;
F—Cardwell variable condenser, .00035 mfd., with Accuratune micrometer control dial;
G—New York mica fixed condenser, .00025 mfd.;
H—Amplex grid-denser;
I—Bradleyleak;
J1, J2, J3, J4, J5—Benjamin "Cle-ra-tone" sockets for UV-201-a tubes;
K—Amsco "Dubl-Wundr" combination potentiometer and rheostat;
L1, L2, L3, L4—Amperite No. 1-a, with mountings;
M1, M2, M3—Improved jacks, double-circuit;
M4—Improved jack, single-circuit;
N—Precise audio-frequency amplifying transformer, No. 285-A;
O1, O2, O3—Bradleyohms, No. 25;
P1, P2, P3—Electrad certified grid-leaks, ½ megohm and mountings;
Q1, Q2, Q3—New York mica fixed condensers, .005 mfd.
Three of each used in parallel in each place, making Q1 = .015 mfd., Q2 = .015 mfd. and Q3 = .015 mfd.;
R—Amsco switch lever;



THE COMPLETE CIRCUIT DIAGRAM

FIGURE 1: *This is the hook-up for the new receiver. It will be noticed that all the symbols for the instruments bear designating letters which reappear in the list of parts below, and throughout the text and the following illustrations. This eliminates the possibility of mistakes in construction and wiring up.*

S—switch points and stops;
T—improved filament-battery switch;
U—Composition panel 7 by 24 by 3/16 inches;
V—cabinet;
W—sub-base;
X1, X2, X3—small panels (connection block = X1, antenna block = X2 and X3 is for mounting grid-leak);
Y—small brass brackets.

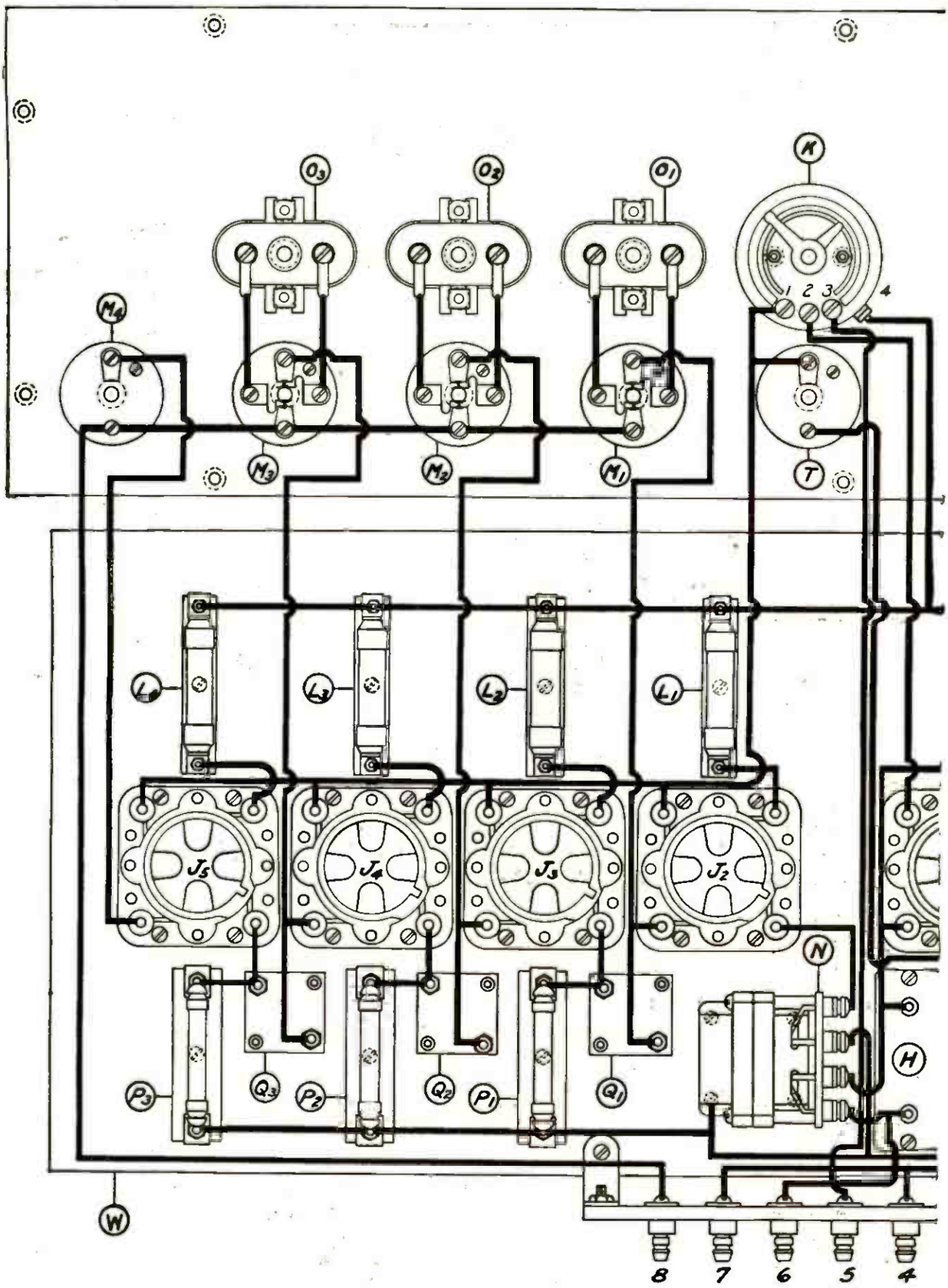
THIS latest addition to the four-circuit line of receivers is the outcome of the last eight months of research work by the author in an attempt to design and build a receiver that will—

produce loudspeaker signals from distant stations;
tune in distant stations through the local stations;
contain not more than two tuning controls;
produce all signals without distortion;
cost not more than $55.00;
not radiate under any conditions;
be simple to construct;
be simple to wire up;
be simple to operate;
be the best all-around set for broadcast reception.

The tuning circuit itself is the familiar tuner with two controls, the variable condenser in the stabilizer circuit and the variable condenser in the secondary circuit. These two condensers are set to exactly the same settings when tuning in a station, and this arrangement places the regeneration control so that maximum regeneration is obtained automatically. The operator does not have to worry about the regeneration control; the set is automatic.

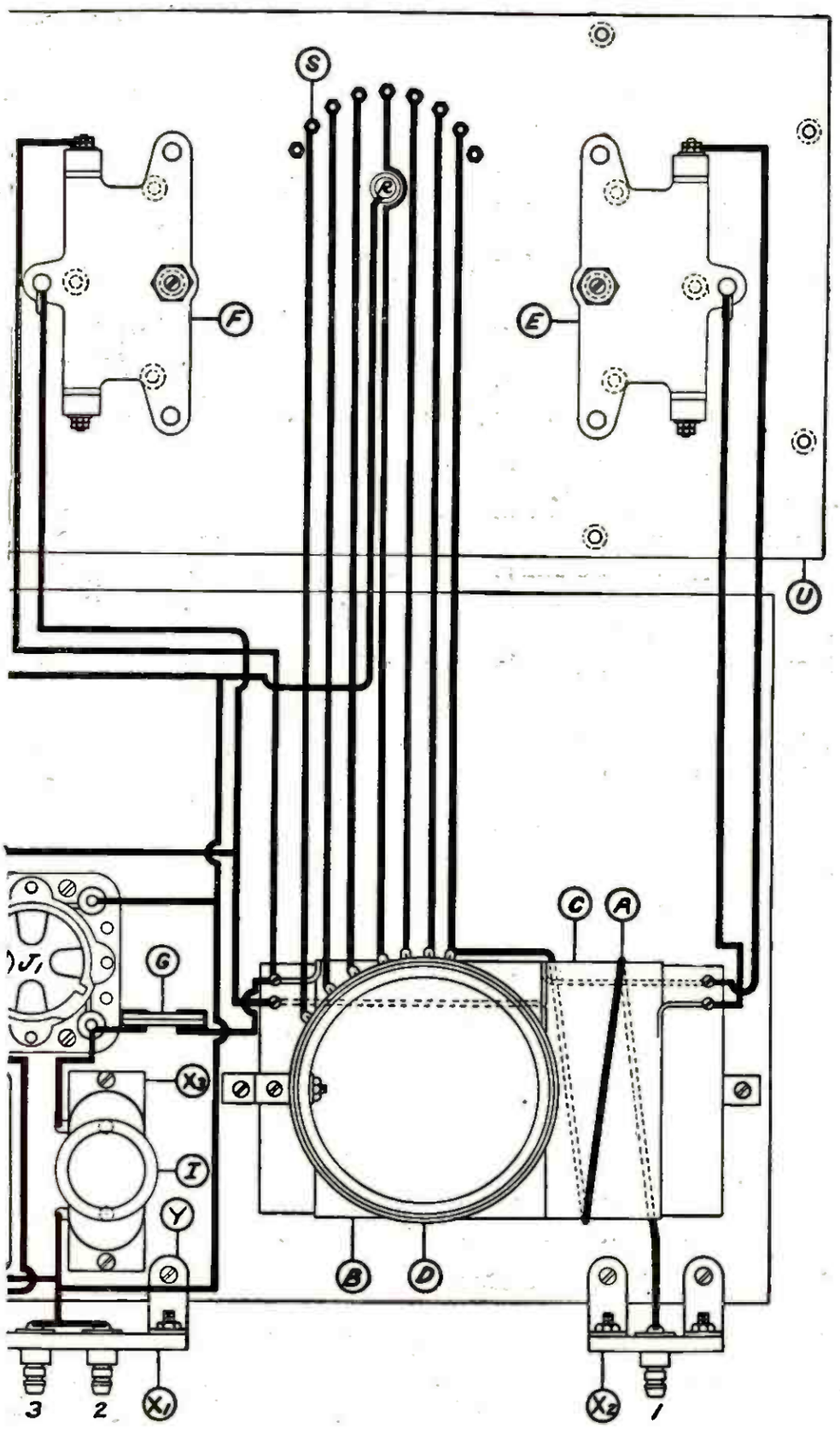
The tuning circuits have been extremely carefully laid out in this new set, with a view to cutting down losses to minimum values. For instance, the coil has been placed at a greater distance from the flat sections of the metal plates of the variable condensers. The grid condenser has been placed so that its plates are at right angles to the inductive field of the secondary winding. The antenna leads and connections have been further isolated from the other parts of the circuit, particularly the grid circuit. These and other important improvements have been made in the tuning circuit, which make it worth while for users of the old four-circuit tuner to build the new in order to get more distance, more quality on reception, still more satisfaction, and withal, at a lower cost.

The type of amplifier used is also a



THE WORKING PLAN FOR WIRING UP THE VARIOUS

FIGURE 2: *This is the latest kind of wiring diagram. It is not only a picture-diagram, but it is also an actual layout of the instruments that are mounted on the panel and the baseboard. The upper rectangle represents the panel and the instruments are drawn to scale in their correct relative positions. The lower rectangle*



INSTRUMENTS THAT MAKE UP THE CIRCUIT

represents the baseboard and the instruments shown there are also drawn to scale in their correct relative positions. The wires drawn in heavy black lines show you THE EXACT WAY TO RUN THE WIRES *to connect up the instruments and parts after you have mounted them according to instructions.*

great improvement. It contains one stage of transformer-coupled amplification with a jack for headphone reception and three stages of resistance-coupled amplification of an improved type, with jacks for each stage so that just the right volume may be obtained from *any* station, be it far or near.

The quality of reproduction is of extraordinary excellence. It brings the broadcasting studio right into your own home.

During the summer months this newest four-circuit receiver has been giving a consistent range of 1,500 miles, static permitting, and now, during September, it is bringing in the west-coast stations in New York City without effort.

Can you at present get distant stations through the locals?

Is your present set easy to tune?

Do you get all signals clear, and do they sound natural?

Are you troubled with body capacity?

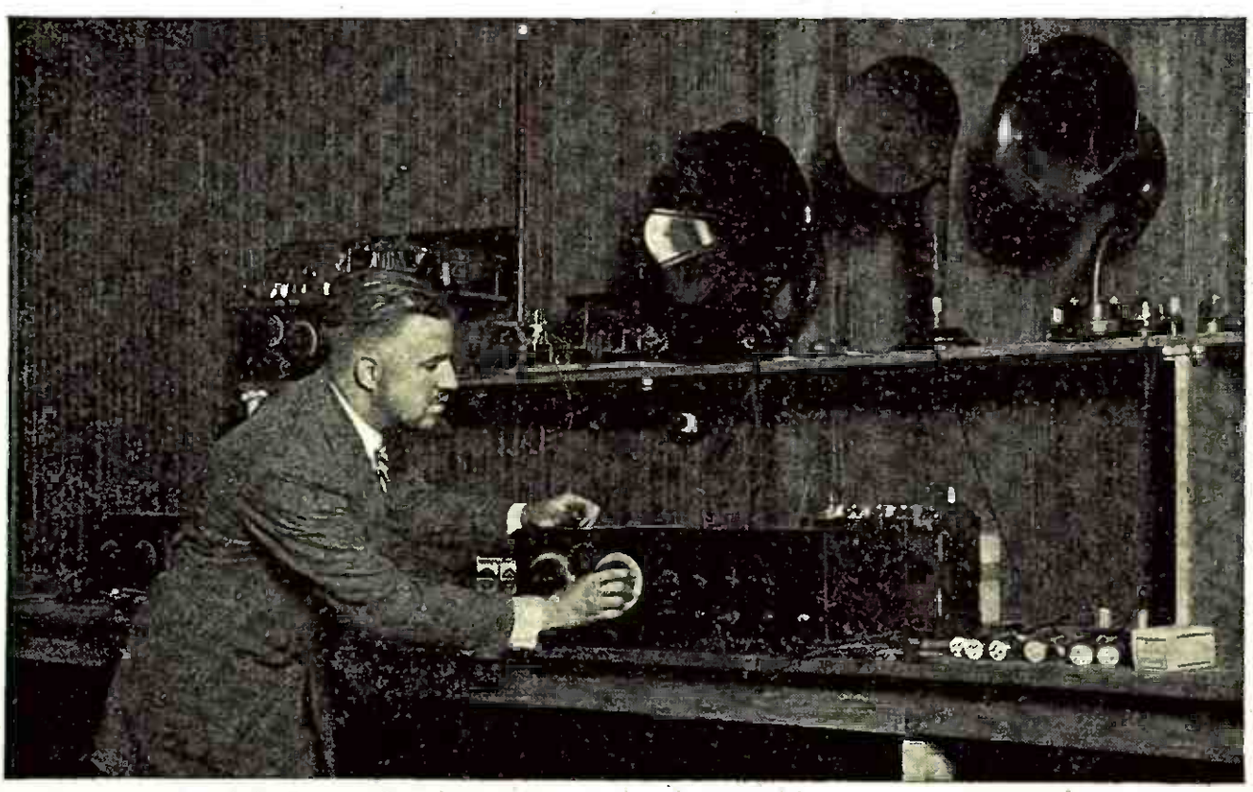
Does your present set radiate and disturb your neighbors?

Does it really give *you* the results you want?

If your set does *not* answer these questions to your satisfaction, it is not exactly what you require, and you will find it worth while to study this article carefully and then build the receiver as described.

The theoretical wiring diagram for the new circuit is shown in Figure 1. This diagram, it will be noticed, is drawn in the old conventional way for the benefit of the regular amateur and experimenter, who has become familiar with the accepted symbols for representing the various instruments.

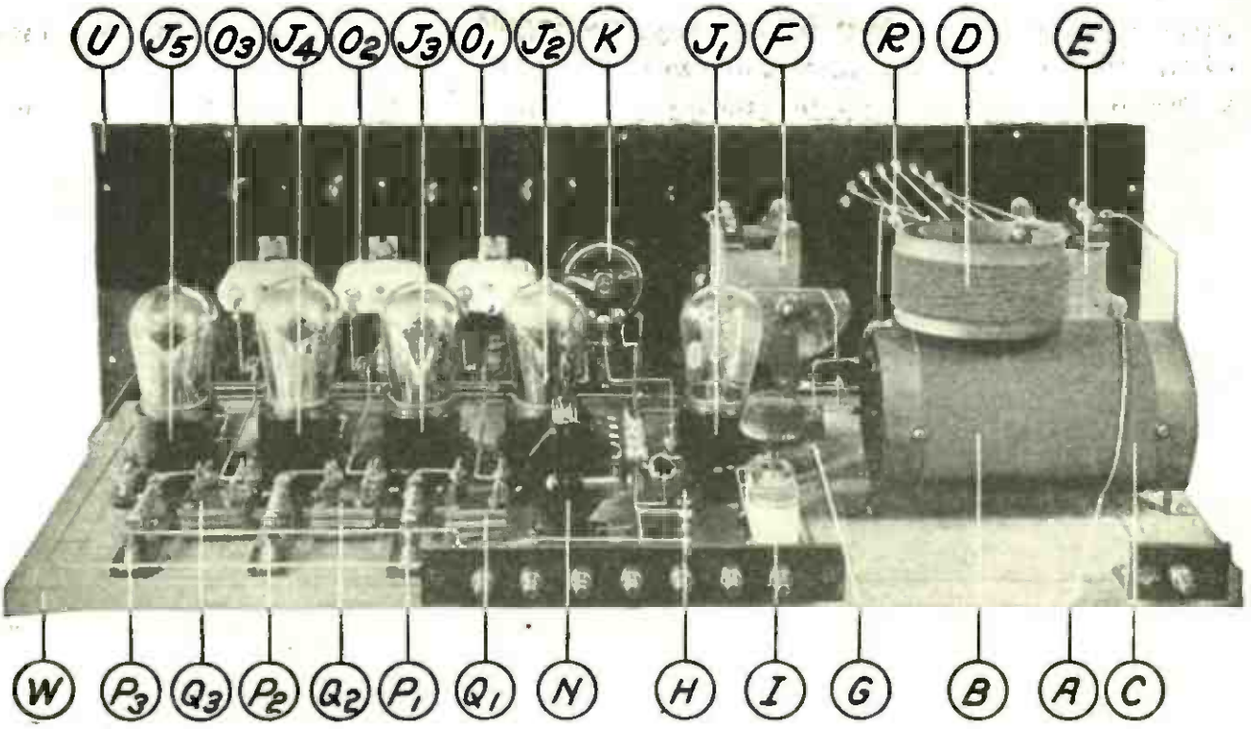
The picture-diagram, which shows the instruments in their exact positions, and the *exact way* the wires should run, is drawn for the benefit of the fans who can better follow the wiring if it is given from left to right, as it goes into the set.



From a photograph made for POPULAR RADIO

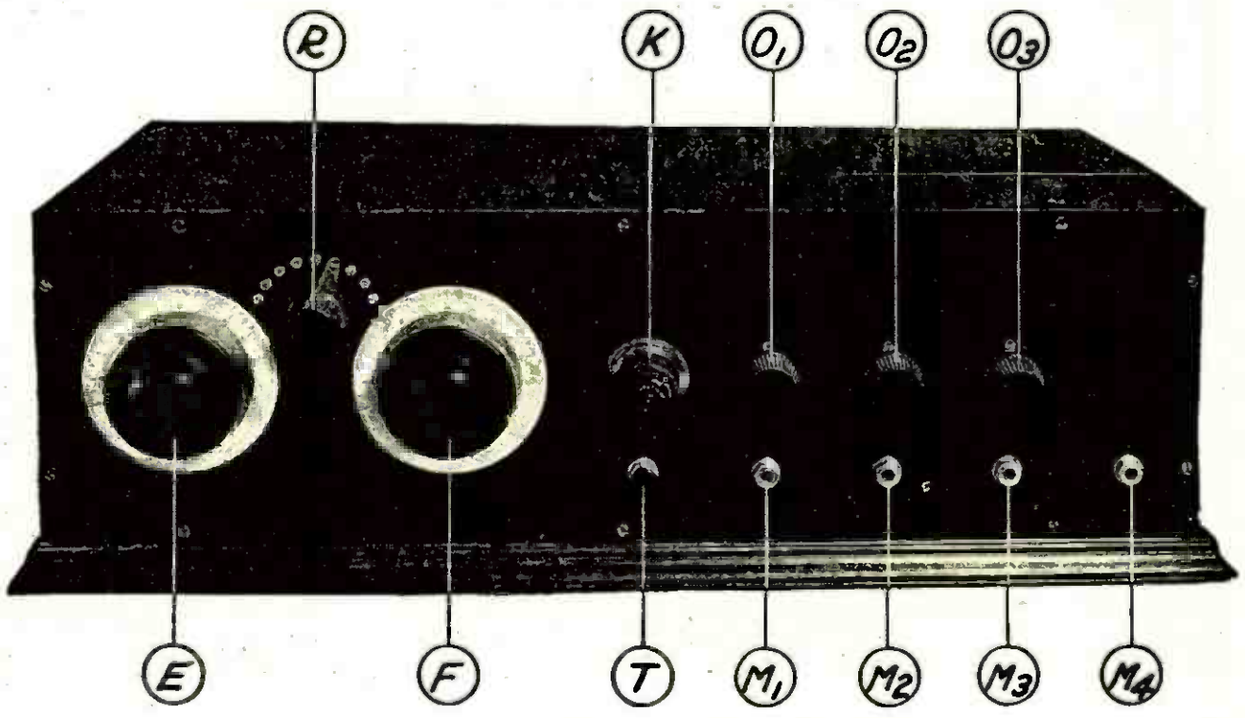
CALIBRATING THOUSANDS OF SETS AT THE SAME TIME

When the author spent three hours in the laboratory in calibrating the set from which the description in this article was made up, he literally did the same work for thousands of sets that have as yet not been built. This is true because the tuning chart (see Figure 12) of the four-circuit tuner remains the same no matter what sized antenna is used with it.



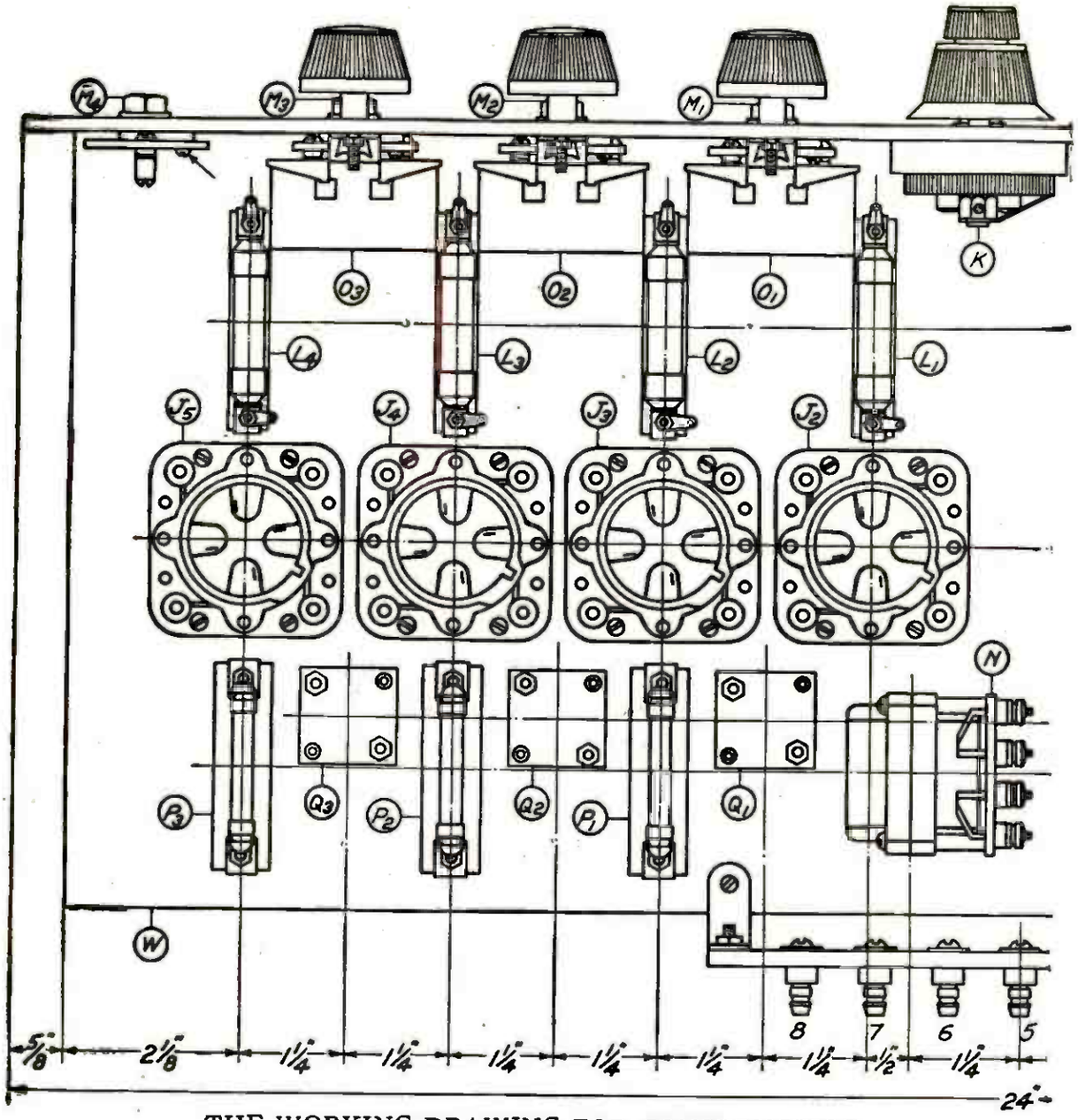
VIEW OF THE SET FROM THE REAR

FIGURE 3: *This picture shows the general arrangement of all the instruments fastened to the panel or base. The exact locations for the instruments are shown in Figures 2 and 5.*



THE PANEL VIEW OF THE RECEIVER

FIGURE 4: *This gives an idea of how the set looks from the front and as the dials and knobs are marked with letters which correspond to the instruments to which they are attached, the prospective operator will have no trouble in locating the various tuning controls as they are explained in the instructions for tuning automatically.*



THE WORKING DRAWING FOR CONSTRUCTION

FIGURE 5: *Here are shown the correct positions for the instruments which are mounted on the baseboard. The positions are given, center to center, for all instruments.*

If you use this chart you cannot make a mistake in wiring. It is simple to follow.

The Parts Used in Building the Set

In all the diagrams in this article each part bears a designating letter. In this way the prospective builder of the set may easily determine how to mount the instruments in the correct places and connect them properly in the electric circuit. The same designating letters are used in the text and in the list of parts at the beginning of the article.

¶ *The list of parts there given includes the exact instruments used in the set from which these specifications were made up; but the experienced amateur will be able to pick out other reliable makes of instruments which may be used in the set with equally good results. For exact duplication of results, however, we recommend the parts specified to the novice.*

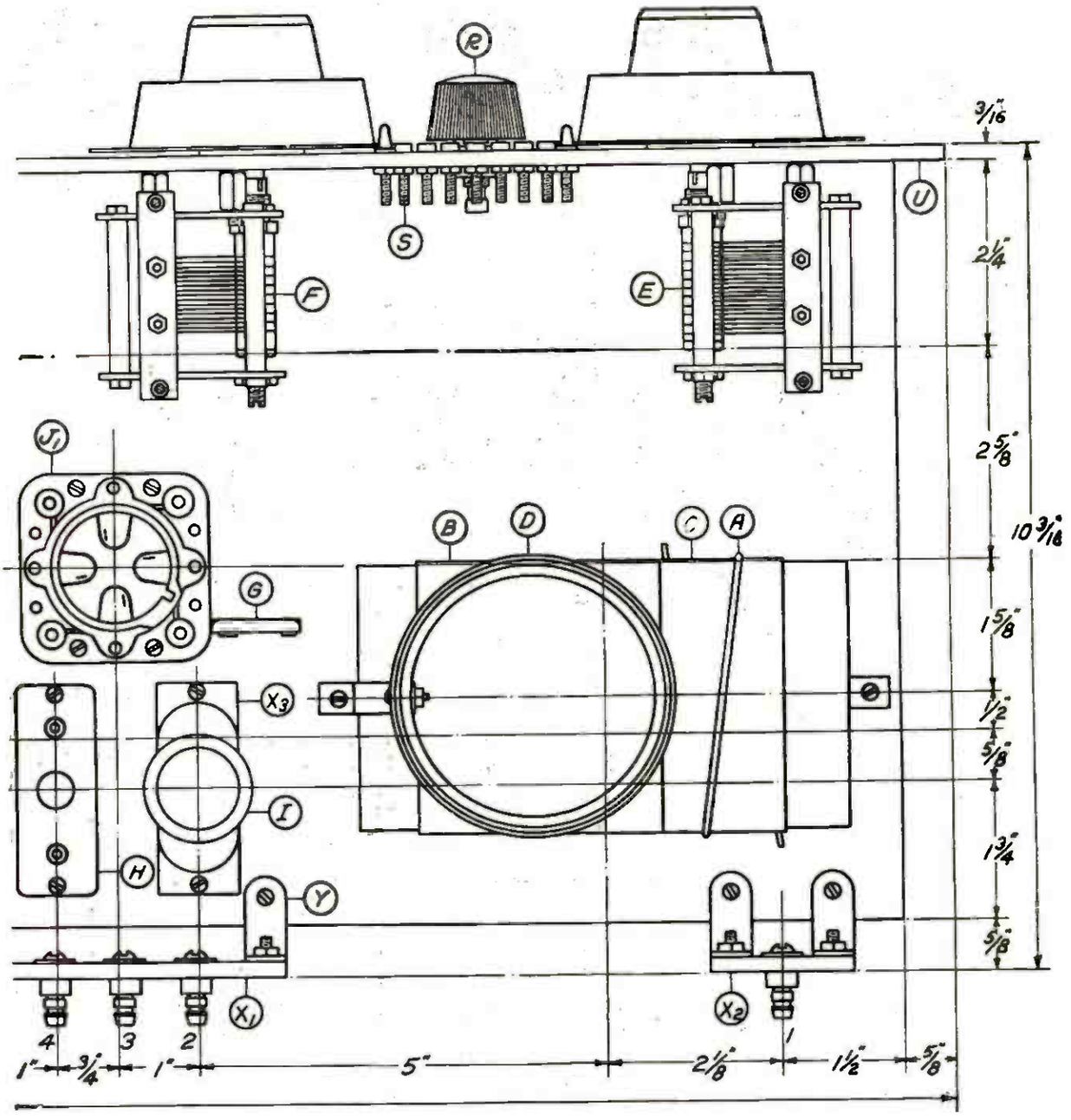
If instruments other than the ones listed are used it will necessitate only the use of different spacing of the holes drilled in the panel for mounting them.

How to Construct the Set

After procuring all the instruments and materials for building the set, the amateur should prepare the panel U. (Shown in Figures 2, 3, 4, 5, 6, 7 and 8.)

First of all, cut the panel to the correct size, 7 by 24 inches.

Then square up the edges smoothly with a file. The centers for boring the holes (which



are necessary for mounting the instruments) should be laid out on the panel as shown in Figure 8. A convenient method of doing this is to lay out all center holes on a piece of paper the same size as the panel; then the piece of paper should be pasted on the panel and the centers marked directly on the panel by punching through the paper.

If all the holes to be drilled are first started with a small drill, one-sixteenth inch in diameter or less, they will probably be more nearly centered.

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

When the panel is drilled, it may be given a dull finish by rubbing lengthwise with fine sandpaper until the surface is smooth; then the same process should be repeated, except that light machine oil should be applied during the rubbing. The panel should then be rubbed dry with a piece of cheese-cloth; a dull permanent finish will be the result. Or, the panel may be left with its original shiny-black finish, if care is exercised, so that it is not scratched during the drilling.

The sub-base W (see Figures 2, 3, 6 and 7) should be cut to size, 9⅜ by 22¼ inches. If a piece of ½-inch hardwood, surfaced on both sides, can be obtained, the work of squaring up and finishing the edges will be a minimum.

The base W is fastened to the panel U, with the panel in an upright position, by three screws, as shown in Figures 3, 6, 7 and 8.

Next, mount the two variable condensers E and F on the main panel U, by means of three screws each and attach the micrometer dials.

You will have to cut off a portion of the shafts of the condensers E and F in order to fit the dials, but this will be easy if you do it with a hacksaw and follow the directions as given in the small pamphlet that comes packed with the dials. Be sure that you set the dials on the shafts so that the plates are "all out" when the dial readings are at zero. This is important if the calibration curve given in Figure 12 is to be used.

Next, mount the switch lever R, as shown in Figures 4 and 5. Then, place and tighten the seven switch points S and the two switch stops as shown in Figures 3, 4, 5 and 6.

Next, fasten the filament-lighting switch T, on the panel, as shown in Figures 3 and 4. Then, do likewise with the three double-circuit jacks M1, M2 and M3. Then, fasten on the single-circuit jack M4. These last five instruments should all be fastened to the panel in the same relative positions; that is, with the small round-head screw in the upper right-hand position, looking from the back of the panel. This screw is indicated by a small arrow in Figure 5, on jack M4, for illustration. If this is done the loudspeaker will have the same polarity maintained, no matter which jack the plug is inserted in.

Now, the potentiometer-rheostat K should be mounted on the panel. This is fastened by two screws, as shown in Figures 3, 4 and 5.

Then, mount the three variable resistors O1, O2 and O3, as shown in Figures 3, 4, 5 and 7. These are fastened to the panel by removing the knob and screwing fast with two screws to each instrument. (If the new type of Bradleyohms are used, the two screws will not be needed and you will only have to drill the center hole. The new type instruments will be single-hole mounting, so be sure which type you have obtained. The electrical characteristics of both types are exactly alike.)

This finishes the mounting work on the panel and now you can start mounting the instruments on the sub-base W.

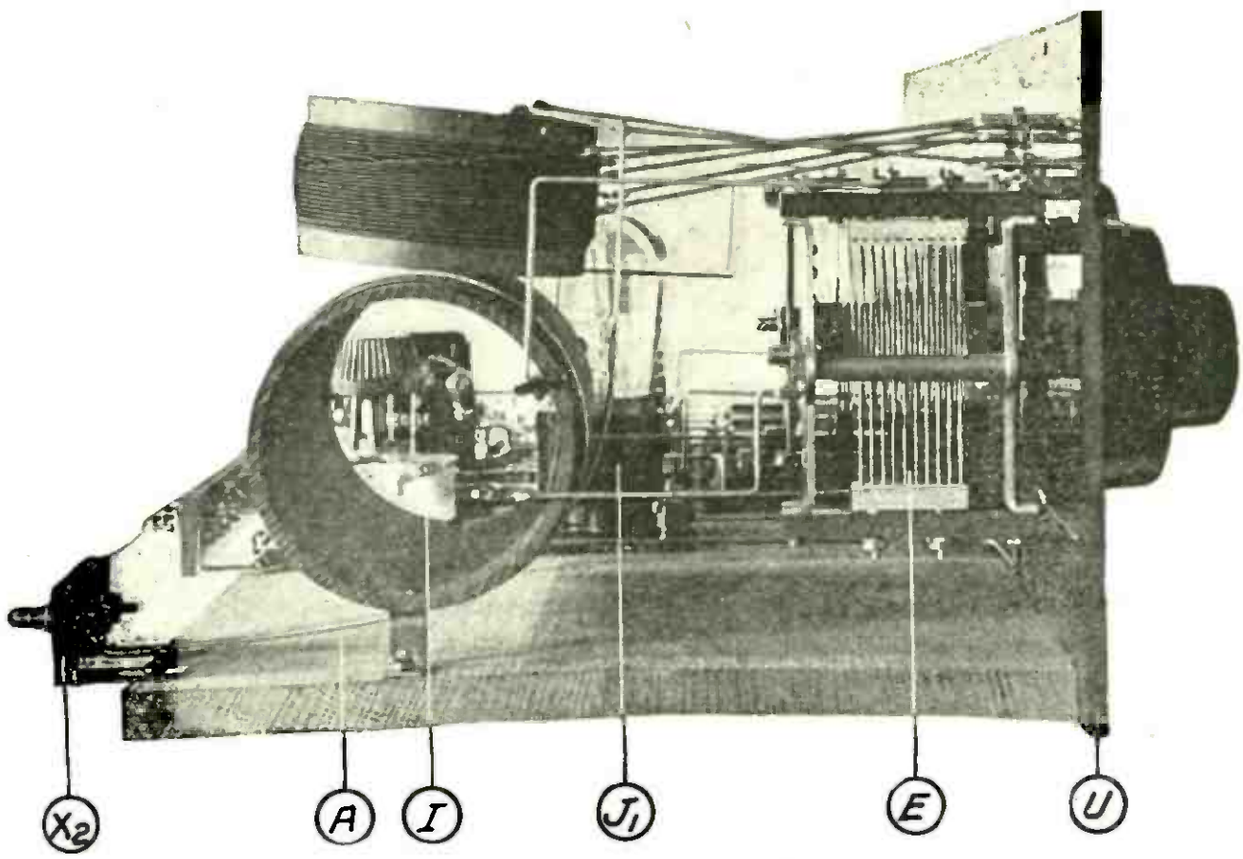
For the correct spacings on the various instruments on the base, consult Figure 5, in which the centers for placing the various instruments are given. It is particularly important that the instruments be placed *exactly* in the positions outlined in this working diagram if you want to duplicate the results as obtained in the model set.

First, mount the coil-set B, C and D as shown in Figures 3, 5 and 6. (Note that coil A is added when the wiring is being done.)

Then, mount the five cushioned sockets J1, J2, J3, J4 and J5 as shown in Figures 3, 5 and 7.

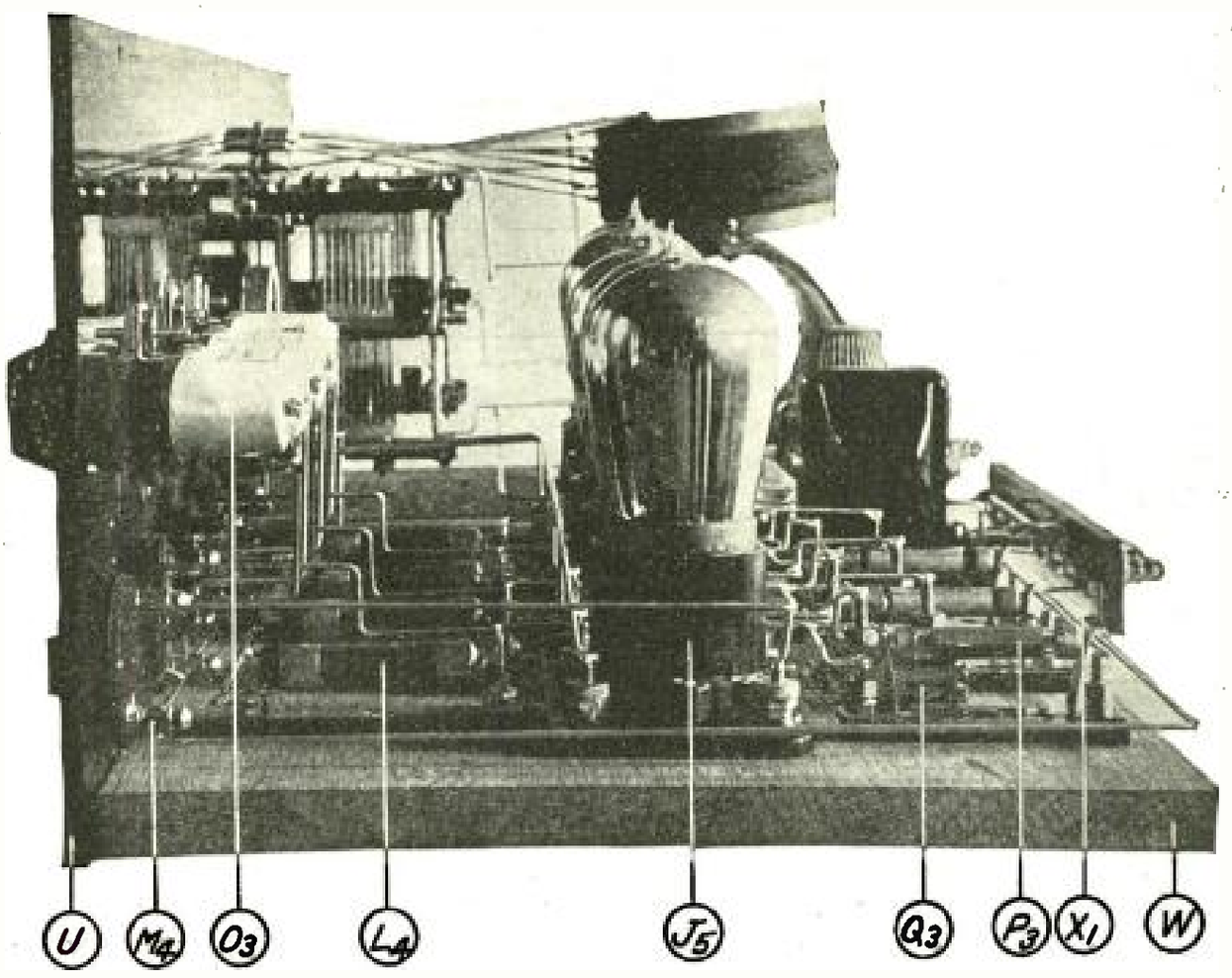
When this is done, mount the four amperites L1, L2, L3 and L4, as shown in Figures 5 and 7, with two screws to each.

Next, mount the grid-leak I, by means of the small composition panel X3, shown in Figure 10. This panel is screwed first to the grid-leak, by taking out the two screws on the in-



VIEW OF THE SET, AS SEEN FROM THE LEFT

FIGURE 6: *This illustration shows the way to mount the condensers and the coil set, and specifically the manner of attaching the single turn of bus bar for the coil A.*



VIEW OF THE SET, AS SEEN FROM THE RIGHT

FIGURE 7: *This view gives a good idea of how to mount the automatic filament controls, the sockets, the grid-leaks and the coupling resistances and jacks.*

strument and inserting them through the two center holes on the small panel. Then the instrument and the panel are screwed to the base W, by means of two more screws, as shown in Figures 3 and 5. (If the new type of Bradleyleak is used, the composition panel X3 will not be needed and you will only have to insert two screws right through the two holes in the instrument to mount it on the base W. The electrical characteristics of both types are exactly alike.)

Then, mount the grid-denser H, on the base with two screws, as shown in Figures 3 and 5, and the transformer N should now be fastened to the base as shown in these same Figures. After finishing this, fasten the three grid-leaks P1, P2 and P3, to the base W, as shown in Figures 3, 5 and 7. These are fastened with two screws to each instrument.

Use brass screws of the right length for all the mounting work. In *no case* use iron screws. The three condenser banks of mica fixed condensers are left until the wiring is being done, as they are held in place by the wiring itself.

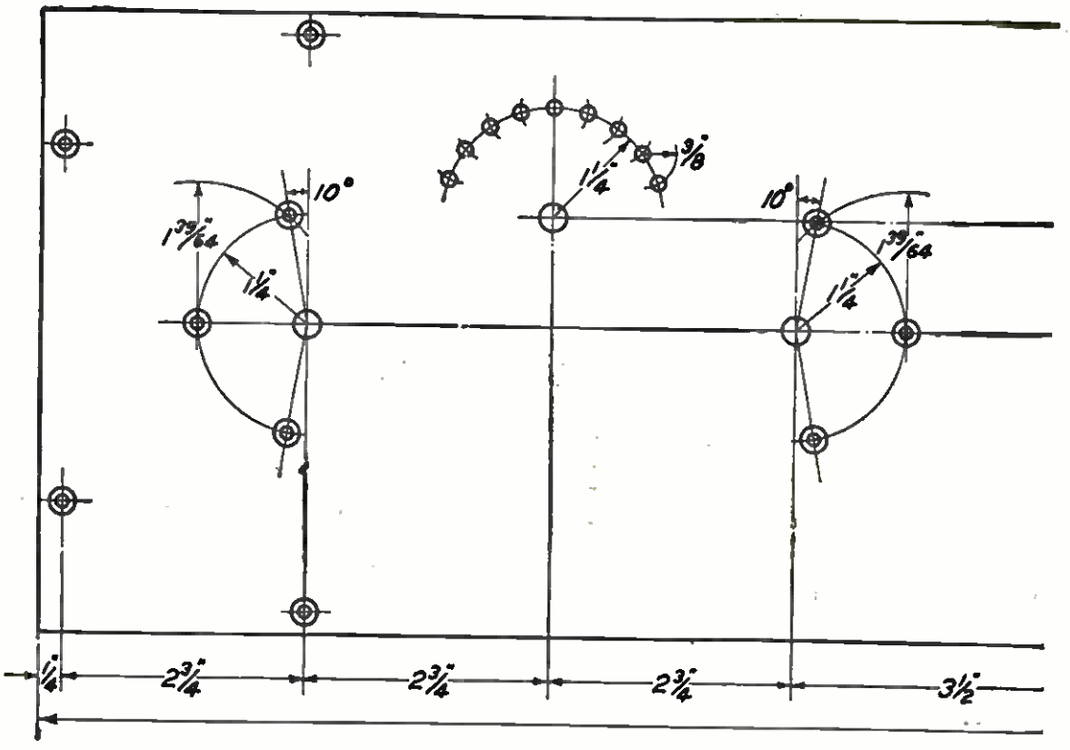
The last construction job is to cut out and mount the two small connection blocks X1 and X2. These should be cut to size, as shown in Figure 10. Then the holes should be drilled and the plug terminals numbering 1 to 8 should be fastened on. (These Rajah terminals serve instead of binding posts and are practical and better than binding posts, for they make a better connection and are easy to snap on or off. With these the whole set can be connected or disconnected in fifteen seconds.) Attach the small brass, mounting brackets Y, detailed in Figure 10, to the connecting blocks and mount the blocks in their proper places as shown in Figures 3, 5, 6 and 7.

This completes the construction and the wiring can be started.

How to Wire the Set

The design of this set is such that the grid-circuit wiring of each of the five tubes may be made extremely short and isolated from the other circuits. In fact, all the tuning circuits and leads are so arranged that short connections may be used. As this is the case, the set may be wired with bus-bar with little loss in efficiency.

A tinned-copper, round bus-wire is recommended. All connections should be first shaped so that they will fit and then soldered carefully in place. Refer to the wiring diagram in Figure 1 and more specifically to the



THE DRILLING PLAN FOR THE PANEL

FIGURE 8: *This drawing shows where to drill the holes for mounting the instruments. The correct spacings are given for the holes. The holes outlined with a double circle should be countersunk.*

picture diagram in Figure 2, for the exact way to run the wires.

Start by wiring up the condenser E to the coil C, being sure that the rotor and stator connections go as shown in Figure 2. Then, wire up the switch points S to the taps on coil D. The coil A is made of bus-wire run from terminal No. 1, on connection block X2, and looped around coil C, as shown in Figure 2. The other end of the loop is bent and soldered to the top tap on coil D, as shown.

Next, run a wire from the switch lever R over to one side of the four amperites L1, L2, L3 and L4, and to terminal No. 4 on the potentiometer-rheostat K, as shown in Figure 2. Run an extension of this wire to the negative terminal of the detector tube socket J1, and over to one side of the grid-leak I, then to terminals No. 2 and No. 3, on the connection block X1, and thence on to the screw that holds the transformer N to the base, and then continue it up to the second terminal of the transformer N, counting from the direction of the panel U. A further extension of this wire should be made to the outside terminals of the three grid-leaks P1, P2 and P3. Connect the remaining terminals of the four amperites L1, L2, L3 and L4 with the respective negative terminals of the sockets J2, J3, J4 and J5 as shown. This whole series of connections can be clearly followed by referring to Figure 2.

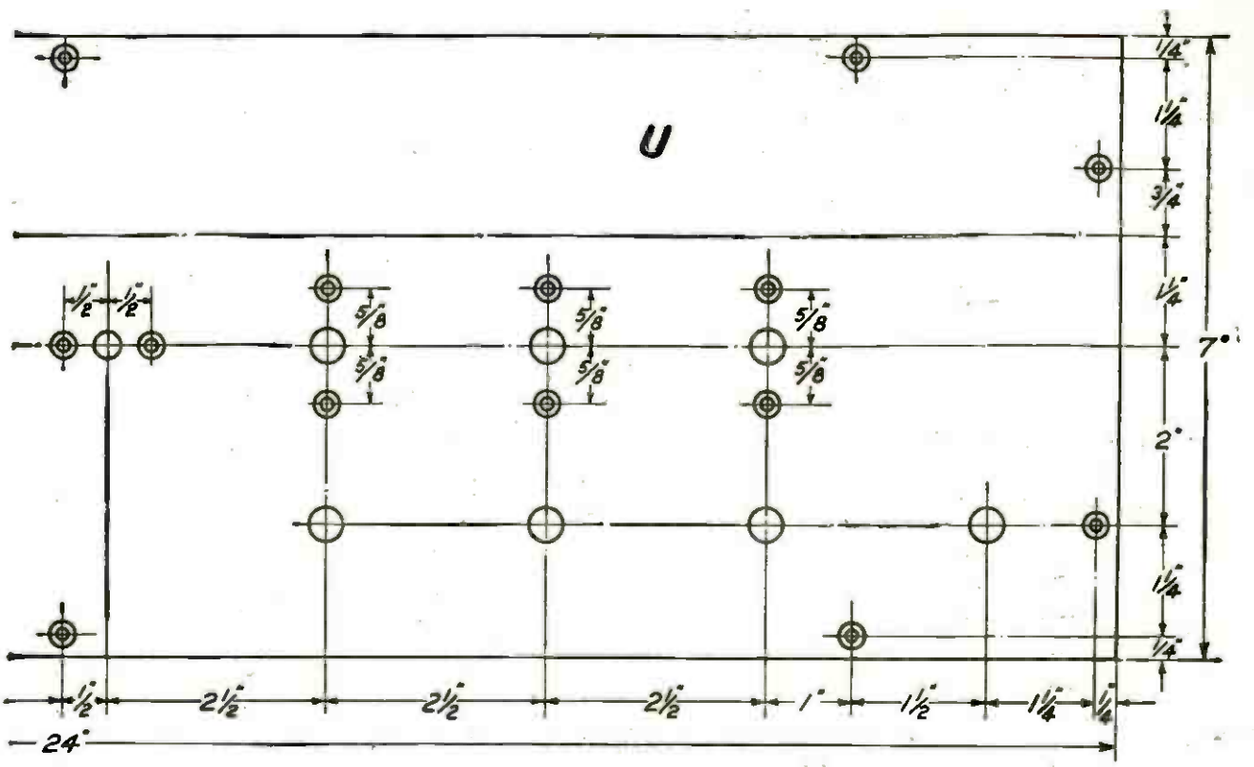
Then, connect the stator plates of the condenser F by a wire running to the upper terminal of the coil B, and solder in the condenser G between this latter point and the grid terminal of the socket J1 and run an extension from here to the remaining terminal of the grid-leak I. Be sure that this condenser G is hung suspended by the wiring in the proper position, as shown in Figures 2, 3 and 5. Then, connect the rotor plates of the condenser F with a wire running to the lower terminal of the coil B and make an extension of this connection to include the plate terminal of the socket J1, the adjacent terminal of the grid-denser H, and the third terminal of the transformer N, counting from the direction of the main panel U.

Next, run a wire from the remaining terminal of the grid-denser H to the fourth terminal of the transformer N, and run an extension of this wire to the terminal No. 6, on the connection block X1.

When this has been finished, bridge terminals No. 4 and No. 7, on the connecting block X1 with a wire, and run an extension. in between tube sockets J1 and J2, over the lower terminal of the filament-lighting switch T, as shown in Figure 2. The upper terminal of this switch should be connected by a wire to the terminal No. 1 on the potentiometer-rheostat K and an extension should be run from here over to the four positive filament connections of the four tube sockets J2, J3, J4 and J5.

Now, connect the four adjacent terminals of the amperites to the four respective negative-filament connections of the above-mentioned tube sockets. (See Figure 2.)

Then run a wire from terminal plug No. 8 on the connection block X1, around the outside edge of the set and over to the lower terminals of each of the jacks M1, M2, M3 and M4. This wire can be threaded right through the



holes in the jack binding posts and the small screws tightened up to make a stout connection.

Now, connect up the two terminals of the Bradleyohm O1 with the two horizontal terminals of the jack M1. Do likewise with the terminals of the Bradleyohm O2 and the two horizontal terminals of jack M2. Do likewise with the Bradleyohm 03 and the jack M3.

Next, take three of the .005 mfd. condensers that make up the grid condenser Q1 and insert a brass screw through each of the two larger holes so that the three condensers will be connected in parallel. Tighten up with two nuts, screwed down tight, so that there will be a good connection. See Figures 3 and 5 for the correct way to fasten these condensers together, and where to place them. Then do the same for condenser bank Q2 and Q3.

Now, run a wire from the right-hand screw of condenser bank Q1, looking from the rear of the set as shown in Figure 2, over to the plate terminal of the socket J2 and run an extension of this wire over to the top terminal binding post of the jack M1. Do likewise with the right-hand screw of condenser bank Q2, the plate terminal of socket J3 and the top terminal binding post of the jack M2. Then do likewise with condenser bank Q3, socket J4 and jack M3.

Next, connect the plate terminal of socket J5 with the top terminal binding post of jack M4. Be sure to follow the diagram in Figure 2 for the proper way to run these wires.

Now, connect the remaining screw on condenser bank Q1 with the grid terminal of socket J3 and run an extension over to the adjacent terminal of the grid-leak P1. Do likewise with the remaining screw of condenser bank Q2, the grid terminal of socket J4, and the adjacent terminal of the grid-leak P2. Do likewise with Q3, socket J5 and grid-leak P3. (See Figure 2.)

Then, run a wire from terminal plug No. 5 on the connecting block X1, over to the terminal No. 3 on the potentiometer-rheostat K. Run another wire from the terminal No. 2 on the potentiometer-rheostat K over to the remaining terminal on socket J1, the positive filament terminal.

The last connection to make is the wire running from the grid terminal of socket J2 over to the first terminal of the transformer N counting from the direction of the main panel U.

This completes the wiring of the receiver.

How to Install the Set

After the set has been completely wired, the cabinet may be attached by means of wood screws (nickel plated) inserted through the panel into the edges of the cabinet.

The terminal plugs Nos. 1 to 8 on the connection blocks X1 and X2 will now protrude through the slot cut for them in the back of the cabinet.

To connect the set, do the following:

Attach the antenna lead-in wire to the terminal plug No. 1.

Attach the ground lead wire to the terminal plug No. 2.

Attach the "A" battery and the "B" batteries according to the diagram of connections given in Figure 11.

For the detector, insert one UV-200 or one C-300 vacuum tube in the first socket, J1.

Insert one UV-201-a or one C-301-a tube in each of the remaining sockets, J2, J3, J4 and J5.

The set is now ready for use.

Operating Data

To place the set into operation, pull out the red plug on the switch T, and adjust the smaller knob on the potentiometer-rheostat K for the proper filament brilliancy of the detector tube. This is usually about three-quarters of the way on. Turn in a clockwise direction to increase the brilliancy. The larger knob on the potentiometer-rheostat K controls the plate potential applied to the plate circuit of the detector tube. Turn in a clockwise direction to increase regeneration and to get louder signals. (Turning in the opposite direction decreases signal strength, but sometimes helps in getting better reproduction.)

The filaments of the other four tubes need no adjustment, as this is taken care of, automatically, by the amperites L1, L2, L3 and L4.

Turn the three Bradleyohms O1, O2 and O3 all the way as far as they go in a clockwise direction.

Next, insert the loudspeaker plug into the jack M3, and look at the broadcasting program in the newspaper for a local station that is broadcasting at the time. Find out the wavelength of this station and consult the chart in Figure 12. This chart will tell you how to set the two dials. Both dials should be set to the same figure.

Suppose the station you pick out is on 360 meters. Pick out the perpendicular line on the chart that runs through 360 meters on the bottom scale. Follow this line up until it hits the curved line. Then follow the horizontal line, which crosses the curved line at the same point, until it ends up on the scale at the left. This will be in this instance 27.5.

This is the dial setting for 360 meters, and when you set both dials to 27.5 you will hear the station you are trying for, provided you have made no mistakes in connections and that you have used the instruments called for in this description and instruments of the correct size.

Then, turn the three Bradleyohms O1, O2 and O3 one at a time in a counter-clockwise position until you get the loudest signals. If you turn too far, the signals will die out.

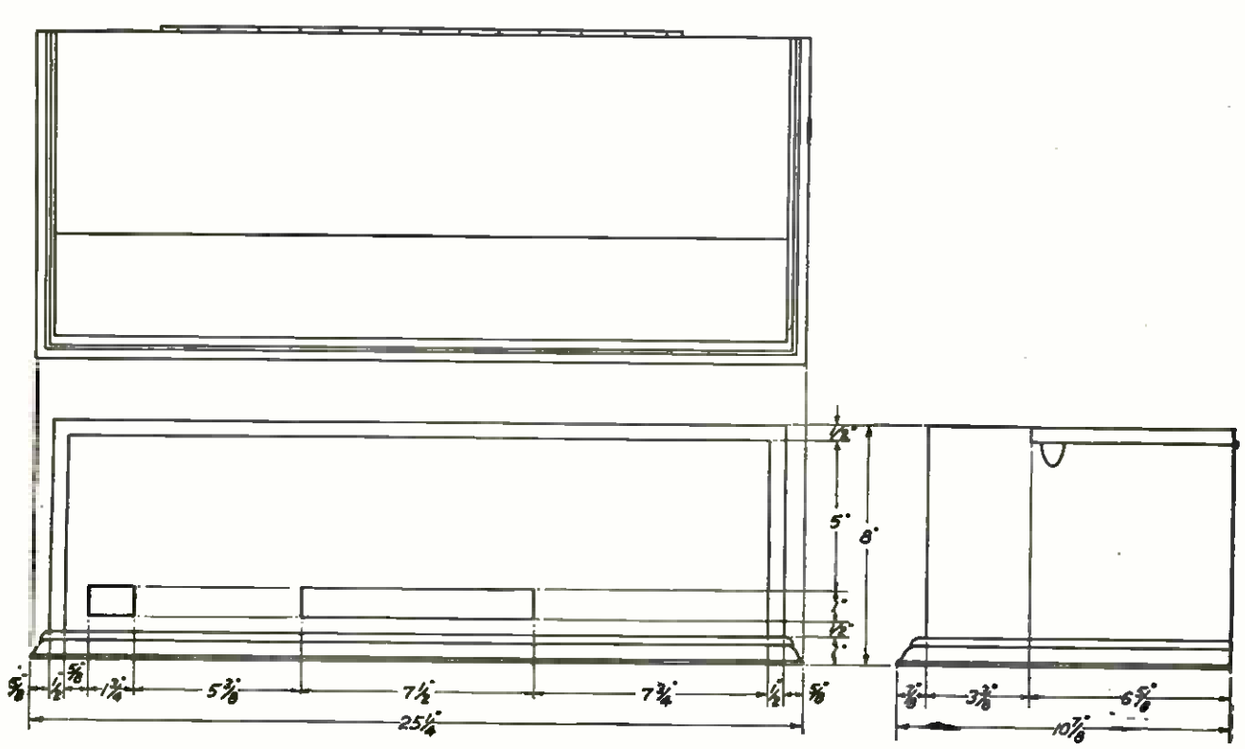
Jack M1 is for the headphones, jacks M2 and M3 are for the loudspeaker for local reception, and jack M4 is for distance reception on the loudspeaker.

All you have to know is the wavelength of the station you want to receive and the chart will tell you how to set the dials. The switch lever R should be set for the maximum signal strength after the two dials E and F have been set.

The only further adjustment necessary is the two knobs on the potentiometer-rheostat K. These will enable final adjustment to be made for clarity and proper signal strength.

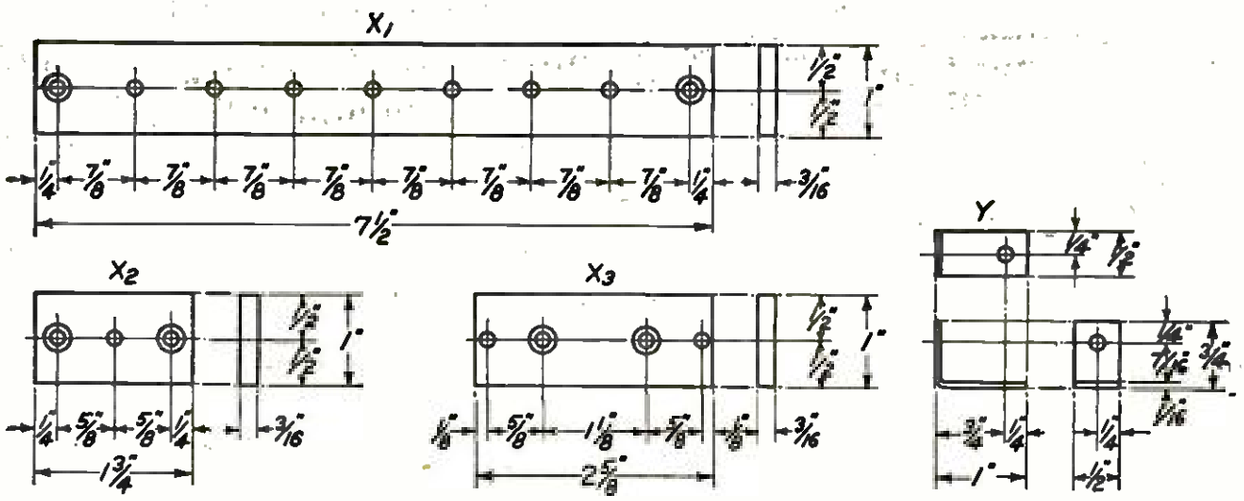
With any kind of antenna 100 feet long, of one or two wires (preferably two) the operator, when he has thoroughly mastered tuning and can remember the dial settings, ought to be able to tune in any station in the country and many outside of its boundaries.

No interference should be experi-



THE DIMENSIONS FOR THE CABINET

FIGURE 9: *This diagram (which contains the top, front, and side measurements for the walnut cabinet) may be turned over for construction to a competent cabinet maker who can build it from these directions exactly the right size for the panel.*



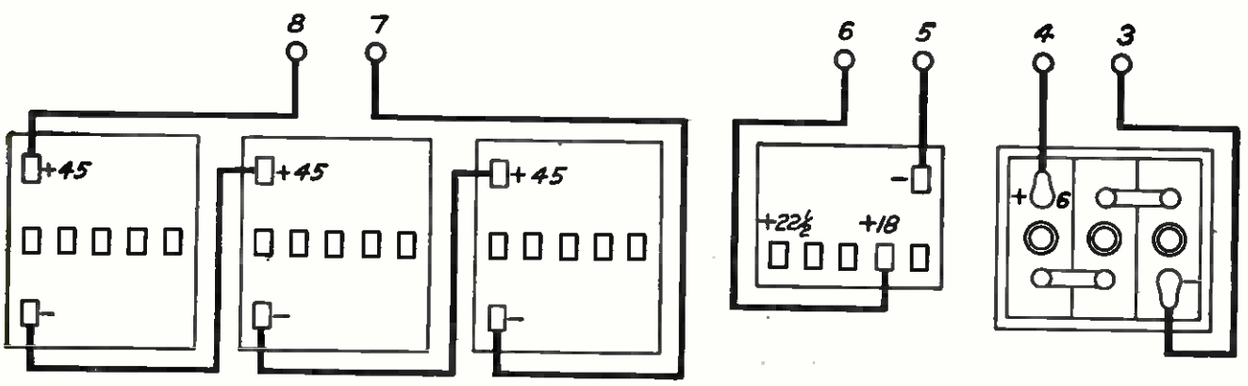
DETAILS OF THE SMALL PANELS AND BRACKETS

FIGURE 10: *This drawing gives the necessary data for making the two small panels for the connection blocks, and the small panel for mounting the grid-leak. It also gives the dimensions for the small brass brackets that are used for mounting the connection blocks.*

enced even up to distances as close as one-quarter of a mile of the powerful broadcasting stations. The set should give a quality of reproduction unsurpassed by any other type of receiver.

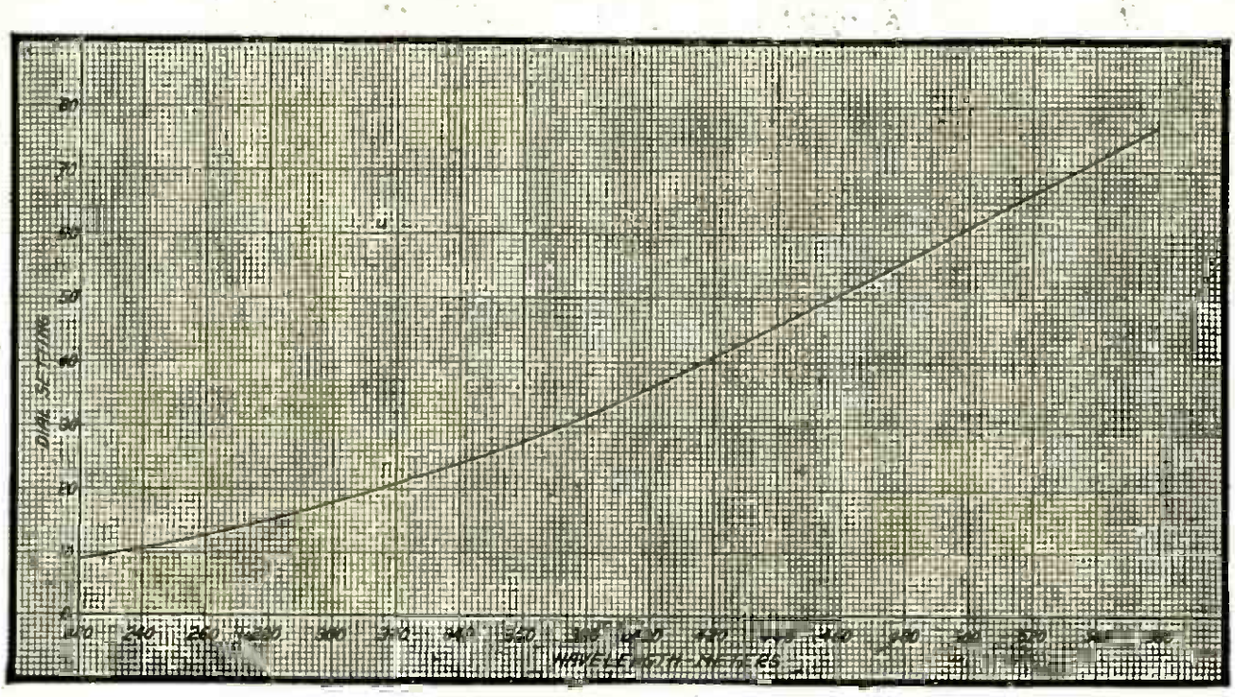
There is no quality, perhaps, outside of selectivity, that a receiver should have that is more important than the quality of truthfulness of reproducion. This is the main consideration that has been kept foremost in the work that has produced this newer receiver that embodies the four-circuit principle. To have a received program sound natural and without extraneous noises, without distortion, without interference from other stations, this is the goal that has been aimed at and really accomplished.

Anyone can duplicate the results that have been accomplished in the laboratory set, from which the preceding instructions have been made up, *if he will follow the instructions as given, exactly.* Use the instruments called for. Use them in the positions called for in the diagrams and last but not least, wire them up as called for in the diagrams. Then the set will give you the proper results, if the experimenter uses good tubes and a good antenna, and follows the tuning chart which is shown in Figure 12.



HOW TO HOOK UP THE BATTERIES

FIGURE 11: *This drawing prevents you from making mistakes in connecting the batteries to the terminals. If you follow these instructions the set will be hooked up correctly because the terminals shown in the wiring diagrams are marked with numbers that correspond with the numbers given here. If the operator wishes, he may use only two 45-volt sections of "B" battery connected between terminals 7 and 8 instead of the three shown. This will reduce signal strength only slightly.*



THIS TUNING CHART TELLS YOU HOW TO SET THE DIALS

FIGURE 12: *Cut out this diagram and paste it securely in the lid of the cabinet. To find any wavelength, and therefore, any station of which you know the wavelength, all you need do is to pick out the perpendicular line that cuts through the wavelength you want; follow the line up to the curved line and then follow the horizontal line, which also runs through the same spot on the curved line, until you end up at the left-hand scale setting which gives the proper settings for both dials, E and F. This is all you need to do to tune the new set.*

Working Blueprints of This Receiver

IN order to accommodate readers who may desire actual-size diagrams of this Four-circuit Tuner with Resistance-coupled Amplifier, a set of three blueprints has been prepared, consisting of—

One panel pattern (actual size);
One instrument layout;
One picture diagram of all parts, showing the wiring.

This set of three prints will be forwarded, postage prepaid, upon receipt of $1.10.

From a photograph made for POPULAR RADIO

With only a short antenna strung about the hotel room, the author is able to bring in the broadcasting from distant stations. To keep the weight as low as possible, flashlight batteries are used. The tuning is simple.

A Radio Set to Pack in Your Suitcase

By D. E. McLEOD

HAVE you ever stopped overnight in a strange town and been forced by circumstances either to loaf about the lobby or to seek the seclusion of your room?

And have you been in the mood neither for sleep nor for reading—and wondered when someone would devise a miniature radio receiver that would make it possible for such travelers as yourself to carry their sets about with them and to listen in on the world?

As I am a radio fan during my time at home, and a traveling man by trade, I decided to build a radio receiver that would be small enough to be easily carried along, and at the same time sensitive and selective enough to warrant the trouble of carting it around with me while covering my territory.

Passing in review the usual home-built receiving sets with the thought of compactness and weight in the back of my mind, the first obstacle met with was the heavy, space filling, variable condenser.

I thought of using two variometers, but finally turned them down as too bulky. At last I came to the conclusion that the entire tuning device must be in one compact, light unit. After much pondering and investigating, a decision was made in favor of a double-rotor tuner to weigh about ten ounces. By using the first rotor for the antenna tuning, a small fixed condenser in the antenna circuit would serve in place of the heavy variable condenser and the second rotor would serve to tune the plate circuit. The tube and socket presented no problem as to weight, and by selecting the UV 199 or the C 299 tube, the second big obstacle—battery weight—was minimized.

In POPULAR RADIO* appeared an article by Spencer Boyd that gave direc-

* For July, 1923, page 49.

tions and wiring diagrams for a receiving set that seemed to me to present possibilities for extreme compactness and light weight.

Traveling salesmen have not much time for home construction work, so I bought all the parts ready-made and the total cost ran to about twenty-five dollars. Here is a list of the items:

1 vacuum tube, type UV 199 or C 299;
1 rheostat, 30 ohms resistance;
1 "A" battery of 3 flashlight cells;
1 "B" battery, small size;
2 dials not over 3 inches in diameter;
1 fixed condenser, .002 mfd.;
1 fixed condenser, .00025 mfd.;
1 grid-leak, 3 megohm resistance;
1 socket;
1 double-rotor tuning unit;
1 panel, 4 inches by 12 inches;
1 special cabinet;
bus-wire, screws, etc.

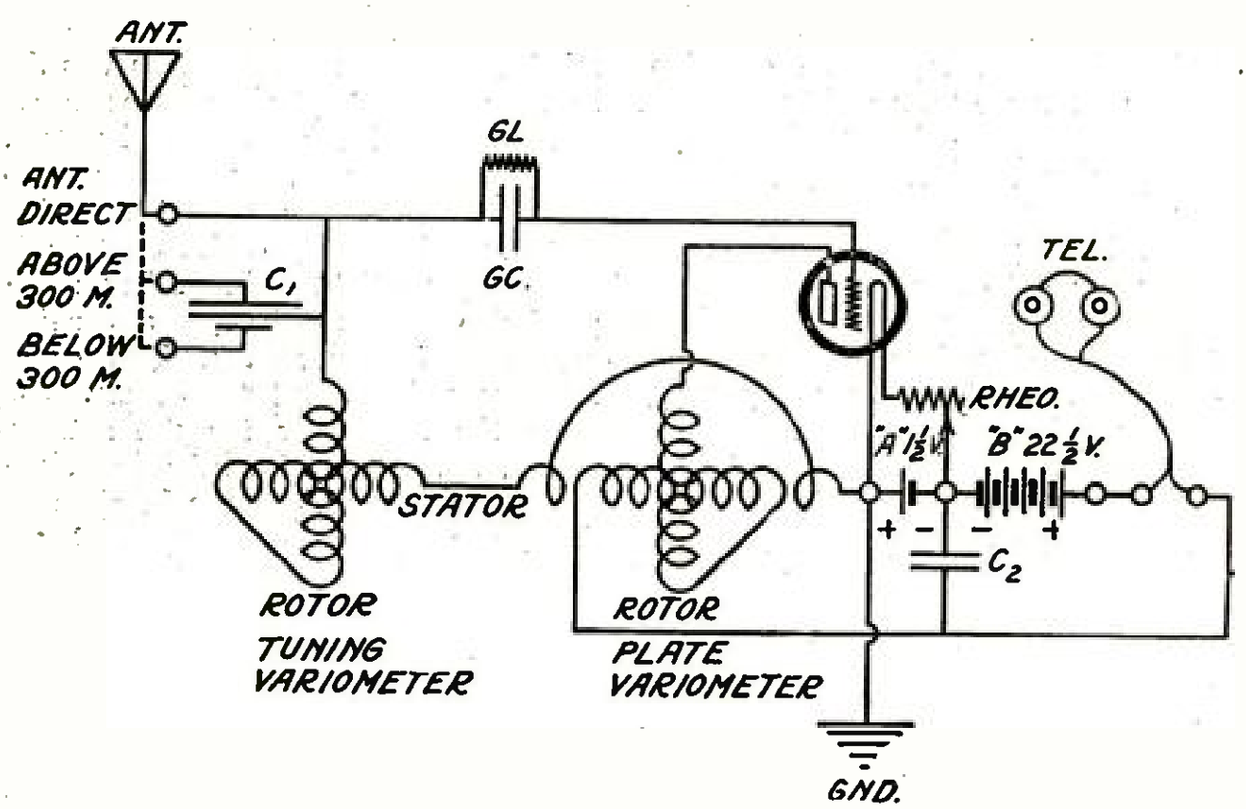
Figure 1 shows the wiring diagram. My panel measures 4 by 12 inches and the cabinet is 4½ inches deep. This size is right if you want to include the "A" and "B" batteries inside the cabinet.

The ground wire is ten feet long and is kept wound around the outside of the cabinet. The antenna consists of fifty feet of wire packed in a separate cardboard box. Any light, flexible, covered wire will do.

In modern, steel-framed hotels, where metal lath is used in the walls, it is best to hang the antenna outside the window, preferably after dark, so that some curious guest on a lower floor will not give it a yank just to see what will happen. In the older wooden hotels the antenna can be strung over the transom and down the hall or simply draped around inside the room.

Now for a report of actual results.

The first time I tested the set was in a corner hotel room in the White Mountains. After I had strung the antenna down the hall and made the ground connection fast to the water pipe in the bathroom, I turned on the tube and rather skeptically rotated the dials. Suddenly a clear, strong voice



HOW THE SET SHOULD BE WIRED UP

FIGURE 1: *The instruments are here shown diagrammatically in their proper places in the circuit. The wires connecting them together should be run from one instrument to the other in the shortest path without touching any other instrument.*

announced, "this is KDKA at East Pittsburg, Pennsylvania."

The following night at Berlin, N. H., in a valley behind the whole range of the White Mountains, flanked by pulp-mill dynamos and high-strung power lines, WGY, Schenectady, came in strong enough to permit five persons to listen to a concert while the phones rested on the table. Later, WDAP, Chicago, came in fairly well. In New Haven, Conn., with the antenna wire thrown out of the window and hanging close to the wall, I received PWX, Havana, with reasonable strength. In a hotel in Vermont, several stations between Chicago and that point could be brought in satisfactorily. Only one hotel out of a dozen tested, offered serious trouble and that was probably due to its electric elevators.

If you are a radio fan and a traveler, the little set will prove well worth building.

The Radio-Grouch

THOSE awful noises we heard in June were not static but the collapse of political booms.

* * *

EVEN the radio has failed to make bedtime popular with the juvenile masses.

* * *

NOW we know how a candidate looks in the news reels and how he sounds in the radio. It's getting harder and harder to put anything over on us.

* * *

HEREAFTER the wise statesman will remember that he is also in the public ear. Chairman Mondell at Cleveland uttered a confidential "damn" and all America snickered.

* * *

IF they'd charge candidates ten dollars a minute for broadcasting, maybe it won't take some of the candidates quite so long to pass a given point.

* * *

AN Iowa robin's song was heard during the broadcasting of a sermon and now divine services have a lot of brand new friends.

* * *

IT'S time the farmers stopped complaining. Seventy-five stations now tell them how high agricultural prices are.

—HOWARD BRUBAKER

From a photograph made for POPULAR RADIO

THE "RADIO LECTURE" ROOM OF TOMORROW

The lecturer need know nothing of his subject and it is not necessary for him to glance at the picture while it is being projected. He simply reads the single illuminated line of the lecture which appears in the top of the desk. As the projection of the picture proceeds, the visible line of the lecture changes in perfect synchronism.

HARNESSING THE

Radio and the "Movie"

The amazing new "movie-desk" that enables a lecturer both to make his talk and to give a perfectly synchronized demonstration before an unlimited audience

By FREDERIC M. DELANO

IF an eminent professor of biology were asked today to demonstrate before 100,000 people at the same time the interesting discoveries that he had made in the digestive system of the tadpole, he would imagine, doubtless, that he had been accosted by a lunatic.

And, if our professor happened not to be familiar with one of the latest radio developments in France, he would be justified in considering such an idea a symptom of lunacy. To dissect a tadpole before a class of even fifty students so that all of them can see it and can hear what you say, is almost an impossibility, even with every possible help from

modern projection lanterns and similar devices.

An illustrated lecture with motion pictures or lantern slides cannot reach more than a few hundred people at a time. To talk before a microphone and have your words go out to 100,000 people or to 1,000,000 people is simple enough, but your hearers are technically blind. They can hear you but they cannot see what you do. An essential element of the demonstration, the visual element, is lacking.

This constitutes an extreme difficulty in the wide and rapid diffusion of knowledge. It is why our colleges are so overcrowded. Certain courses are almost impossible to get into. Popular professors are so rushed with the press of students that they are worn out, unfitted for their work and especially for the making of new advances in the special branches of science in which their interests lie.

And at the same time millions of young men all over the world are longing for a college training which they cannot obtain at all because they lack the means to drop their occupations, travel to a college town and spend four years or more apart from their real business of earning a living.

This situation has been the opportunity of that excellent American invention, the correspondence course. But cannot we do better? Is there not some way in which the advantages of the university can be carried both to the eyes and to the ears of the millions who long for education but cannot afford it on its present basis?

A device recently developed in Paris promises to answer this question in the affirmative. A Parisian company is actually beginning the commercialization of this device; a new method of linking a radio lecture to a motion picture. It suggests what we might call the "Radio-movie University" for everybody.

This new device was invented by a young French engineer, Monsieur Charles Delacommune. He calls his invention the *Ciné-pupitre*, which means, literally, the "movie-desk."

When M. Delacommune began working on this invention he had little idea of its application to radio. His whole thought was that great lecturers, scientists or orchestra leaders have not the time to go out into the provinces, giving the citizens of the smaller towns the benefit of their knowledge and skill of their own subjects. Yet there are such great possibilities of error in illustrated explanations that another man trying to read a lecture, prepared by a great scientist, to accompany, for example, a motion picture, would be apt to get off the track and destroy the unity of the lecture and the film. A projection machine cannot stop and turn back for phrases that have been missed.

So this young Frenchman developed a little desk, somewhat suggestive of a school desk, except that slightly above its center there is an oval aperture into which is fitted a piece of plain window glass. Under this glass there is a roll of paper moving upward in much the same way that a pianola roll moves down. Below the roll of paper is another wooden board with a slot in it. Through this slot passes the beam of light from a small electric light so that the beam shines on the under side of the paper.

This beam of light is the width of one typewritten line of the lecture that is written on the roll of paper. This roll moves upward one line at a time over the beam of light. One line of the lecture to be delivered is visible at a time, and this lecture corresponds to the motion-picture subject that is being thrown on the screen. The movement of the paper roll is controlled from the motion-picture projector, not from the desk.

Beside the projection apparatus M. Delacommune has placed what he called a "distributor," to control the movement of the paper roll in the movie-desk, the roll that carries the lecture. The distributor is actually a little box contain-

ing a set of levers pressed upward by springs against a paper band. This band moves across the front of the distributor in time with the film going through the projector.

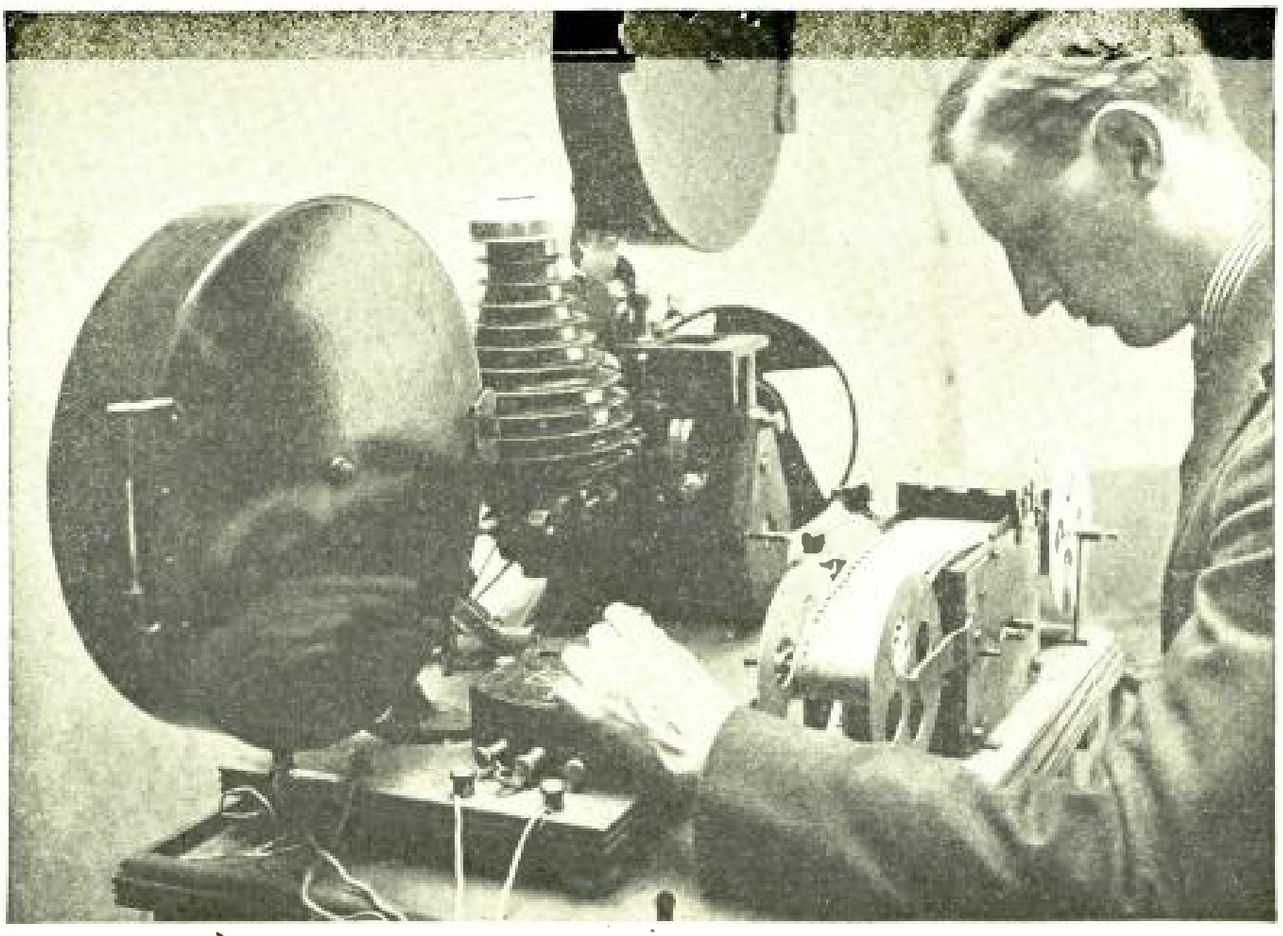
This band is perforated to represent either certain scenes in the film or so many feet of it. Each time that a perforation passes over one of the levers the latter jumps up, forming an electric contact which passes to an electromagnet beside the upper or receiving reel of the speech-roll in the movie-desk. This electromagnet moves a ratchet system on the roll, pulling the paper up one notch farther for each contact established.

This produces, automatically, a perfect synchronization of the motion picture and the paper roll. A layman, knowing nothing of his subject, can sit down before the movie-desk and read in perfect time to the film unwinding before his eyes a complete lecture on the most abstruse matters.

Not only that, but as he mentions the various parts, for instance, of a dynamo, a hand or pointer on the film will come into the picture, indicating the object referred to in the lecture. Only a blind man or a deaf one could miss the meaning of both lecture and film.

The "movie-desk" originally was developed with the idea of using it in the same theater in which the picture is shown. The further step of tying it to radio was very simple. A special receiving set, installed at the theater, a moment's test before operation, checked by telephone, and a radio lecture accompanying a motion picture is in progress.

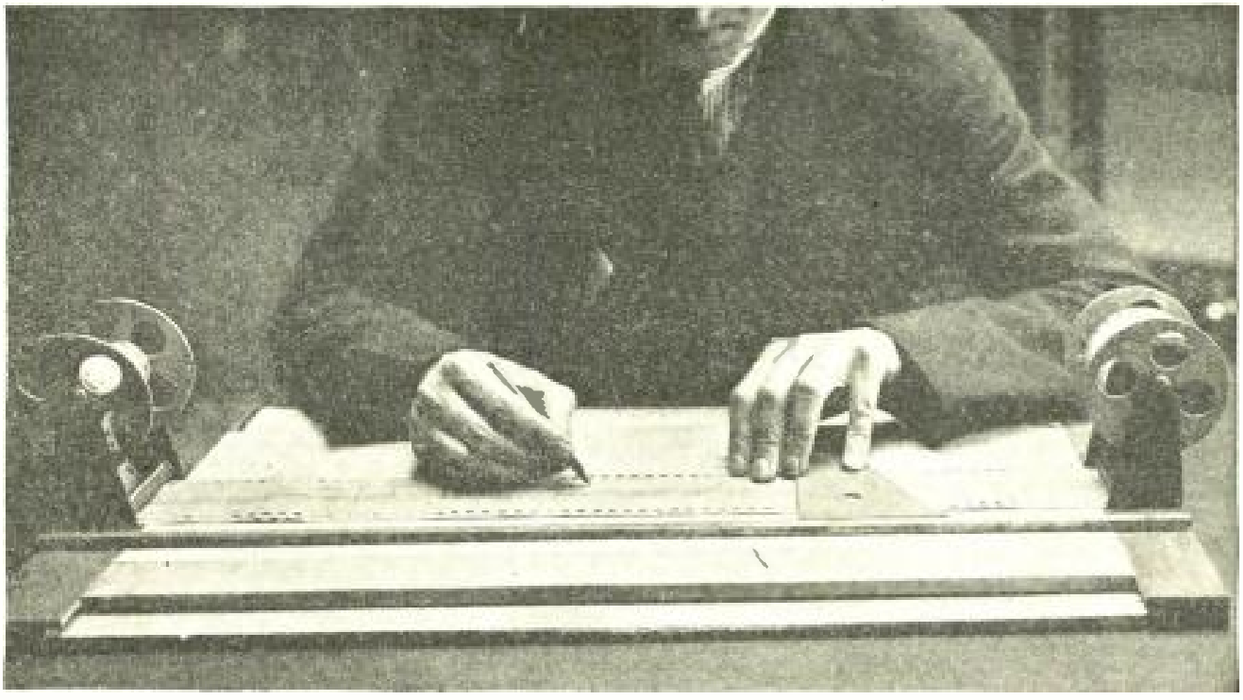
Or a full operatic ballet dances before



From a photograph made for POPULAR RADIO

PERFORATING THE FILM IN TIME WITH THE LECTURE

Each time a perforation in the film passes over a lever in the projection machine, an electric contact is made that operates an electric feeding mechanism for the paper roll on which the lecture is printed.



From a photograph made for POPULAR RADIO

CHECKING THE LECTURE ON THE PRINTED PAPER ROLL

The latest development of the ciné-pupitre *permits a lecture to be received at a distant hall by radio and the lecture delivered by a loudspeaker is perfectly synchronized with the projection of the movie film which illustrates it.*

the delighted eyes of the audience in perfect time with the orchestra in the theater; or, to speak more exactly, with the theater orchestra in perfect time with the ballet.

Perhaps one of the most impressive demonstrations of the revolutionary possibilities of this apparatus is the motion picture film which M. Delacommune is using now as an example of what can be done with scientific lectures.

This film portrays a kind of voracious and ill-mannered water insect catching and devouring a tadpole. With the tadpole appearing (on the film) to be almost twice the size of a man's head and the insect appearing equally large, there is little of the battle that one misses. First a black beetle and a tadpole are seem swimming about in a tank together. Suddenly the beetle seizes the poor polly-wog by the tail. The doomed tadpole puts up a mighty struggle for his life. In vain. Gradually it is sucked out of him by the relentless hunter.

At each sharp twist of victim or assailant, each change in the strangle hold of the attacker, the calm voice of the lecturer or the loudspeaker calls attention to the different means of defense attempted by the tadpole or to the maneuvers of the beetle.

When the final death scene is finished, the loudspeaker invites you to inspect the vitals of this cruel and powerful beetle. Whereupon the motion picture treats you to an underneath view of the beast, out of his tank, quite dead and enlarged to the full size of the screen.

"You will note," remarks the loudspeaker, "that the jaws of this voracious creature" (here a hand holding a sharp steel instrument reaches over on the screen and opens these wicked looking pincers) "are especially designed for the kind of attack you have just witnessed. The stomach (a pair of forceps pulls that organ into clearer view), forms the center of the alimentary tract." And so the demonstration—visual and aural—goes on.

Not a word is missed, not a false motion made. Every observer leaves the theater knowing something more of in-

sect life than when he entered, besides having a far greater respect for radio.

The next step forward will be, naturally, to have one lecturer do the work of a hundred or more. Then the eminent professor of biology mentioned at the beginning of this article will be able to make his demonstration to his hundred thousand auditors, or to as many more as he desires.

Films can be made up at will. Professor Bohr can describe his atomic theories; Major Armstrong can explain the modifications of his famous superheterodyne; Camille Flammarion can prove that the North Star has moved three degrees since prehistoric times.

In the April issue of POPULAR RADIO, Mr. Cockaday tells in writing how *not* to tune the single-circuit receiver. He uses a few photographs to illustrate his points. But suppose that you saw him actually set his hand on the different parts mentioned and move them properly. Suppose he showed them to you in his hand, telling you in his own voice at the same time why it is bad to do this or necessary to do that. No one would misunderstand a demonstration like this.

And everyone can hear, remember, the actual voice of the lecturer. He is talking at a broadcasting station. At each receiving station, in the scattered lecture rooms or theaters, there is a copy of the motion picture. This has been prepared and distributed in advance. At one projector, perhaps in the broadcasting station itself, there is the master "distributor." This controls the motion of the paper lecture roll on the desk before the speaker who is talking to the microphone. At the same time, by simple radio signals, it controls the motion of the projectors in the countless other theaters where the film it being presented and where the broadcast lecture is being received.

And so, even if a radio-vision apparatus for the actual broadcasting of sight does not become a reality, it may still be possible for students who live in Kansas City to go to college at Yale without ever leaving home at all. Lectures delivered at New Haven in the evening (so that persons who have to work in the daytime can listen to them) will be received in halls all over the country. And in each one of these halls there will be run off simultaneously the motion picture which gives the visual side of the same demonstration.

Distinguished teachers and scientists—Sir Oliver Lodge, Dr. Einstein, Professor Low—can bring the whole world into their laboratories and classrooms. Everyone in the United States who wishes to listen to the radio-movie lectures will know just what these men look like, how they talk and what they are talking about.

The university classrooms will be less crowded, and at the same time a vastly larger body of students will be reached by the world's great men. A reference library of films and lectures can be established in every radio broadcasting station, to which various colleges or associations can write for courses.

A college graduate of the future may well have a diploma in chemistry from the University of Michigan, in physics from Columbia, in biology from Harvard, in psychology from Yale and in botany from Pennsylvania—all without ever having left his home town of Springfield, Illinois!

How Do Atoms Broadcast Ether Waves? How Do Other Atoms Receive Them?

"In the answers to these two questions lie the secrets of the universe itself—secrets which science is slowly deciphering," states Dr. E. E. Free in his article in the next issue of POPULAR RADIO*—for November. And then he tells what science has done and may do in the solution of this all-important problem.*

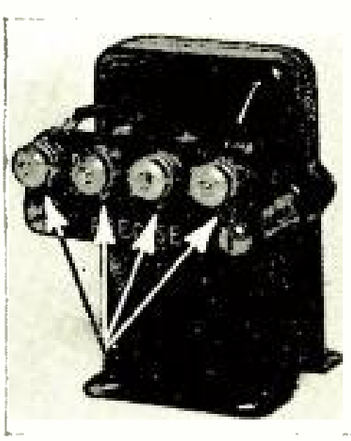
THIS *department is conducted by* POPULAR RADIO LABORATORY *for the purpose of keeping the radio experimenter and the broadcast listener informed concerning the newest inventions and the approved developments in radio equipment. Only such apparatus as has been tested and endorsed by the Laboratory is noted in these columns.*

VARIABLE CONDENSERS

Variable condenser; Coto Coil Co.
Connecticut condenser; Connecticut Tel. and Elec. Co.
Chelten "Special" condenser; Chelten Electric Co.
Chelsea condenser; Chelsea Radio Co.
Cardwell condenser; Allen D. Cardwell Mfg. Corp.
Flewelling condenser; Buell Mfg. Co.
Bruno 3 in 1 variable condenser; Bruno Radio Corp.
Lifetime condenser; Bremer-Tully Mfg. Co.
Super variable condenser; J. T. Boone Corp.
Condenser plate cleaner; Atwood Electric Co.
Aragon neutralizing condenser; Aragon Radio Co.
Fada variable condenser; F. A. D. Andrea, Inc.
Variable condenser; Amsco Products, Inc.
Amplex grid-denser; Amplex Instrument Laboratories.
Worm-drive vernier condenser; American Brand Corp.
Variable condenser; Acme Apparatus Co.

JACKS

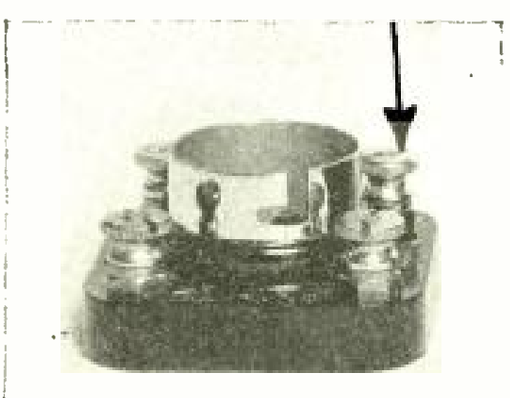
Radio jack; Adams Radio Mfg. Co.
Tri-jack; Brooklyn Metal Stamping Co.
Carter portable jack; Carter Radio Co.



Terminals plainly marked

TO INSURE TRUTHFUL REPRODUCTION

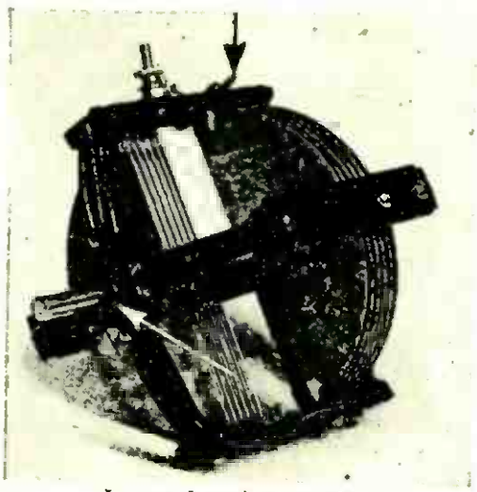
Name of instrument: Audio-frequency transformer.
Description: A well-made, shielded transformer with a neat connection panel equipped with four binding posts which are stamped for the proper connections in an amplifying circuit.
Usage: In an audio-frequency amplifying circuit, as an interstage coupling.
Outstanding features: Good reproduction at all audio-frequencies. Connections brought out neatly and plainly marked.
Maker: Precise Manufacturing Co.



Slotted binding post nuts for tightening

SOCKET FOR DRY-CELL TUBES

Name of instrument: Vacuum-tube socket.
Description: Midget socket made with a view to small size. The metal shell is stamped for holding the socket pin of the C-299 or UV-199 tubes. Four screws hold the stiff contacts and also serve for anchoring the binding posts.
Usage: For mounting dry-cell tubes mentioned above.
Outstanding features: Take up very small space on base. Good workmanship.
Maker: King Sewing Machine Co.



Large bearing surface

THREE CONDENSERS IN ONE

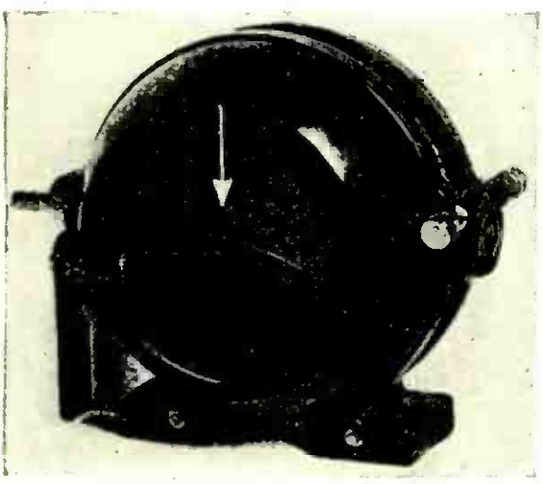
Name of instrument: Variable condenser.

Description: A balanced condenser built in two sections, with heavy bearings and having two rotor and two stator sections spaced opposite each other on the shaft. The sections may be used in series, giving lowest capacity range. or singly, giving the medium capacity range, or in parallel, giving the highest capacity range. Hard rubber is used for insulation.

Usage: In any radio-frequency circuit as a method of tuning.

Outstanding features: Triple range, low loss, and novel construction.

Maker: Bruno Radio Corporation.



No shellac on windings

A PLATE-CIRCUIT VARIOMETER

Name of instrument: Variometer.

Description: A well-made tuning device for either panel or base mounting with windings that are "dry," without shellac or other covering. The connections are brought out to two effective binding posts located at the rear of the instrument.

Usage: In any radio-frequency circuit as a method of tuning.

Outstanding features: Low minimum and high maximum inductance. Sturdy construction. Good bearings.

Maker: Radio Products Co.

RADIO-FREQUENCY TRANSFORMERS

Acme radio-frequency transformer; Acme Apparatus Co.
Tri-coil radio frequency transformer; Brooklyn Metal Stamping Co.
Cardwell radio-frequency transformer; Allen D. Cardwell Mfg. Corp.
Tuned-intermediate frequency transformer; Como Apparatus Co.
Radio-frequency transformer; Coto Coil Co.

RHEOSTATS

Rheostat; Cutler-Hammer Mfg. Co.
Vernier rheostat; Carter Radio Co.
Autostat; Automatic Electrical Devices Co.
Amsco rheostat; Amsco Products, Inc.
Regal rheostat; American Specialty Co.
Bradleystat; Allen-Bradley Company.
Acme rheostat and potentiometer; Acme Apparatus Co.
Fada rheostat; F. A. D. Andrea, Inc.

SETS IN KIT FORM

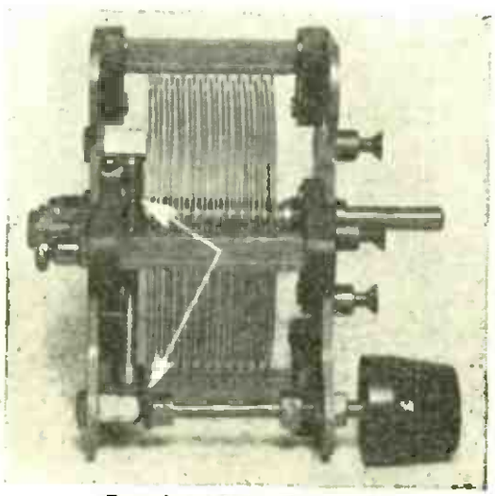
Reflex and super-heterodyne circuits; American Radio Mfg. Co.
Kits for Cockaday circuits, and distortionless amplifier; Amplex Instrument Laboratories.
Melco Supreme kit; Amsco Products Co.
Fada neutrodyne kit; F. A. D. Andrea, Inc.
Super-heterodyne kit; J. T. Boone Corporation.
Super-heterodyne kit; Chas. A. Branston, Inc.
"Nameless" circuit kit; Bremer-Tully Mfg. Co.

LOOPS

Super-folding loop aerials; J. T. Boone Corporation.
Calvert loop; Calvert Specialty Co., Inc.

PHONOGRAPH ATTACHMENTS

Atwater-Kent unit; Atwater-Kent Mfg. Co.
Dulce-Tone phonograph adapter; Cleveland Radio Mfg. Co.
C. I. C. phonograph attachment; Connecticut Instrument Co.



Bevel and worm gears

A CONDENSER WITH A WORM DRIVE

Name of instrument: Vernier variable condenser.

Description: A sturdy condenser constructed of brass, with a grounded rotor and large bearing surfaces. The stator plates are supported in a novel manner by small triangular-shaped insulators. The vernier is operated through two bevel gears and a worm giving a ratio of 100 to 1.

Usage: In any radio-frequency circuit as a method of tuning.

Outstanding features: Micrometer control. Low loss. Rigidity of construction.

Maker: American Brand Corporation, Inc.

GRID-LEAKS AND RESISTANCES

Bradleyleak; Allen-Bradley Company.
Bradleyohm; Allen-Bradley Company.
Amplex "Lavite" resistances; Amplex Instrument Laboratories.
Brady grid-leak; A-C Brady Co.
No. 106 adjustable grid-leak; Central Radio Laboratories.
Crescent "Lavite" resistances; Crescent Radio Supply Co.
Variable grid-leak; Cutler-Hammer Mfg. Co.

PANELS

Radion panels; American Hard Rubber Co.
Bakelite products; Bakelite Corp.
Condensite products; Bakelite Corp.
Redmanol products; Bakelite Corp.
Bakelite-Dilecto panels; Continental Fibre Co.

TUBES

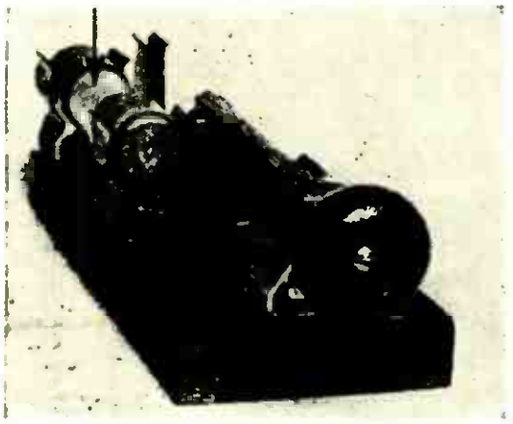
Sodion tube; Connecticut Tel. and Elec. Co.
Cunningham tube; E. T. Cunningham, Inc.
Dutch radio valve; D. R. V. Importing Co.

BATTERIES

Arrow storage batteries; Arrow Battery Co.
Radio "B" batteries; Ayres Battery Corp.
Burgess "A" and "B" and "C" batteries; Burgess Battery Co.
"A" and "B" batteries; Carbon Products Co.
Flashlight batteries; Champion Carbon Mfg. Co.
Copper Giant "A" battery; Copper Giant Battery Co.
No. 225 Storad unit; Cleveland Engineering Laboratories.

CRYSTAL DETECTORS

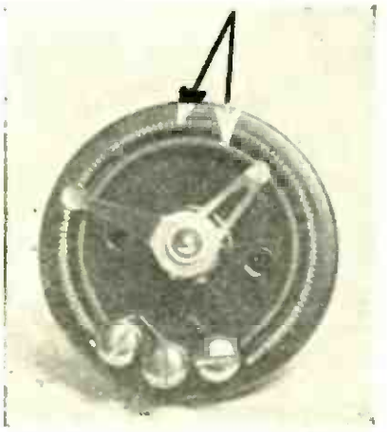
Reflex super-sensitive crystal; American Radio Mfg. Co.
Syn-tec radio crystal; Appliance Radio Co.
"B"-metal crystal; "B"-Metal Refining Co.
"De-tex-it" (fixed detector); Celerundum Radio Products Co.
Radio Reflex crystal; Century Products Co.
"Maxitone" crystal; Century Products Co.



Lightning arrestor on switch

ADEQUATE LIGHTNING PROTECTION

Name of instrument: Combination ground switch and lightning arrestor.
Description: Sturdy single-pole-double-throw knife switch, mounted on a slate base. The switch also contains a protective gap arrestor connected between the hinge and one of the outer switch contacts.
Usage: In an antenna circuit as a protection against static discharges.
Outstanding features: Provides a means of grounding the antenna when not in use and gives protection against surges when the receiving set is being used.
Maker: Barkelew Electric Manufacturing Co.



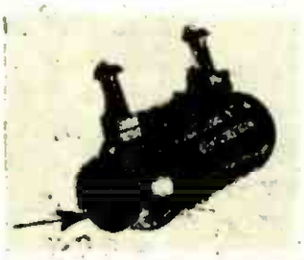
Double resistance windings

TWO RHEOSTATS IN ONE

Name of instrument: Double rheostat.
Description: The resistance windings of this instrument are wound on Egyptian fibre strip and inserted edgewise in a circular slot cut in the moulded-bakelite base. The three terminals are brought out so that two tubes may be controlled by the single instrument. This is done by a double knob and two sliders.
Usage: In the filament circuit of two vacuum tubes as a current control.
Outstanding features: Saves space on the panel, simplifies wiring, looks neat.
Maker: Amsco Products, Inc.

POTENTIOMETERS

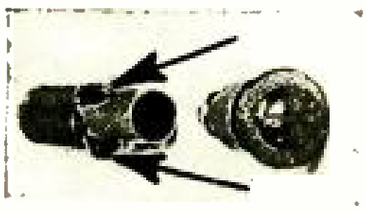
Acme potentiometer and rheostat; Acme Apparatus Co.
Bradleyometer; Allen-Bradley Company.
Regal potentiometer; American Specialty Co.
Amsco potentiometer; Amsco Products Co.
Fada potentiometer; F. A. D. Andrea, Inc.
400 ohm potentiometer; Central Radio Laboratories.
2,000 ohm potentiometer; Central Radio Laboratories.
C-H potentiometer; Cutler-Hammer Mfg. Co.



Convenient adjusting knob

A SEMI-FIXED CRYSTAL DETECTOR FOR REFLEX WORK

Name of instrument: Crystal detector.
Description: An inclosed crystal with an adjusting knob protruding from one end. There are two screws provided so that the whole tubular shell may be fastened directly to the front of the panel with the adjusting knob pointing upward.
Usage: In any detector circuit where a crystal may be used as a rectifier of weak radio-frequency currents.
Outstanding features: Good sensitivity. Not easily knocked out of adjustment. Easy to adjust. Good appearance.
Maker: R.-U.-F. Products Co.



Spring clips make good contact

A NEW FORM OF TERMINAL PLUG

Name of instrument: Connection terminal.

Description: One part of this terminal fastens directly to the panel like an ordinary binding post. The other part contains a pressure screw arrangement which clamps the connection wire in a tight grip. This second part snaps on to the first mentioned part with a click, making a good connection. All parts are nickel plated and make a good appearance.

Usage: In any place where binding posts or terminals are used as a means for connecting to batteries or antenna or ground.

Outstanding features: Tight connections. Quick action in hooking-up a set. Practical.

Maker: Rajah Auto Supply Co.

RECEIVING SETS

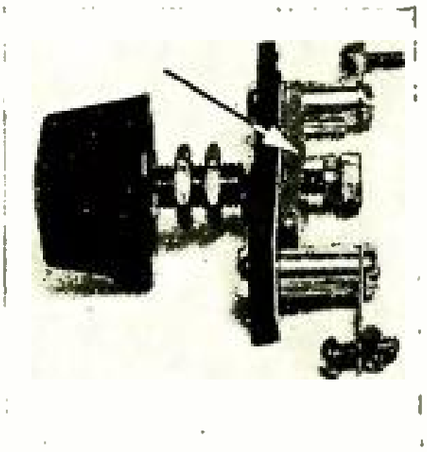
Teledyne receiver; Cutting and Washington Radio Corp.
Town and country receiver; Cutting and Washington Radio Corp.
C and W receivers; Cutting and Washington Radio Corp.
Crosley receiving sets; Crosley Radio Corp.
Chelsea receiver; Chelsea Radio Company.
Bristol receivers; Bristol Company.
Benson portable superflex; Benson Engineering Co.
"Baby Grand" crystal receiver; Beaver Machine and Tool Co., Inc.
Radio-frequency receiver; Atwater-Kent Mfg. Co.
Neutrodyne receiver; F. A. D. Andrea, Inc.
Melco Supreme receiver; Amsco Products, Inc.
Amrad receiver; American Radio and Research Corp.
Paragon receivers; Adams-Morgan Co.
A-C Dayton receiver; A-C Electrical Mfg. Co.
Clear-o-dyne receiver; Cleartone Radio Co.
Goldcrest Cleartone receiver; Cleartone Radio Co.

LOUDSPEAKERS

Dodge tone-amplifier; Ackerman Brothers Co., Inc.
Madera Clearspeaker; American Art Mache Co.
Atwater Kent Loudspeaker; Atwater Kent Mfg. Co.
Bel-Canto Loudspeaker; Bel-Canto Mfg. Co.
Sonochorde Loudspeaker; Bondette Mfg. Co.
Brandes Table Talker; C. Brandes, Inc.
Bristol Audiophone Loudspeaker; Bristol Company.
Callophone Loudspeaker; Callophone Co. of New York.
C. I. C. Loudspeaker; Connecticut Instrument Co.

SWITCHES

Fil-tone control switch; A-C Electrical Mfg. Co.
Inductance switch; Ackerman Brothers Co., Inc.
Inductance switch; Amsco Products, Inc.
Combined switch and arrestor; Barkelew Electric Mfg. Co.
Bruno inductance switch; Bruno Radio Corp.
Bruno double inductance switch; Bruno Radio Corp.
Inductance switch; Carter Radio Co.
Jack switch; Carter Radio Co.
Filament battery switch; Cutler-Hammer Co.
Filament battery switch; Allen-Bradley Co.



Adjustable compression bar

FOR THE GRID OF YOUR TUBES

Name of instrument: Variable grid-leak.

Description: A neatly made instrument with a fixed resistance element, which is partially or almost wholly short-circuited at will by flexing a curved spring with a clamp that is adjusted by revolving a knob. The knob is the only part of the instrument which protrudes through the panel when the device is mounted.

Usage: In the grid circuit of vacuum-tube detectors or amplifiers (resistance or impedance-coupled) as a grid voltage control.

Outstanding features: Resistance values vary without jumps. Smooth operation. Permanance.

Maker: Central Radio Laboratories.

TUNING INDUCTANCE UNITS

"Copp" vario selector; A-C Electrical Mfg. Co.
Silver radio-frequency outfit; Aragon Radio Co.
Atwater Kent units; Atwater Kent Mfg. Co.
Ballantine variotransformer; Boontown Rubber Mfg. Co.
Branston radio-frequency transformer; Chas. A. Branston, Inc.
Branston honeycomb coils; Chas. A. Branston, Inc.
Branston three-coil mounting: Chas. A. Branston, Inc.
Branston oscillator coupler; Chas. A. Branston, Inc.
Bremer-Tully tuner; Bremer-Tully Mfg. Co.
Flewelling tuner; Buell Mfg. Co.
Radio-frequency tuner; Chelsea Radio Co.
Antenna tuning unit; Chelsea Radio Co.
Compact variometer; Coto Coil Co.
Compact variocoupler; Coto Coil Co.
Honeycomb coils: Coto Coil Co.
Remler panel mounted variocoupler; E. T. Cunningham, Inc.
Remler panel mounted variometer; E. T. Cunningham, Inc.
Honeycomb coils; Atwood Electric Co.

AUDIO-FREQUENCY TRANSFORMERS

Audio-frequency transformer; Acme Apparatus Co.
Audio-frequency transformer; American Specialty Co.
Amertran audio-frequency transformer; American Transformer Co.
Fada audio-frequency transformer; F. A. D. Andrea, Inc.
Audio-frequency transformer; Allen D. Cardwell Mfg. Corp.
Audio-frequency transformer; Coto-Coil Co.
Globe audio-frequency transformer; Coyne Radio Service.
Crescent push-pull transformer; Crescent Mfg. Co.

Crescent audio-frequency transformer; Crescent Mfg. Co.
Duplex (push-pull) transformer; Como Apparatus Co.

BATTERY CHARGERS AND RECTIFIERS
Silent battery charger; Acme Engineering Co.
"S" tube rectifier; American Radio and Research Corp.
"B" battery charger; Apco Mfg. Co.
"A" battery charger; Apco Mfg. Co.
"Gold Seal" Homcharger; Automatic Electrical Devices Co.
Battery charger; Belmont Battery Co.
No. 4 Chemical Rectifier; Cleveland Engineering Laboratories.

SOCKETS AND ADAPTERS
Sockets and adapters; Alden Mfg. Co.
Amsco socket; Amsco Products Co.
Bell socket; Bell Mfg. Co.
Coto tube socket; Coto-Coil Co.

PHONE PLUGS
Ajax multi-phone plug; Ajax Electric Specialty Co.
Multiple phone plug; Barkelew Electric Mfg. Co.
Series phone plug and post; Barkelew Electric Mfg. Co.
Series phone plug for binding post mounting; Barkelew Electric Mfg. Co.
Cico 2-way plug; Consolidated Instrument Co.
Cico automatic plug; Consolidated Instrument Co.

POWER AMPLIFIERS
One stage power amplifier; Bristol Co.

HEADPHONES
Callophone headset; Callophone Co. of New York.
Navy Type headset; C. Brandes, Inc.
Superior headset; C. Brandes, Inc.
Ear cushion for phones; Bates and Co.

DIALS
Na-ald dials; Alden Mfg. Co.
Amsco dials; Amsco Products, Inc.
Bell dials; Bell Mfg. Co.
E-Z-tune dials; Butler Mfg. Co.
Radion dials; American Hard Rubber Co.
Regal knobs and dials; American Specialty Co.

RADIO CABINETS
Blandin radio cabinet; Blandin Phonograph Co., Inc.
Corbett's radio cabinet; Corbett Cabinet Mfg. Co.

MISCELLANEOUS ACCESSORIES
Ribbon copper aerial; Acorn Radio Mfg. Co.
Radio pin map; American Map Co.
Aragon silver wire; Aragon Radio Co.
Junior bench saw; W. J. Boice.
Bruno engraving set; Bruno Radio Corp.
Church automatic template; Clark and Tilson, Inc.
Pyrex insulator; Corning Glass Works.
Tuf glass battery tray; Russell B. Cressman.

¶ This list of apparatus approved by the POPULAR RADIO LABORATORY will be continued as a part of the WHAT'S NEW IN RADIO APPARATUS 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 goes only to the end of the letter C.

Gilliams

A RADIO SET FOR YOUR VEST POCKET

This unique crystal set, which costs but a trifle, is becoming popular abroad for local reception of the broadcasting in Continental Europe. Tuning is accomplished by turning the knurled knob in the center and the sensitive spot on the crystal is found by means of the knob at the lower left-hand corner.

CONDUCTED BY DR. E. E. FREE

Putting the "Starlight Detector" to Real Use

THE success of General Ferrié, M. R. Jouaust and Commandant Mesny in detecting starlight by a radio amplifier—the so-called "hearing starlight" experiments—has been noted already in this department.* Recent news from Paris discloses that two practical uses have already been developed for this remarkable apparatus.†

One of these uses is in the determination of standard time. The ray of light from a star is automatically recorded as it comes through the telescope. When the star passes a cross wire in the telescope, that marks the instant by which the standard time is set. The radio apparatus automatically detects and records this instant without the intervention of any human agency.

The other use of the apparatus was suggested at the last meeting of the Academy of Marine, in Paris, by General Ferrié himself. It is an application for signalling from ship to ship at sea. Light beams from one ship to another can be made to carry the signals and these beams can be made so feeble that they will be practically imperceptible to an enemy eye. The radio amplifiers at the receiving end will restore full power to the signal. It may be possible, even, to use beams of ultra-violet light, which are entirely invisible to the human eye.

Meanwhile, it develops that an American inventor, Mr. Theodore W. Case of Auburn, New York, had developed, independently of the work in France, an apparatus capable of converting light rays into radio signals.‡ Mr. Case is already known to radio engineers through his work with the thalofide cell, an especially sensitive variety of photoelectric cell employing as active material a compound of the metal barium.

His apparatus for "hearing" starlight makes use of this thalofide cell. The discharge of the cell is communicated directly to the grid of a gas-filled vacuum tube. With the building up of the potential due to the starlight the ionization in the vacuum tube increases until the gas finally breaks down with a disruptive discharge between the filament and the plate. This causes an audio-frequency note in the telephones, much as in the apparatus of General Ferrié and M. Jouaust.

Technically, the chief differences between the two methods lie in the use of different kinds of photoelectric cells (General Ferrié uses the familiar potassium cell) and in the fact that Mr. Case apparently makes his vacuum tube do double duty, both as an amplifier and as a condenser. The French scientists employ external condensers, a series of tubes, and a rotating interrupter, which makes the starlight intermittent and thus produces the audio-frequency note. It is probable that the French apparatus will prove rather more sensitive to very feeble light rays than the apparatus of Mr. Case.

* "Measuring Starlight with a Radio Amplifier." POPULAR RADIO for April, 1924, page 408.

† Information is from "The Radio Week in Europe," a news service by F. M. Delano, Jr.

‡ Described in an article written by Mr. Lemuel F. Parton for the *North American Newspaper Alliance*.

Electron Collisions That Produce Ions

WHEN a stream of rapidly moving electrons is directed against the atoms of a gas what happens is that some of the gas atoms are "ionized." One or more of the atomic electrons are knocked out and the atom becomes an "ion." This is what happens, for example, to the gas atoms in a "soft" vacuum tube or to the sodium atoms in the familiar sodion tube.* It is the sodium ions that operate this type of tube, not the free electrons as in ordinary vacuum tubes.

These phenomena are becoming of more and more importance in work with vacuum tubes and other electron devices. It is ioniza-

* The principle of the sodion tube was described in this Department in POPULAR RADIO for March, 1924, pages 302-304.

tion, too, that is supposed to be responsible for the creation of the Heaviside Layer and for the difference in radio transmission through the air in the daytime and at night. Full knowledge of the atomic and electronic relations that underlie these phenomena is one of the important needs of radio science.

Some quantitative measurements of interest have just been published by Drs. Found and Dushman of the General Electric Company.† They have determined the number of ions produced under known conditions by electrons colliding with atoms of hydrogen, helium, nitrogen, neon, argon and carbon monoxide gas.

It was found that not every collision produces an ion. In argon, for example, only about 24 percent of the actual collisions resulted (under the conditions of this experiment) in the production of an ion. It is interesting, too, that the probability of a collision producing an ion seems to be proportional to the number of electrons in the atom that is hit; the more electrons the atom has, the better chance there is that one of them will be knocked out.

† "Studies with Ionization Gauge. II. Relation Between Ionization Current at Constant Pressure and Number of Electrons per Molecule," by C. G. Found and Saul Dushman. *Physical Review* (Corning, New York), vol. 23, pages 734-743 (June, 1924).

Can We Hear Shooting Stars by Radio?

A NUMBER of readers have written to this Department to inquire about the theory, widely published in the newspapers, that the hissing variety of static is due to meteors which enter the earth's atmosphere and burn up, making what we call a shooting star.

There seems to be no conclusive evidence either way. These meteorites are believed to be small pieces of stone and iron, quite like the ones that fall to the surface and have been found by scientists, except that they are smaller, so small that the friction of the air consumes them altogether. The number of these small meteorites that enter the earth's atmosphere is enormous, probably more than one a second during every hour of the twenty-four.

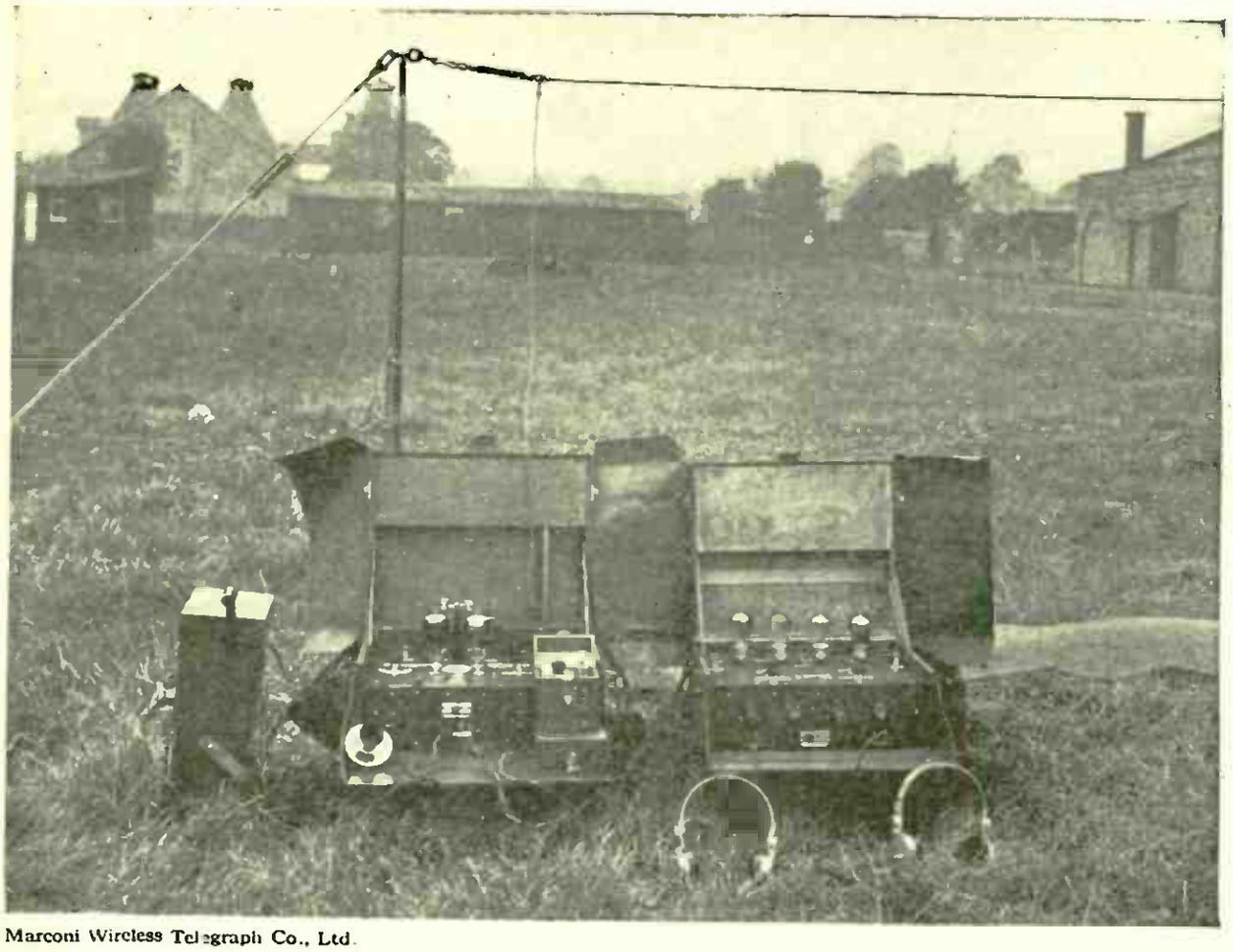
It is quite possible that the interaction of these bodies with the air might produce electric charges as well as heat and light. There is no scientific improbability, therefore, about the idea that static of some variety might be produced by them. But neither is there any evidence that static actually is so produced.

It would be well to try this out. Why do not a few radio fans who want to do some scientific work arrange their receivers so that

Courtesy of Mr. H. P. Donlé

THE MAN WHO PUT IONS TO WORK IN RADIO

Mr. Harold P. Donlé is the inventor of the sodion tube, the variety of radio vacuum tube that is operated by ions of sodium instead of by free electrons as in the usual varieties of tubes. Mr. Donlé is determining the current and voltage characteristics of the sodion tube shown on the table in front of him. The phenomena of ionization in gases is likely to play an increasingly important rôle in future radio developments.



Marconi Wireless Telegraph Co., Ltd.

THE LATEST MARCONI OUTFIT FOR MEDIUM WAVELENGTHS

This outfit, known as Type YP, is the latest product of the Marconi Wireless Telegraph Company, Ltd., of England, intended for quick portability in military use. The wavelengths used are from 190 to 260 meters. All apparatus is arranged in carrying cases so that it may be taken down and set up quickly; the photograph on the opposite page indicating how the entire outfit may be transported. The aerial consists of a single wire supported inconspicuously on posts only three or four feet above the ground.

they can see the night sky, listen to the static and at the same time watch for meteors? If there is any relation between the two it ought soon to be apparent. But such work should be done in the country, where there is less local interference from electric machinery than there is in the city, and where, also, the air is clearer and more meteors can be seen.

Marconi's New Short-wave Tests

THE experiments conducted by Senator Marconi on transmission at wavelengths in the neighborhood of 100 meters, already widely heralded in the newspapers, were described by the Senator himself in a lecture delivered on July 2, 1924, before the Royal Society of Arts in London.

In all the tests, the transmissions were made from the great station of the Marconi Company at Poldhu, England. Reception was aboard Marconi's yacht, the *Elettra;* aboard the steamship *Cedric;* in South America, on Long Island and in Australia.

The most comprehensive tests were those made between Poldhu and the *Elettra.* For a part of these tests a parabolic reflector was used to concentrate the transmitted waves into a directed beam. The wavelength was 97 meters and the transmitting power varied between 12 kilowatts and one kilowatt. Even with this lowest power the signals were readable over the greatest distance tested, 2,230 nautical miles. At this distance the yacht was lying off Cape St. Vincent, Spain, with the entire width of the Spanish peninsula intervening on the direct line between Poldhu and the yacht.

The amount of concentration produced by the reflector was such, the Senator reported, that a transmitting power of 9 kilowatts produced a received signal strength equal to that produced by 120 kilowatts without the reflector. This is a calculated ratio, the high power of 120 kilowatts not having been actually tried.

In the tests between Poldhu and other continents, the power was raised to 25 kilowatts and the wavelength was changed to 92 meters.

No reflector was used. Both telegraphy and telephony were received successfully in South America and in Australia.

It is to be regretted that the tests with the reflector were not continued and extended. This is really the only part of the work that has much novelty, the spanning of the oceans by broadcasts on 100-meter waves having become a more or less daily affair. Most radio engineers now agree that waves of about this length are especially favorable for long-distance transoceanic transmissions. It is on the use of directed beams of these waves that we need more data. Perhaps Senator Marconi intends to continue his work along this line.

A New Theory of Fading Signals

In the course of a recent address on radio relay methods Mr. E. K. Sandeman suggested a theory of fading which has considerable interest.* It is well known, he reminds us, that whenever the same space is traversed by direct and reflected waves (whether of sound or of electromagnetic radiation) there is set up a series of nodes and antinodes, the combined wave strength being alternately greater and less than the average value. The distance between these reinforced and decreased places is approximately half a wavelength.

If we assume this, and assume, further, that the radio waves are being reflected from a mirror-like something of the nature usually ascribed to the Heaviside Layer, "it is evident," says Mr. Sandeman, "that a receiving aerial may be one moment at a node and the next moment at an antinode, as the configuration of the reflecting surface changes."

This may be responsible, he thinks, for some of the phenomena of fading, especially for the fact that the fading is sometimes much more pronounced at certain wavelengths than at others. This would be determined by the distance between the reflecting elements (hollows or bumps) in the Heaviside Layer as related to the wavelength and to the positions of the nodes and antinodes in the combination of direct and reflected waves.

* *Wireless World* (London), vol. 14, page 283 (June 4, 1924). Mr. Sandeman's article began in the preceding number (May 28, 1924) of this publication, page 260.

Is Power from Atoms Improbable?

The dream of extracting useful power from the inside of atoms is beginning to fade. Scientists are coming to the conclusion that there may not be so very much available power inside atoms after all.

It is true that the atoms of radium and uranium set free very large amounts of power when they explode. One ounce of radium, for example, would produce by its entire explosion more power than we get from thirty tons of dynamite.

But it is probable, the experts have decided, that these radioactive atoms are exceptional. In a recent statement prepared for the Engi-

neering Foundation, New York, Sir Ernest Rutherford, probably the greatest living authority on radioactivity, expresses this conclusion thus:

"It may be that the elements, uranium and thorium,* represent the survivals in the earth today of types of elements that were common in the long distant ages when the atoms now composing the earth were in course of formation. A fraction of the atoms of uranium and thorium formed at that time has survived over the long interval on account of their very slow rate of transformation.

"It is thus possible to regard these atoms as having not yet completed the cycle of changes which the ordinary atoms have long since passed through, and that the atoms are still in the 'excited' state where the nuclear units have not yet arranged themselves in positions of ultimate equilibrium, but still have a surplus of energy which can only be released in the form of the characteristic radiation from active matter.

"On such a view, the presence of a store of energy ready for release is not a property of all atoms, but only of a special class of atoms like the radioactive atoms which have not yet reached the final state for equilibrium."

Sir Ernest goes on to say, however, that there is another kind of transformation of matter which may be competent to yield energy. This is the consolidation of the lighter atomic units into heavier ones. For example, it is believed that four hydrogen atoms combine in some way to form one helium atom. In so combining, a part of the mass of the four hydrogen atoms disappears. It was suggested some months ago by Dr. F. W. Aston. that this vanished mass is perhaps converted into energy and that this may be an actual source of energy in the sun and the stars. It is perhaps a helium factory that keeps our sun alight.

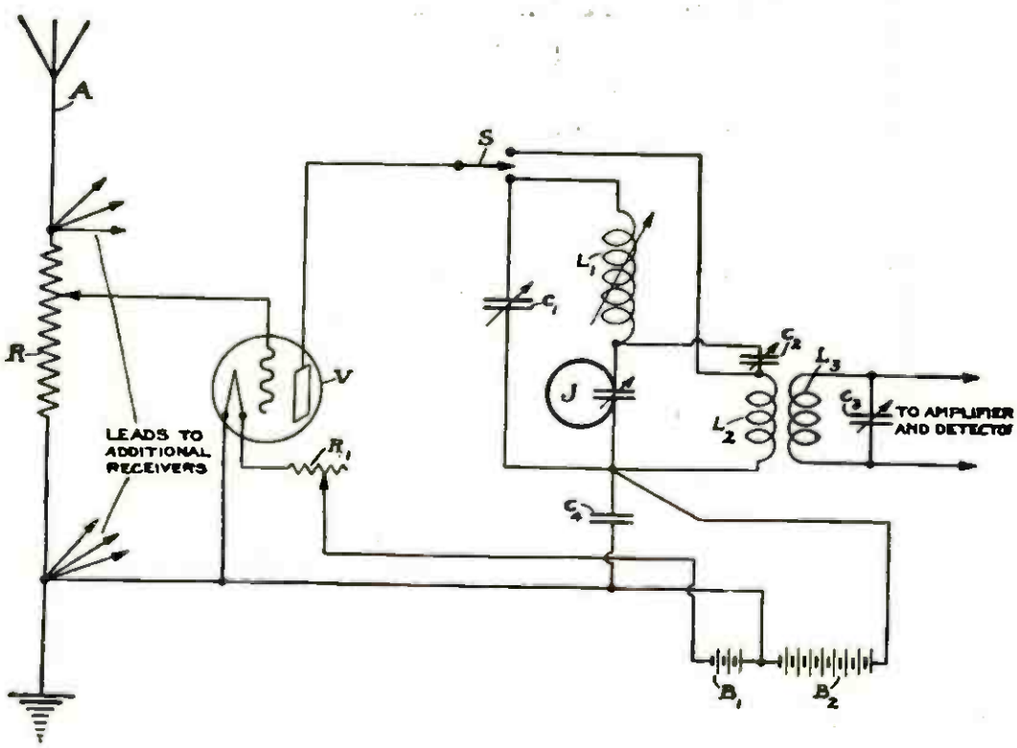
In the statement quoted, Sir Ernest Rutherford gives the amount of power thus available theoretically. "Calculation shows," he says, "that the energy released in the formation of one pound of helium gas is equivalent to the energy emitted in the complete combustion of about eight thousand tons of pure carbon."

For the possibilities of radioactive power which Sir Ernest feels compelled to deny us, he substitutes, therefore, a theoretical power source that is tremendously greater. The only catch in it is that nobody knows how to make four atoms of hydrogen combine into one atom of helium here on earth. And as yet, we cannot visit the stars to find out how it is done.

* These are the two original radioactive elements known. Radium is produced by the disintegration of the atoms of uranium.

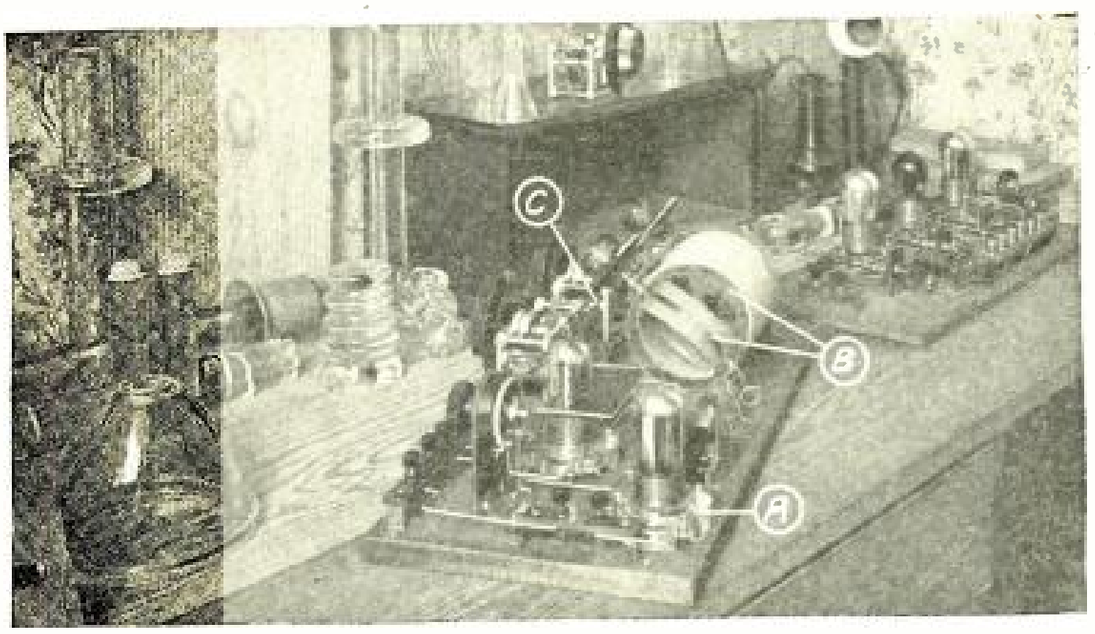
Navy Device for Multiple Reception on One Antenna

It is well known that the United States Navy has been using for some time a device



DR. TAYLOR'S "REJECTOR" FOR MULTIPLE RECEPTION ON ONE ANTENNA

The tuned, low-resistance unit that constitutes the rejector is shown at J. This unit can be connected directly in the antenna circuit instead of after the amplifying vacuum tube shown in the drawing. The switch S provides for connecting the incoming signal directly to the amplifier and detector so that a station may be located more easily; after which the rejector circuit is switched in for more precise tuning.



THE NEWEST INSULATING MATERIAL FOR RADIO APPARATUS

This receiver, constructed by Dr. A. E. Marshall. contains special tube sockets, A, made of special (Pyrex) glass. The tubes for both stator and rotor, shown at B, are also made of this special glass, and the parts of the condensers are insulated by the same material, as shown at C. In an early issue of POPULAR RADIO, *Dr. Marshall will describe the properties of this glass which make it an unusually valuable insulator in radio work.*

permitting the attachment of several receiving circuits, each one differently tuned, to the same antenna. This device has now been announced for commercial production under the trade name of "unitenna."*

Published descriptions of the commercial apparatus are incomplete, but from a United States patent issued recently to Dr. A. Hoyt Taylor, research physicist of the navy and inventor of the navy's system, it appears that the essential idea is the use of a special, tuned, low-inductance unit termed the "rejector." This rejector is shown at J in the figure reproduced herewith and taken from Dr. Taylor's patent.†

As described in the patent, the rejector is preceded in the circuit by an antenna rendered aperiodic by the inclusion of a high resistance, by a vacuum-tube amplifier and by a preliminary selector circuit comprising the inductance L_1 and the condenser C_1. It is apparent, however, that the rejector might be inserted directly in the antenna circuit, where it would pick up the impulses to which it was tuned without interfering materially with other impulses passing through the antenna circuit, this circuit being aperiodic.

According to the patent the rejector unit "comprises a very low inductance element having a very low resistance, usually being one or more turns of very heavy copper strip or wire, and a large-capacity condenser constructed to have small resistance."

* "Multiple Reception with One Antenna," by Malcom Jonsen. *Radio Section of the New York Telegram and Evening Mail*, July 12, 1924, page 12.

† U. S. Patent number 1,489,287; issued April 8, 1924.

Darkness Does Not Deflect Radio Direction Signals

THE two shadow lines that race daily around the earth making what we call sunrise and sunset are supposed to mark exceptional disturbances of radio transmission. Much evidence indicates that this is the case. Among other effects, it has been claimed that bearings taken with a radio direction finder will be inaccurate when either the sunset zone or the sunrise zone intervenes between the transmitter and the receiver.

To test this point the Lighthouse Service of the United States Department of Commerce made recently a nine day test between a transmitting station at the Cape Henry Lighthouse, Virginia, and a receiving station at the Wolf Trap Lighthouse, in Chesapeake Bay, thirty miles away.

The results are announced in a recent statement of the Lighthouse Service.

For a period of about three hours each morning and evening direction readings were taken every few minutes, covering the times when the sun was rising and setting; 290 readings were made in all. The deviations ascribable to the effect of the shadow line were very small: certainly not over two percent, which is less than is often encountered accidentally in direction-finding work by radio.

A CORRECTION

On page 309 of POPULAR RADIO for September, 1924, the ion of hydrogen, as it exists in solutions, was described as having gained one electron and a negative charge; the sulphate ion as having lost one electron and being charged positively. The truth, of course, is exactly the reverse. The hydrogen ion is positive; the sulphate ion is negative.

New Tests of Underground Radio

THE investigations of the United States Bureau of Mines into the use of radio for rescue work after mine disasters, the first report of which was noted in this department last month*, have now been extended by the issuance of a second report, this time upon the underground reception of ordinary radio waves and their relation to the presence of metallic conductors such as rails, electric wires, pipes and the like.†

The author of this report, Mr. Jakosky, is of the opinion that propagation of radio along such conducting paths is one of the chief reasons for the numerous recorded instances of radio reception in mines and tunnels. It has been discovered that the intensity and direction of the radio waves underground vary in almost every case as though the waves were coming in along such conductors.

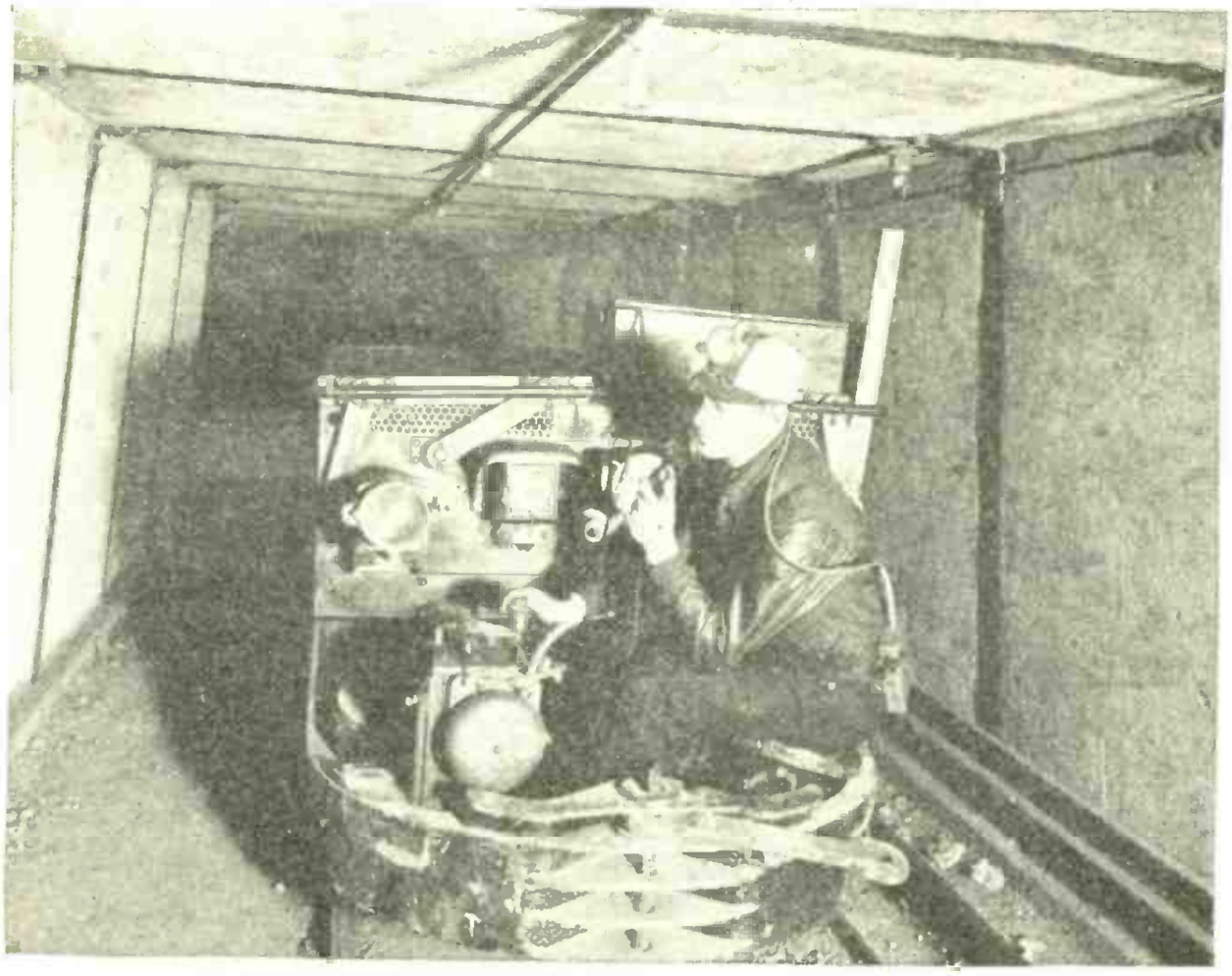
Direct propagation of the waves through the earth is possible, and seems actually to happen in the upper levels of a mine. But in the lower levels, especially when the workings being tested are below the level of the ground water, the signal strength for direct reception usually falls off very sharply. It is probable that the "transparency" of rocks or soils for radio waves is more largely determined by the wetness of the materials than by anything else. Wet rock is a fairly good conductor and absorbs the radio waves. Dry rock is more nearly an insulator; the waves pass through it much more freely.

Nearly all the underground tests that have been made so far apply to the reception of waves from ordinary broadcasting stations, which stations are very much more powerful than stations that could be set up underground after a disaster for the use of entombed miners in communicating with the surface. But the fact that all waves, even the powerful ones, seem to make preferential use of the metallic conductors suggests what the perfect rescue radio may be like.

It is probable, Mr. Jakosky believes, that such a rescue set will operate by line radio,

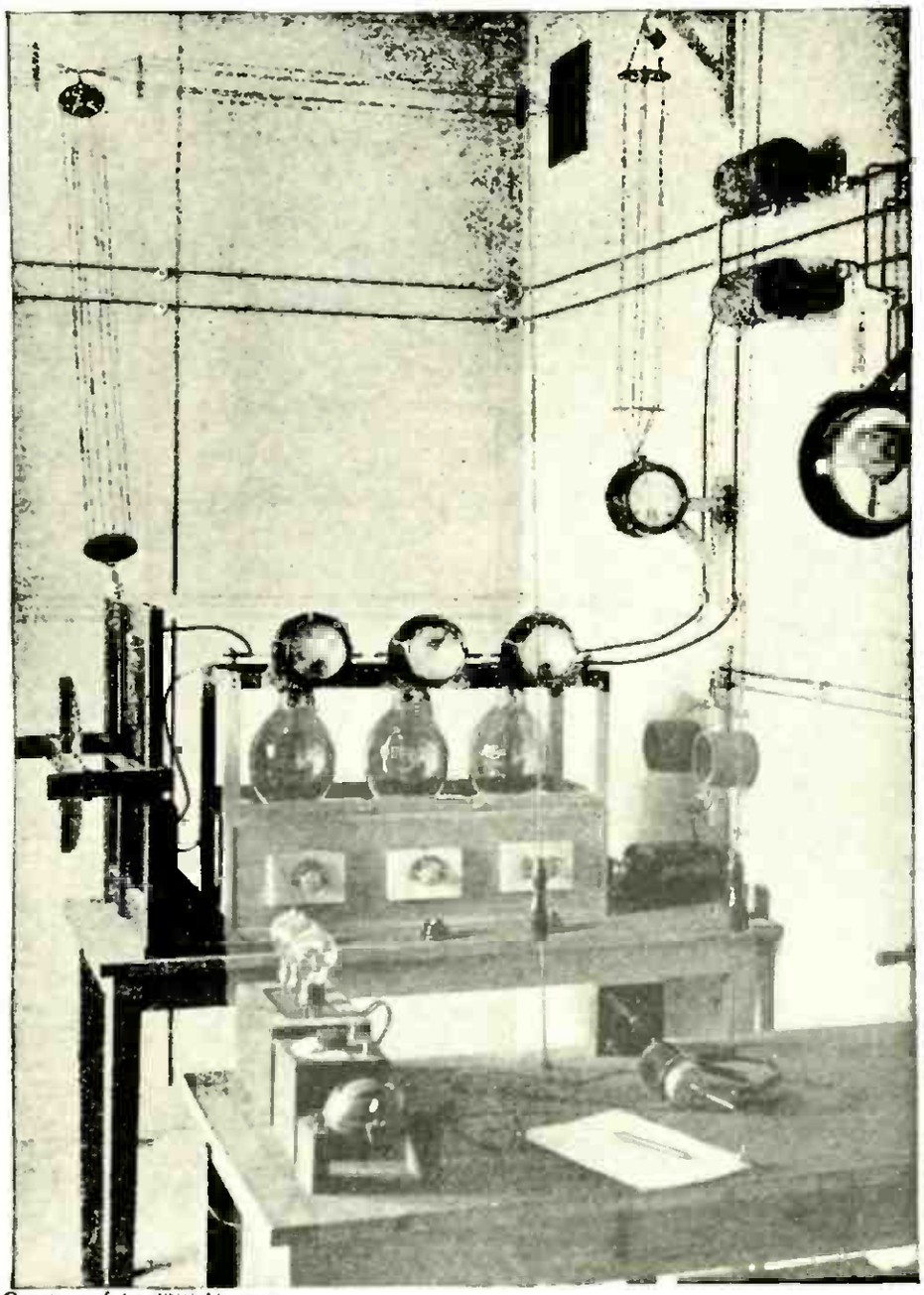
* POPULAR RADIO for June, 1924, page 624.

† "Radio as a Method for Underground Communication in Mines," by J. J. Jakosky. United States Bureau of Mines (Washington, D. C.). Reports of Investigations (mimeographed). No. 2599, 6 pages, issued April, 1924.



A PORTABLE RADIO TRANSMITTER UNDERGROUND

As a part of the experimental work of the United States Bureau of Mines on using radio for mine rescues a portable transmitting set was mounted on a mine locomotive. The signals were sent out to the surface by line radio, using the trolley wire, the track or similar metallic conductors.



Courtesy of *La TSF Moderne*

FRENCH RADIO MAGAZINE INSTALLS AMATEUR TRANSMITTING STATION

LA TSF MODERNE, *one of the chief radio magazines in France, owns and operates Radio Poste 8AE, a part of which is shown in this photograph. In the center are the three Mullard tubes rated at 500 watts each. At the left are the tuning inductances and above them the cage connection to the counterpoise. The other cage, at the right, is the lead-in.*

using the power and light wires or the tracks of the mine railway or some other conductor. Successful tests have been made with a ten-watt telephone transmitting set mounted on a mine locomotive and arranged for line-radio communication with the surface in this way.

Probably the final solution of the mine communication problem will be some form of line radio, working over the power wires or the railway tracks, and used regularly for ordinary communication just as mine telephones are used now. Such a system would not be put out of commission by short breaks in its conductors after an accident. The greater cost of the transmitting and receiving apparatus would be offset, in part at least, by the fact that no special set of wires would be needed for telephone purposes.

And the use of such a radio system in the daily work of the mine would mean, says Mr. Jakosky, that the "purchase of sets, maintenance, and apparatus charges can be charged to 'operating' rather than to 'safety'—and there is always more money available for the former"; a statement which is a trifle cynical but—unfortunately—is all too true.

CONDUCTED BY LAURENCE M. COCKADAY

IN justice to our regular subscribers a nominal fee of fifty cents per question is charged to non-subscribers to cover the cost of this service, and this sum must be inclosed with the letter of inquiry. Subscribers' inquiries should be limited to one question or one subject.

Simple Regenerative Receiver with a Wave-trap for Use in Congested Areas

QUESTION: Please let me have a circuit for the tuned-plate regenerative circuit including an inductive wave-trap in the antenna circuit. I live within three miles from four powerful broadcasting stations and cannot get much when they are going, so I know I will have to use the wave-trap. Can you also tell me how to make the trap?

ELDRED J. BARNES

ANSWER: The circuit you require is given in Figure 1. The parts you will need are the following:

L1 and L2—primary and secondary coils of the inductively coupled trap;
L3 and L4—primary and secondary coils of an ordinary variocoupler;
VC1 and VC2—variable condensers, .0005 mfd.;
GC—grid condenser, .00025 mfd.;
VGL—variable grid-leak;
VAR—variometer;
TEL—headphones;
R—filament rheostat, 6 ohms.

Use a soft detector tube, such as the C-300 or the UV-200 tube.

Coil L1 is made by winding twelve turns of No. 18 DSC copper wire over the periphery of a honeycomb coil, size L-50, which serves as the secondary coil L2.

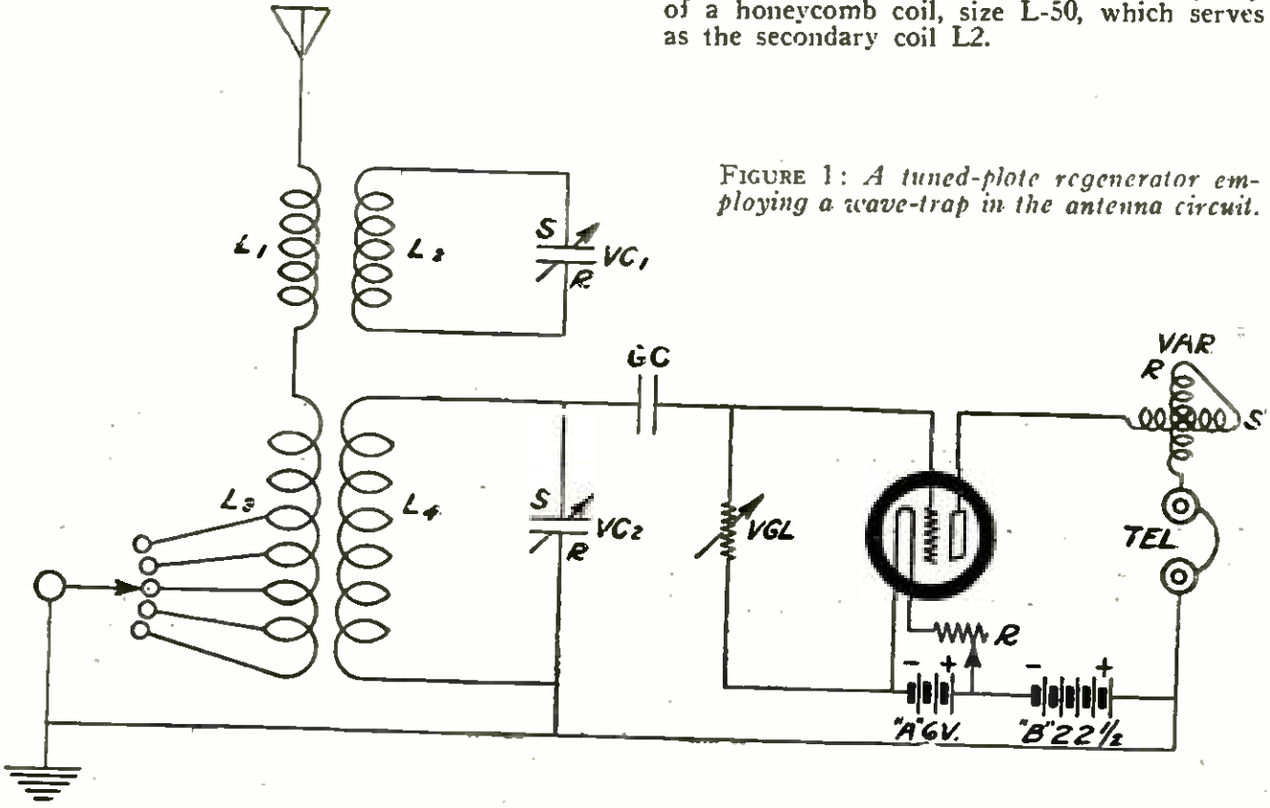


FIGURE 1: *A tuned-plate regenerator employing a wave-trap in the antenna circuit.*

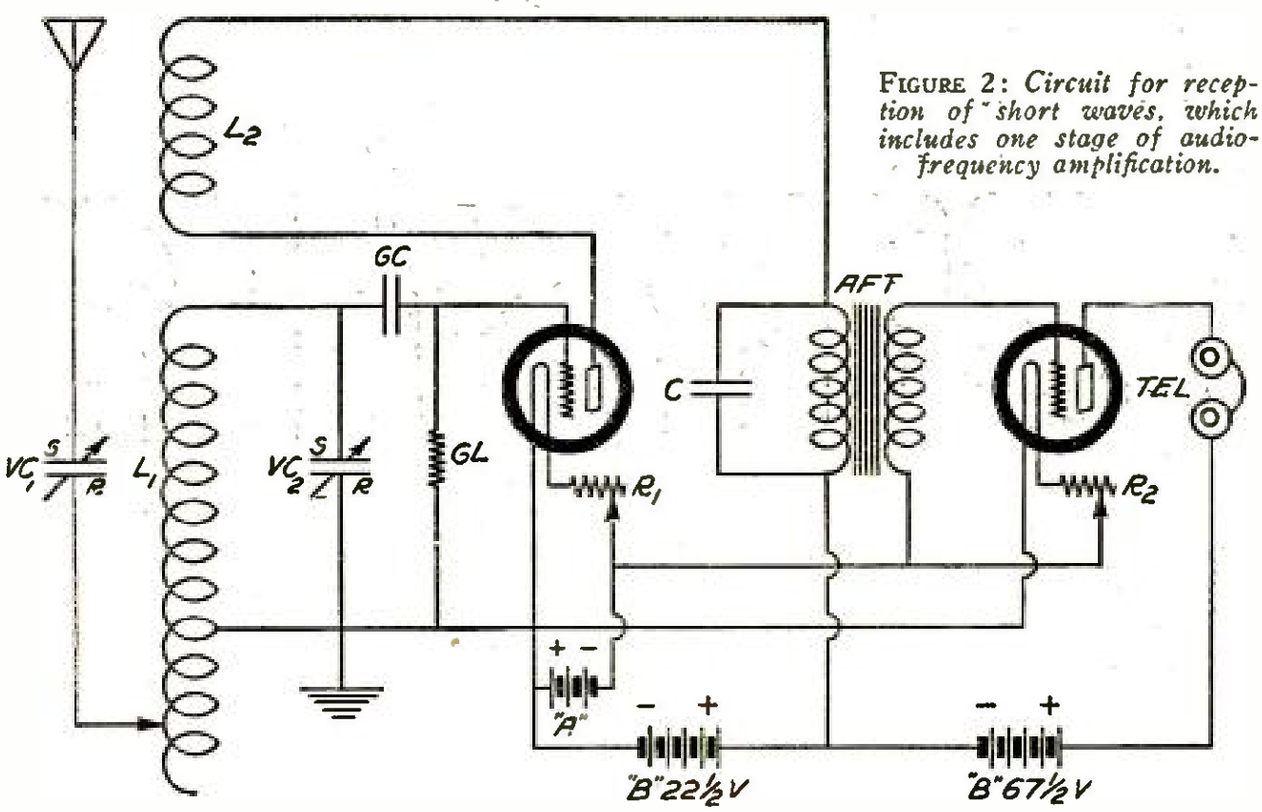


FIGURE 2: *Circuit for reception of short waves, which includes one stage of audio-frequency amplification.*

Low-wave Receptor

QUESTION: I would like to get a circuit for short-wave reception. I want to use the circuit in a home-made set for use with headphones, and for this purpose don't want to use more than one stage of audio-frequency amplification. Can you give me one of the latest circuits for this purpose together with the necessary data for its construction?

WALTER CLARK

ANSWER: A circuit that will be satisfactory for the purpose you have outlined in your query is drawn for you in Figure 2.

The parts you will require are given in the list below:

L1—tuning coil;
L2—tickler coil (honeycomb or duolateral coil, size L-35);
VC1—variable condenser, .0005 mfd.;
VC2—vernier variable condenser, .00025 mfd.;
C—mica fixed condenser, .0003 mfd.;
GC—mica fixed condenser, .00025 mfd.;
GL—variable grid-leak;
R1—filament rheostat, 6 ohms;
R2—filament rheostat, 20 ohms;
AFT—audio-frequency amplifying transformer;
TEL—telephones;
two sockets.

The tuning coil L1 may be made by winding 40 turns of No. 18 DSC copper wire on a tube 3 inches in diameter and tapping the lower end at the 32nd, 34th, 36th. 38th and the 40th turns. The ground is connected to the 32nd turn and the antenna is connected to a tapped switch connected to the taps. The honeycomb coil should be mounted on a shaft at the grid end of the coil L1, so that it is rotatable.

Use a soft tube, such as a C-300 or a UV-200 tube. for the detector, and a hard tube. such as the DV-3 or the UV-201-a or the C-301-a tube.

Smallest Antenna for the Tobias Tuner

QUESTION: What is the smallest size of indoor antenna that can be used with the Tobias indoor-antenna tuner? Can I use a short wire in one room? I live in a Y.M.C.A. and have but one room.

J. H.

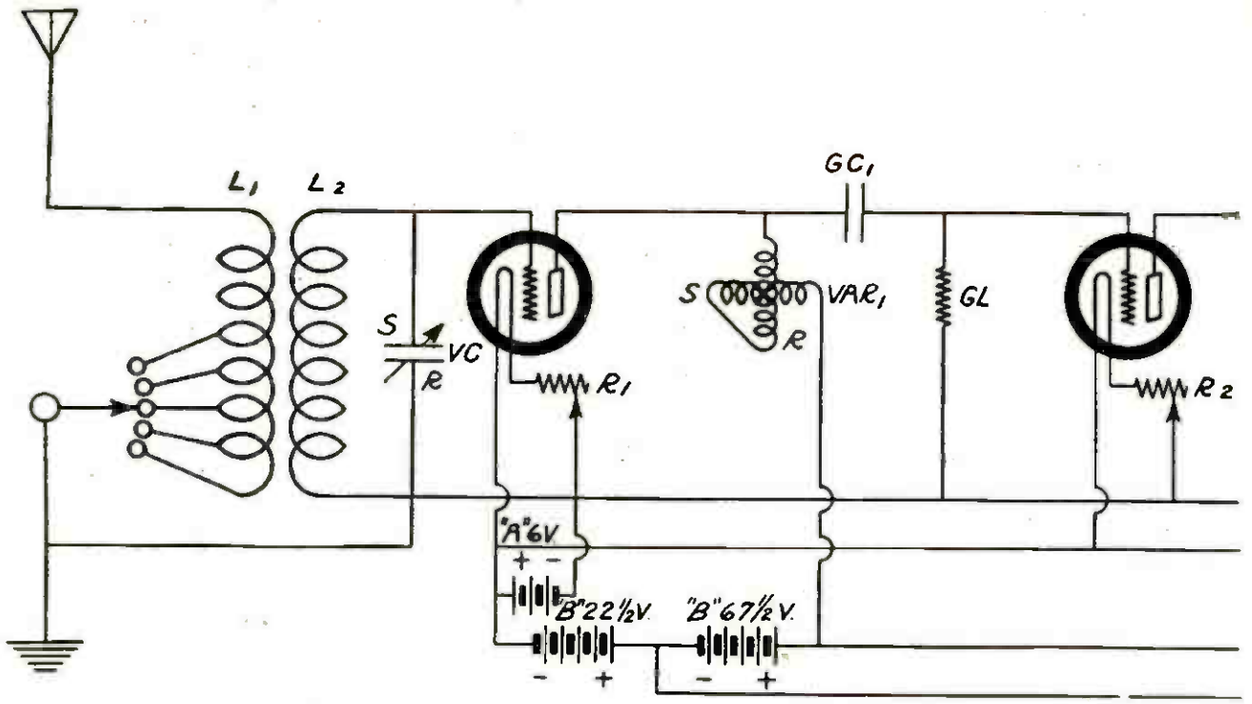
ANSWER: This tuner will work in a room six feet by ten feet. Put up a wire twenty to twenty-five feet long in back of your picture moulding and you will have good results.

The Proper Contact for Galena

QUESTION: What kind of contact or catwhisker is most suitable for use with the galena crystal for a reflex detector?

WILL ADAMS

ANSWER: A flexible spiral of springy wire with small pressure will give best results in locating and holding the proper adjustment with this type of crystal.



Impedance Tuning for Radio-frequency Amplification

QUESTION: I have been using, for the past year, the regular two-variometer, regenerative circuit. I would like to experiment with a radio-frequency hook-up using these two variometers for tuning two stages of radio-frequency amplification. Can you give me the proper diagram of connections that I should use, with the necessary constants for the condensers, rheostats and grid-leaks? I wish to use the UV-200 tube for the detector, and hard tubes for the amplifiers. Kindly include one stage of audio-frequency amplification to the circuit.

H. G. TROWELLY

ANSWER: A circuit for the purpose you mention is given in Figure 3. The parts you will require and their constants are given in the following list:

L1 and L2—primary and secondary windings of an ordinary variocoupler;
VC—variable condenser, .0005 mfd.;
GC1—mica fixed condenser, .0005 mfd.;
GC2—mica fixed condenser, .00025 mfd.;
VAR1 and VAR2—variometers for the plate circuit;
GL—grid-leak, 1 megohm;
VGL—variable grid-leak;
R1, R2 and R4—filament rheostats, 30 ohms;
R3—filament rheostat, 6 ohms;
AFT—audio-frequency amplifying transformer;
J—single-circuit jack.

Use the soft tube in the third tube socket with the potential from the "B" battery reduced to about 22½ volts, as shown in the diagram. You will find that the 30-ohm rheostats are necessary in the radio-frequency stages in order to control regeneration when you get the two variometers in tune.

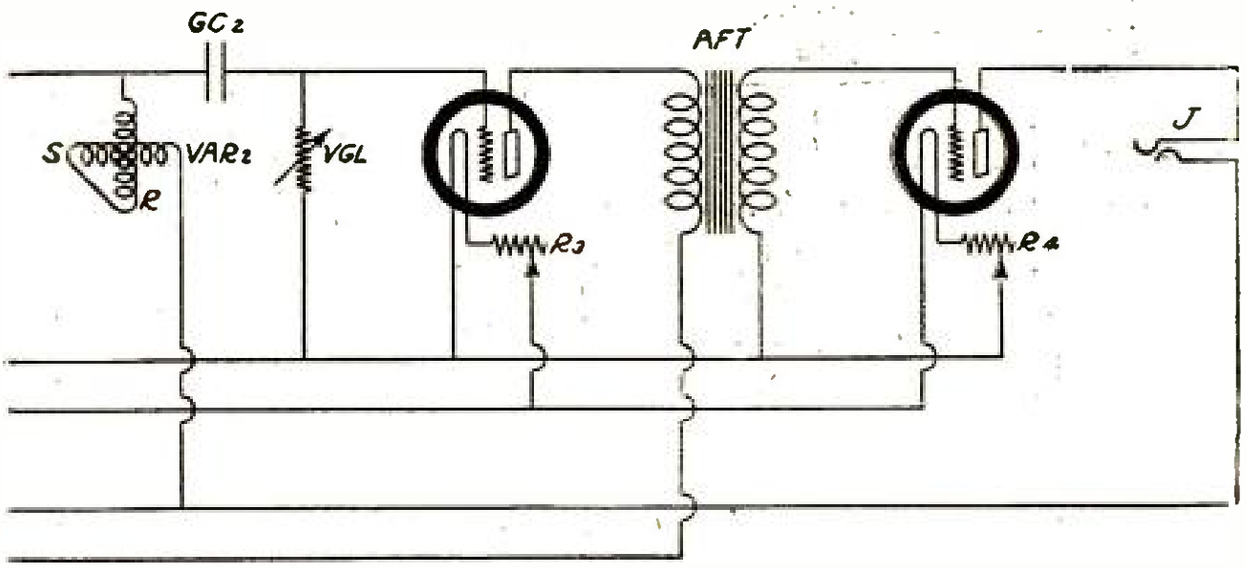
Transformer-coupled and Tuned-radio-frequency Amplification

QUESTION: I have been following your "What Readers Ask" department ever since your magazine was brought out. I have made many of the more simple sets and two of the more complicated ones. Now I would like to make another one with two stages of radio-frequency amplification.

One of the sets that I have made contained one stage of transformer-coupled radio-frequency amplification. What I would like to have you tell me is whether or not *tuned*-radio-frequency amplification is really more efficient than ordinary transformer-coupled amplification.

I know that it is more difficult to tune, but what I want to know is whether the tuned variety will give me more signal strength, more distance, better results generally, than the same number of tubes used with the transformer-coupled variety. I have two circuits picked out of your magazine, one of each variety, and

FIGURE 3: *Two stages of variometer-tuned radio-frequency amplification, vacuum-tube detector and one stage of audio-frequency amplification.*



I am only waiting for your advice before I start in to build one of them. The choice lies with you.

ROBERT DENNIS BROWN

ANSWER: The tuned-radio-frequency amplification will give the best results, because the efficiency per stage is higher. This is due to the fact that the circuits are tuned to the particular wavelength that you desire to receive. The tuned variety will give you better results for DX reception, although you will not notice much difference in volume on local work. The tuned variety will also be more selective.

Tube Loading in a Reflex

QUESTION: In a reflex receiver, the amount of radio-frequency load on each tube increases per stage. Then, when the radio-frequency currents are finally rectified by the detector, they are reflexed back on the radio-frequency tubes. Then again, the audio-frequency load on each tube increases per stage. The last stage or stages would, it seems to me, be carrying a pretty large load while the first stage or stages would be carrying relatively small loads.

Now, if enough stages were used, the load on the last tubes would be too great, and I believe that larger tubes should be used in the last stages. Am I correct? I got the thought when listening to a friend's reflex. He complained to me that it worked very well on medium signals, clear and undistorted. But, when a loud signal was tuned in, the signals were mushy and distorted. I went over to look at the set and found the symptoms he had told me of were true. Are my surmises correct?

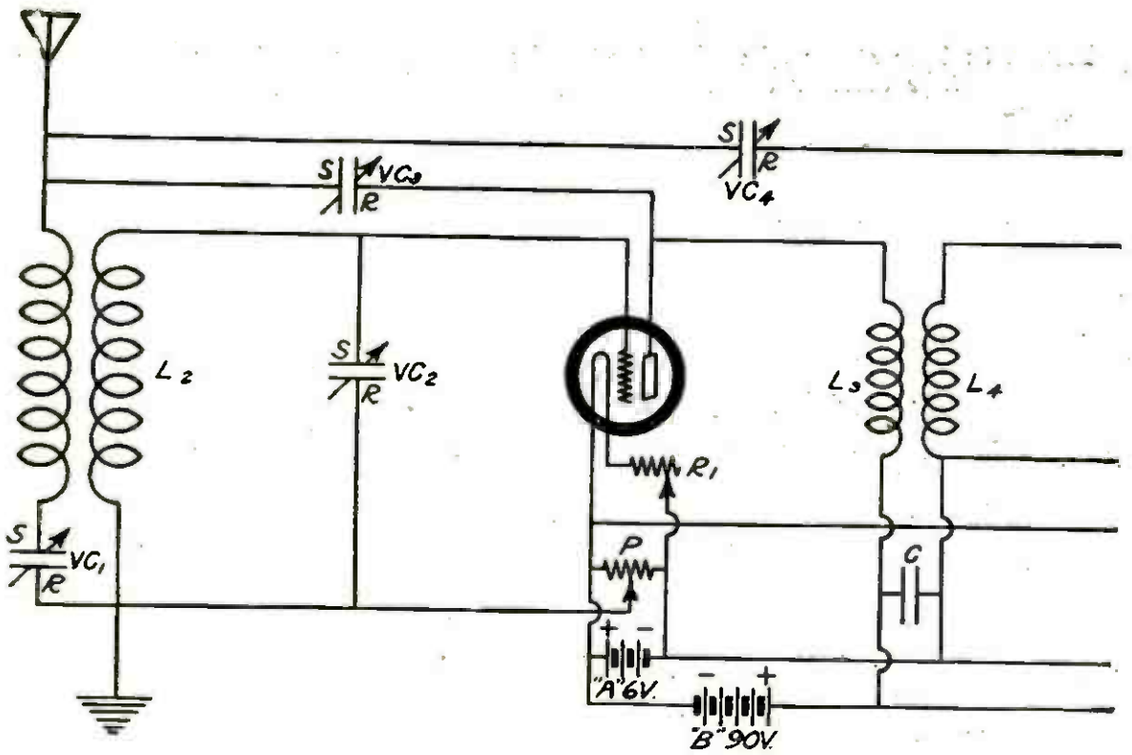
WILLIAM D. HAYES

ANSWER: You are right as far as theory goes. And you are right where the radio-frequency impulses supplied to the input of the set are strong impulses. This would substantiate the results your friend got on large-volume signals. They were distorted because the last tubes were overloaded.

Grimes, in his work on the reflex principle, has devised a type of circuit for obtaining proper tube loading. His development is called the inverse-duplex.

The general scheme of his circuit arrangement is such that the radio-frequency load on each tube increases per stage, then the radio-frequency current is rectified by the detector, and the audio-frequency impulses reflexed on the last stage of radio. The audio-frequency output of this tube is then reflexed on the next preceding tube and so on to the first tube (the first radio-frequency stage). In this way the tubes slightly loaded with radio-frequency currents are heavily loaded with audio-frequency currents, and the tubes heavily loaded with radio-frequency currents are only slightly loaded with audio-frequency currents. This distribution of the radio and audio-frequency loads applied to the tubes is designed to keep the plate current variations well within the characteristics of the tubes, and thus, only one type of tube is necessary and the last stages will not be overloaded.

We recommend that you become familiar with the latter type of circuit as recently published in this magazine.



A Novel Circuit Employing One Stage of Tuned-radio-frequency Amplification, Regenerative Detector and One Stage of Audio-frequency Amplification

QUESTION: Will you please give me your criticism on the accompanying circuit? I have been experimenting with it for the last two months and have had some rather surprising results. It is, however, rather critical, and I am unable to overcome this condition. I thought that maybe you would be interested enough in it, on account of its novelty, to try it out in the laboratory, and fix up the circuit so that the condition of unstability would be eliminated. If you could do this, I would like to have the corrected circuit published, as I have had results on distance reception that have really been extraordinary. I will watch the "What Readers Ask" department for the necessary data. If you make any changes in the constants please give the new constants with the diagram.

HAMILTON ROUGH

ANSWER: This is an interesting circuit and the changes we have made, after testing the circuit in the laboratory, help to stabilize operation greatly. Especially the addition of the condenser C. The diagram of electrical connections in the improved circuit is shown in Figure 4. The list of parts and their constants is given below:

L1 and L2—honeycomb coils, size L-25 and L-50, respectively;
L3 and L4—honeycomb coils, size L-50 and L-60, respectively;
L5—honeycomb coil, size L-25;
VC1—variable condenser, .001 mfd.;
VC2 and VC5—variable condensers, .0005 mfd.;
VC3 and VC4—variable condensers, .00025 mfd.;
R1, R2 and R3—filament rheostats, 30 ohms;
P—potentiometer, 400 ohms;
C—mica fixed condenser, .001 mfd.;
GC—mica fixed condenser, .00025 mfd.;
GL—grid-leak, 2 megohms;
AFT—audio-frequency amplifying transformer;
J—single-circuit jack.

The coils L1 and L2 should be mounted in double honeycomb-coil mountings, and the coupling varied by swinging one coil. Likewise with coils L3 and L4. It may be found necessary to reverse the leads to coil L1 to get proper control.

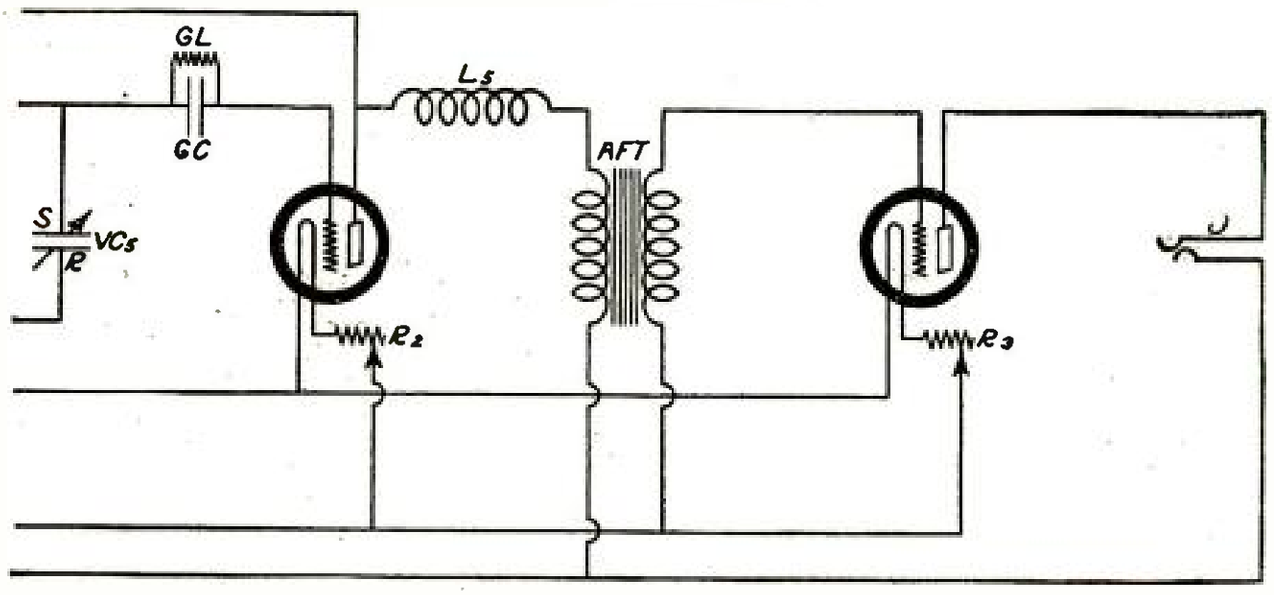
Use hard tubes, such as the UV-201-a or C-301-a or Deforest DV-3 tubes.

The tuning is controlled by condensers VC1, VC2 and VC5, while regeneration is controlled by condensers VC3 and VC4.

How to Clean Your Panels

QUESTION: What kind of solution should be used for cleansing the composition panel of a radio receiver? I first thought water would be good and

FIGURE 4: *New circuit that employs capacity feed-back in the radio-frequency amplifier. Although the controls are rather numerous, the results on long-distance reception are extraordinary.*



then, upon more reflection, I decided that it might harm the set. Am I right? Next I thought of some form of furniture oil. This would be all right, would it not? At any rate, please let me know what is the best to use.

J. L. M.

ANSWER: Water would be harmful. It might cause serious damage if it ran into the switch taps or between insulated parts. It would also damage windings and cause leakage generally. The proper thing to use is alcohol. This will remove grease and fingermarks and will evaporate without any traces being left behind.

Ranges to be Expected with Crystal Receivers

QUESTION: I live about six miles from three broadcasting stations in this city. I am unable to leave the house on account of an accident, and, therefore, I believe that a radio set would help considerably to pass away the time until my leg gets well. Now, as we have no electricity in our house for charging batteries, I will have to use a crystal set or else use a vacuum-tube set with dry batteries.

Will you please tell me if the crystal set will enable me to receive the broadcasting from these three stations at this distance? I can have some of my friends put me up a fine long antenna, we have lots of space, and I want to use the head telephones. Would the crystal set do it? Or, will I have to get a tube set anyway?

HAROLD ENSIGN

ANSWER: The crystal set should give you good headphone reception at your distance providing that the broadcasting stations have a power of 500 watts or more, and providing that you can get up a good long antenna of 100 to 150 feet in length.

Ordinarily, crystal receivers give consistently favorable results up to a distance of 15 miles.

Receiving Antenna for the Craig Set

QUESTION: How many strands do I need in my antenna for reception with the Craig two-tube set. I can string it up about 125 feet long.

GEORGE MOORE

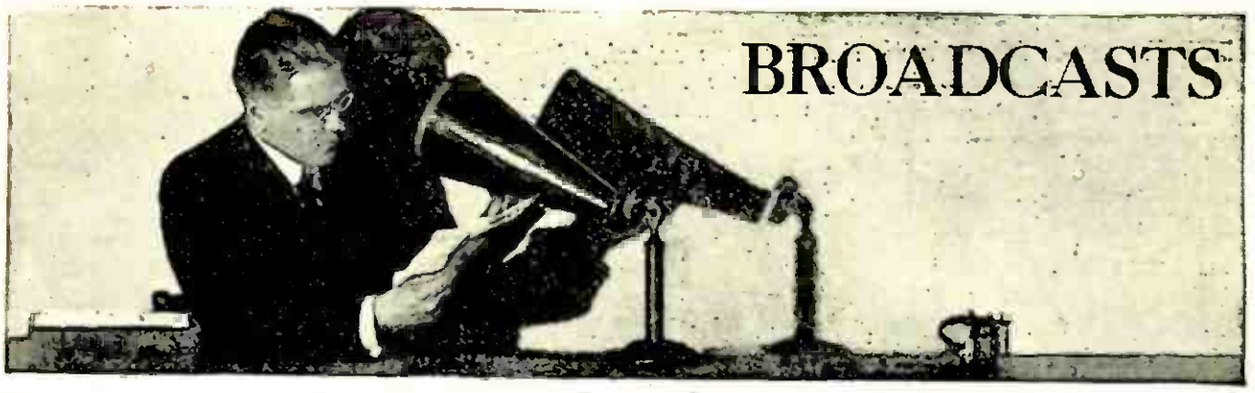
ANSWER: One wire of this length will be suitable.

Silk-covered or Cotton-covered Wire?

QUESTION: Which do you consider the best insulation for the copper wire used for winding coils for radio tuning instruments, cotton or silk?

GEORGE MOORE THOMSON

ANSWER: Silk wire is the better of the two.



BROADCASTS

ITEMS *of general interest that you ought to know; bits of useful information that every radio fan ought to know.*

CONDUCTED BY DAVID LAY

Do Earthquakes Cause Static?

THIS idea is suggested by a French radio amateur, M. Robert Lenier. He has compared the records of the occurrence of heavy static both at sea and ashore at the times when earthquakes have been reported. There appears, he says, to be a considerable degree of correspondence. A severe earthquake shock anywhere on earth is likely to be accompanied by static of unusual severity. No theory is suggested, but M. Lenier urges that further investigation is desirable.

* * *

"Radiocasting" Not Approved by Word Expert

DR. FRANK H. VIZETELLY, managing editor of the *New Standard Dictionary*, is not favorably impressed by the newly-coined word "radiocasting," according to an article by him in the *New York Herald*. "We shall probably live to see the time," he says, "when, just as we 'phone' and 'wire,' we shall 'radio,' and the people will understand what is meant without the necessity of our adding any suffix to convey the sense of dissemination." In the meantime Dr. Vizetelly thinks that the familiar and popular "broadcasting" is as good as any word that we have.

* * *

New Detector Uses Colloidal Solution

THE use of colloidal solutions, containing a multitude of very tiny solid particles, as a means of detecting radio signals, has been suggested many times. The tiny particles carry electric charges and behave, therefore, in much the same way as the electrons do in a vacuum tube. When three electrodes, corresponding to the plate, the grid and the filament, are introduced into such a solution, the apparatus becomes a fairly good detector. The chief difficulty is to keep the colloidal solution in the best condition for detection. This difficulty is said to have been solved by a new German device in which the solution is a mixture of gallic acid and a compound of iron. This mixture is almost exactly the same thing as the old-fashioned kinds of ink made out of oak galls and iron.

* * *

Eiffel Tower to Replace Spark with Tubes

THE chief radio station of the French Government at the Eiffel Tower in Paris, has decided to abandon the spark transmitters that have been in use there for many years and that have been objected to by French listeners because of interference with broadcast programs. The spark sets are to be replaced by tube oscillators driven by the newly invented demountable vacuum tubes of Dr. F. Holweck. One of these demountable tubes with a power rating of 30 kilowatts has been constructed recently and is under test.

* * *

Patent Vaccuum Tube is Operated by Radium

A PATENT has been granted in France on a vacuum tube that has no filament, the necessary electrons being supplied by a small quantity of radium or of some other radio-active element. The amount of radium necessary is not stated in the patent, but is probably fairly large, the electron emission from radium being rather a small quantity.

* * *

Does Moonlight Affect Radio?

ACCORDING to the American Radio Relay League there has been some evidence in the course of long-wave tests with transatlantic telegraphy that radio transmission is better at times of full moon than at other times. It is difficult to see any reason for this, but anything is possible in radio. The League suggests that interested amateurs make series of careful observations, which is something that certainly ought to be done.

"Curfew" for Radio Loudspeakers

RADIO enthusiasts who own loudspeakers are subject to fines if their use of these instruments late at night disturbs the neighbors, Magistrate Gresser held in a Jamaica (N. Y.) court recently. He found a radio fan guilty of violating a city ordinance when neighbors testified that he kept his loudspeaker going loud enough to disturb them after nine o'clock at night.

* * *

Taxicabs Dispatched by Radio

W. O. ARZINGER of Birmingham, Alabama, has been working for a number of months on a radio transmitter with which to dispatch taxicabs. He announces that his invention is now perfected. Mr. Arzinger claims that with one of his transmitters in the central taxicab office and a receiving set in each taxicab, the central office will be able to get in touch with any driver at a moment's notice.

* * *

Stringent Ruling Arouses British Amateurs

A SHORT sentence in the new government regulations regarding amateur transmission, which passed almost unnoticed at first, is to the effect that "messages shall be transmitted only to stations in Great Britain or Northern Ireland which are actually co-operating with the licensee's experiments, and shall relate solely to such experiments." If not modified, this rule will prohibit any further two-way communication by British amateurs with those in any other country. An organized campaign against the ruling is to be made and there is hope that a change in the regulations can be put through.

* * *

Loudspeaker in Paris Subways

THE Paris subways have followed New York in adopting for one of their lines a system of loudspeakers to announce the station names. If the experiment is successful, this method will be extended to the entire subway system.

* * *

Indian Guides Terrified by Radio

A PARTY encamped on Dog Lake, about nine hundred miles north of Cleveland, had in their outfit a portable radio set. One night the set was brought out and tuned in to a dance program from WTAM. The Indian guides, none of whom had ever seen or heard of radio, watched in silence for a few moments and then took to their canoes. They refused to return until the radio set had been packed away again.

Keystone

A CABARET *A LA* RADIO

That radio waves and water waves may be happily blended into an antidote for hot weather is the assurance of POPULAR RADIO'S *special correspondent in Paris. And he offers this picture as evidence.*

Radio Aided Relief After Ohio Tornado

THE navy answered its first "SOS" from the land when the naval radio operator of the cruiser *Wilmington,* anchored in Put-in-Bay, picked up fragments of radio calls which indicated that the cities of Sandusky and Lorain were practically destroyed by the tornado. The cruiser *Dubuque* went to Sandusky and the *Wilmington* to Lorain; they aided materially in guarding the cities, furnishing medical assistance and supplies to the injured and homeless.

* * *

New Wavelengths for Amateur Transmitters

ALL the radio amateurs who own transmitting sets are rejoicing over the news that Secretary Hoover's radio aides have opened four new short wave bands for their exclusive use. General and restricted amateur radio station licenses now permit the use of the wavelengths between 75 and 80 meters; 40 and 43 meters; 20 and 22 meters; and 4 to 5 meters, for pure CW telegraphy, 24 hours a day. On these low waves the antenna circuit must not be directly coupled to the transmitting circuit; this provision is made in order to minimize key thumps that might be heard on other waves. Other forms of amateur transmission will continue, just as usual, on the waves from 150 to 200 meters.

* * *

A Remarkable French Crystal Set

THE circuit shown in the accompanying diagram for a crystal set was worked out by a French amateur: it is so arranged that the variable condenser can be thrown either in parallel with the tuning inductance or in series with it. Closing the center switch alone places the condenser in series. With the center switch open and the end ones closed the condenser is placed in parallel.

Loudspeaker Made from Roll of Paper

A FRENCH amateur has constructed a workable loudspeaker from materials that almost everyone has at hand, for no cost at all.

First he takes a sheet of heavy wrapping paper and rolls it into the conical shape of a megaphone except that the pointed end is left closed. About three inches in front of this point he cuts two small holes, one on each side of the cone. Through these he thrusts a six-inch piece of bamboo fishing rod, the pith of which has been removed. In the center of this there is a notch. Against the two ends of the bamboo tube thus formed he places the openings in the rubber caps of his headphones. The bamboo tube receives the sound, which then escapes through the notch in the bamboo and goes out through the paper cone.

* * *

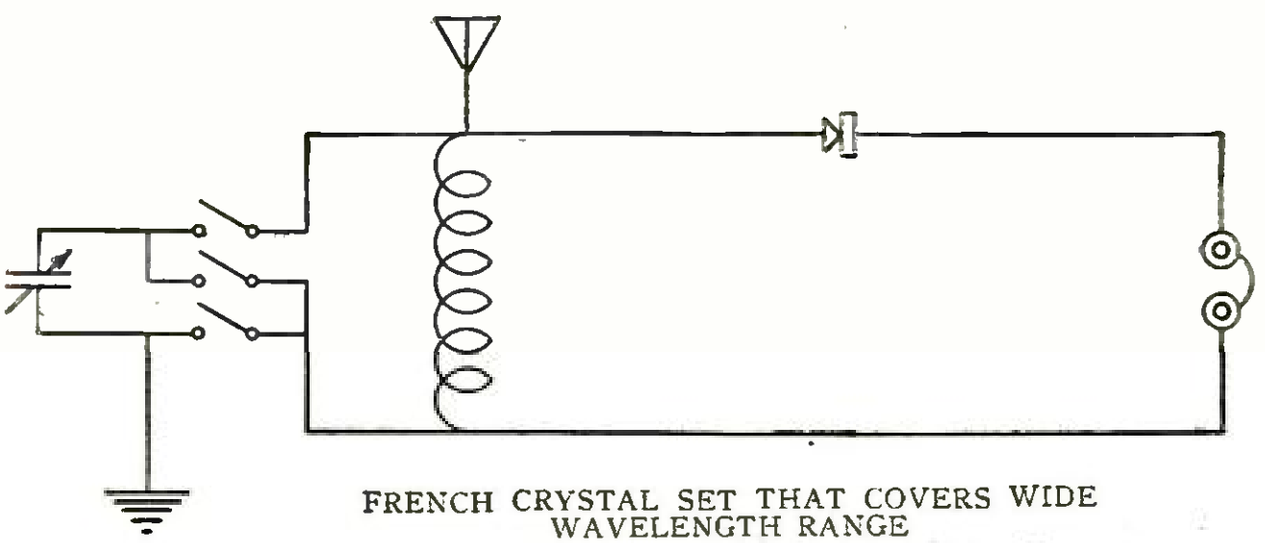
Amateurs Transmit on Trains

ON a run from London to Newcastle, British amateurs were successful in exchanging messages with 6XX in London and with numerous amateur stations along the route. A special car was attached to the "Scotch Express" in which the transmitting and receiving apparatus was installed. Unlike most experiments of this kind, the antenna, instead of being strung along the top of the car, was located inside.

* * *

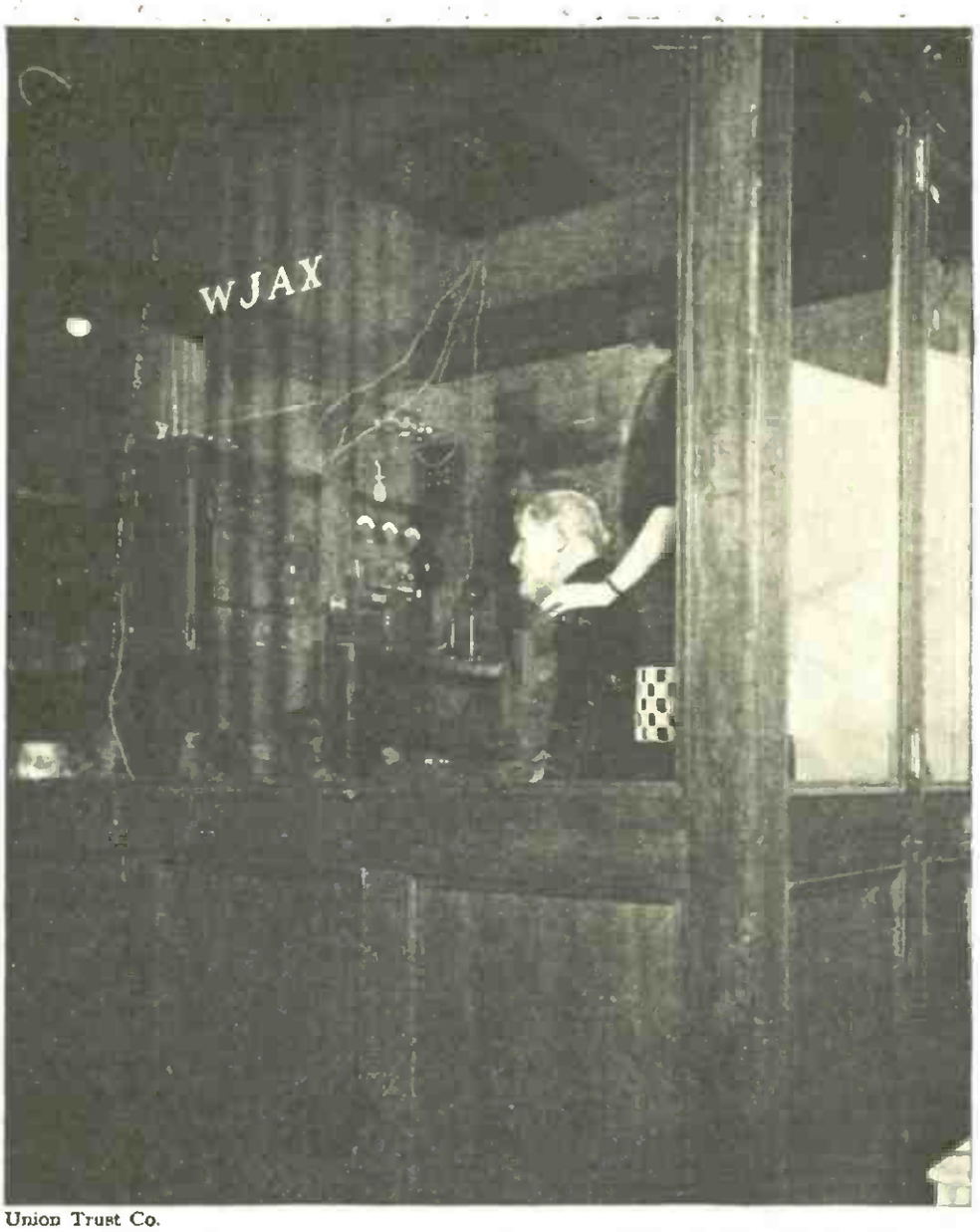
Radio Amateurs in Touch with MacMillan Expedition

A YEAR has passed since Captain Donald B. MacMillan sailed on his schooner *Bowdoin* for the Polar regions. During this period, (which includes the complete cycle of Arctic daylight and darkness) positively reliable communication was maintained for nearly seven months, with amateur operators of the American Radio Relay League, while intermittent contact was had at various times during the remainder of the trip.



FRENCH CRYSTAL SET THAT COVERS WIDE WAVELENGTH RANGE

Here is a variation of the series-parallel switch used in this country as worked out by a French experimenter. It is particularly useful in Europe, where the broadcasting is done on many bands of wavelengths.



Union Trust Co.

THE OLDEST BROADCAST ARTIST IN THE WORLD

Moses Cleaveland, a 102-year old grandnephew of the Moses Cleaveland who founded the city of Cleveland, recently sent a message to the radio fans from a glass-enclosed booth installed in broadcasting station WJAX. Until evidence is received to the contrary, POPULAR RADIO *will believe that Mr. Cleaveland is the oldest-living human being whose voice has ever been transmitted.*

Radio Waves Suggested for Water Finding in Deserts

MR. OSKAR TAUSSIG, a distinguished Austrian engineer, suggested to the recent World Power Conference in London the use of radio waves sent downward from airships for the purpose of locating bodies of underground water as well as deposits of minerals. The possibilities in this direction forecast in the August, 1924, issue of POPULAR RADIO are stated by Mr. Taussig to have been realized by an invention recently made in Austria. Short waves are sent out continuously from a transmitter on a Zeppelin airship. When these waves are reflected upward by the buried rock strata, that is an indication of either hidden mineral deposits or underground water.

Crooks Listen in on Police Reports

CROOKS are only a step behind the enterprising sleuths in the use of radio, according to information received *via* the "stool pigeon" route. While elaborate broadcasting systems have been devised by Bureaus of Criminal Identification throughout the country, by which descriptions of fugitives from justice are furnished various police departments, the crooks are now listening in themselves, police have learned. As soon as a description has been broadcast a brother in crime instantly notifies the fugitive that he is a marked man—and the crook lays his plans accordingly. As a result of the "listening in" habit of crookdom police now are planning to send all radio bulletins by code.

A Broadcast Call for Help

An appeal for volunteers to give blood to save the life of a woman in a Philadelphia hospital was broadcast by station WFI recently. Thirty marines from the Philadelphia Navy Yard offered to submit to the transfusion. It is said that the patient now has more than a fighting chance for recovery.

* * *

How Radio Effects Real Estate Values

Real estate dealers say that a good location for radio broadcast reception is often a factor in the sale of a house or a plot of ground to the home builder. That the importance of this point is recognized is shown by an advertisement which appeared recently in one of the metropolitan newspapers: "Farm for sale; nine room house; fruit trees; 2 hours by rail from New York; excellent radio reception, KGO being heard consistently on one-tube set. Price ——. Box ——."

Kadel & Herbert

RADIO WITH YOUR SHINE

This enterprising lad, Joseph Camerato of New York, has installed a compact dry-cell tube radio set in his shoe-shine box. He reports a healthy increase in trade as a result.

* * *

Amateur Communication Conflicts with Commercial Traffic

H. J. Jesse, Jr., prominent radio experimenter of Leiden, Holland, was arrested for exchanging messages by radio with an amateur in the United States. The case was dismissed on the ground that regular telegraphic communication in competition with commercial traffic was not intended, and the clerk of the open ministry congratulated the defendant for having communicated with a station in America. All of which shows that the science of private radio communication among the radio experimenters has grown much faster than the antiquated laws governing the subject.

* * *

New Radio Sets for Army Airplanes

The recently demonstrated Army Air Service radio transmitting and receiving set for observation planes, is remarkable for its lightness; it weighs only 110 pounds without the batteries. The transmitter uses four tubes and a master-oscillator circuit. The receiving equipment is basically a super-heterodyne of eight tubes. In a special test of these sets in two fast, single-seater planes traveling at about 150 miles an hour, perfect telephone conversation was maintained, with only wing-tip antenna.

* * *

Portuguese Now Legally Own Receiving Sets

According to a recent decree of the Portuguese Government, authority to install and operate radio-telephone apparatus is now granted. Prior to this action, no legal right existed whereby receiving sets could be installed, although no objection had been interposed by the government.

* * *

A Unique Demonstration of Radio Phenomena

A radio amateur of St. Thomas, Ontario, recently staged an interesting demonstration of the speed of radio waves. Station WTAM in Cleveland was broadcasting a late dance concert when the experimenter called up on the long-distance telephone and then put the transmitter of the land line against his loudspeaker. The speed of the round trip of the signals was so great that the music came back from Canada at the same instant that it was going into the microphone in the next room. Of course the transmission required the merest fraction of time, but the listener's ear was unable to detect any lag.

CONDUCTED BY ALBERT G. CRAIG

Cushion Sockets for Eliminating Ringing Noises

THERE are a number of manufacturers who have now on the market new types of sockets in which the tubes are suspended by spring contacts or supported on soft rubber cushions. The use of this kind of socket in a radio receiver that has been noisy up to the time of change will go a long way towards elimination of this noise.

The noise is often caused by the sound waves from the loudspeaker causing mechanical vibration of the cabinet of the set, with corresponding vibrations of the tubes and their elements. When the elements of the tubes vibrate, the spacing between the grid, plate and filament varies and the plate current of the tube varies, thus producing a howl.

If this has been your trouble it would be worth while to change to cushion-mounted sockets.

Short Connections Make for Efficiency

TRY to keep all the grid and plate connections as short as possible. This will place the maximum amount of energy where it belongs and prevent it leaking out to other parts of the circuit where it can do no work and where it may do harm.

Keep the grid wires short and isolated from other connections as far as possible. Never run the plate connections near the grid connections.

Where to Place a Loudspeaker

A LOUDSPEAKER should not be set at the side of the set where the antenna and ground wires are brought out. Keep it on the other side of the receiver and at least a foot away. Neither should the wires connecting the loudspeaker to the set run near the antenna and ground wires or the battery leads. If they do they will cause distortion. Keep them clear of the external wiring to the receiver.

Learning the Insides of Radio Reception

IF you are really interested in finding out all about radio reception and its peculiarities and accompanying phenomena, do not fail to read every line of the series of helpful articles on this subject now running in this magazine from the pen of John V. L. Hogan. They will tell you many things that you really should know and that would take you years to find out by yourself.

Round or Square Bus-wire?

THE square bus-wire makes a very pretty job if you have the time or the patience to bend each corner exactly square, but sometimes the result does not always look very neat.

The round wire (tinned) is easier to work with and the final result looks just as neat, and you do not have to take as much time to do it.

A Tip on Drying Out Your Coils

USE no kind of binder on radio tuning coils if you make them yourself. The usual insulating paint or varnish or shellac will add to the distributed capacity of your coils and make them tune broadly or it may even cause leakage losses that will be greater than that caused by moisture absorption of the coils when left dry.

If the coils are kept in a protected position, not near open windows, they will not gather much moisture.

If your coils *do* get damp you can dry them out by placing a turned-on electric drop light near them. Just take the electric lamp on a cord and put it inside the cabinet, near the coils and close the lid of the cabinet and leave it for an hour or so.

Testing Out a Coil Winding for Open Circuit

SOMETIMES a radio set fails to function on account of a broken connection in one of the transformer windings or in one of the tuning-coil windings.

An easy way to detect an open circuit is to connect a telephone receiver in series with an ordinary dry-cell and the coil to be tested. Then, upon opening and closing one of the connections, a click should be heard in the receivers if the winding of the coil or winding is continuous. If no click is heard, the winding is broken and it should be replaced or repaired.

Such a test will sometimes save many long hours spent in locating trouble in a receiver.

Where to String the Antenna

NEVER put up an antenna near power wires, for obvious reasons. Never put up an antenna so that it runs through trees, near brick structures, near steel smokestacks or near any kind of steel or stone structure. Antennas should be kept at least ten or twenty feet clear of these. This will prevent any loss of energy.

Put up the antenna as free and clear of obstructions as possible. The antenna does not have to run in a straight line; it may be bent at right angles, using an insulator to support the elbow.

A Tip for Laying Out a Panel

IF you decide to build a set from a magazine description, it is a good plan to cut a piece of heavy paper to the exact size called for in the panel drawing, and then to lay out the centers of the holes used for mounting the instruments.

Then fasten the paper onto the face of the panel with clamps, and use a center-punch and a hammer to prick the centers through the paper onto the panel. You will have the holes neatly centered and spaced exactly right when you drill the holes and the instruments will fit correctly.

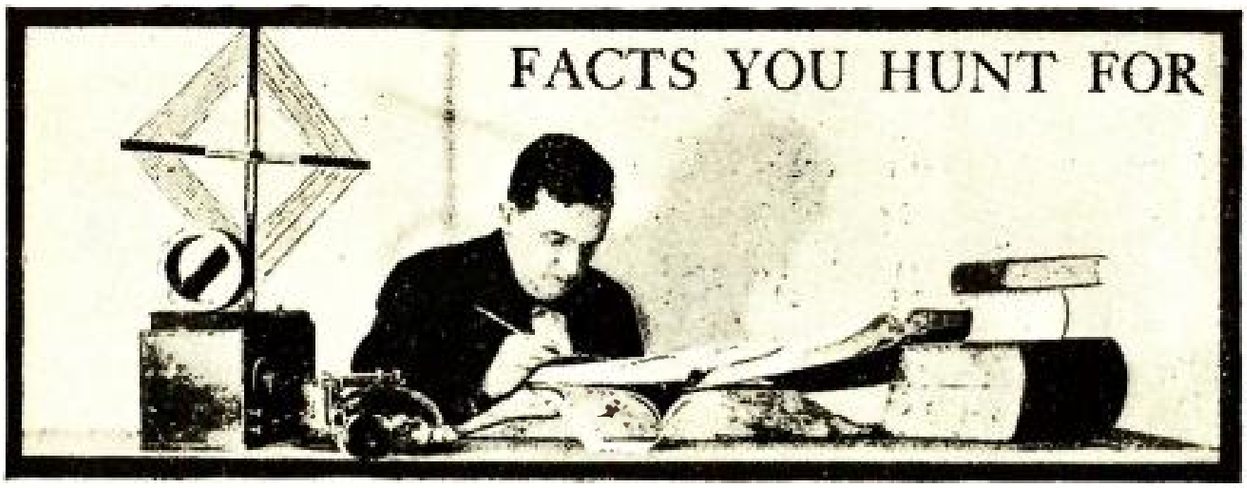
Get Ready Now for DX Reception

Now is the time to plan and decide what kind of receiver you will choose for getting the distant programs that come in so well during the winter months. Start now to check up on the popular circuits and ready-made receivers so that you will be all set and ready when the distance comes booming in.

Check Up Your Wiring

ALWAYS go over the connections of a set that you have built yourself a number of times before you put it into service. This precaution will sometimes enable you to catch a mistake and save burned out tubes.

It is best to have someone else check your wiring if possible as they often find a mistake that the builder passes over as O. K.



CONDUCTED BY RICHARD LORD

A limited number of questions of general scientific interest will be answered each month in this department. Readers are invited to send in questions that have puzzled them—but the selection of questions for answer cannot be guaranteed nor can questions outside the radio field be answered by mail.

Why is American radio broadcasting received in England so much better than English broadcasting is received over here?

THIS is simply an effect of the difference in radio transmission between day and night. The difference of time between the United States and Great Britain is such that when our stations are on the air it is night over the ocean. When the British stations are on it is daylight.

What is a "dull-emitter" valve, mentioned in foreign publications, apparently as a kind of vacuum tube?

THIS is the British name for the low-current-consumption vacuum tubes, usually called "dry-cell" tubes in America. In England vacuum tubes are known as "valves," in reference to their action in letting the current pass only in one direction. The term "dull emitter" refers to the fact that the filaments of these tubes emit electrons even when burning dully instead of at the degree of brightness necessary for the older types of tubes.

How can I impregnate paper with parafin in order to make condensers?

GET a good grade of parafin that is pure white in color, not yellowish. The kind called "parawax" is satisfactory. Melt this in a clean saucepan or frying pan, being careful to see that all the wax is melted to a clear liquid. Do not heat it hot enough to make it smoke more than a very little. Dip the paper in the hot wax, the whole sheet at once, and hold it under the wax with a bit of stick until absolutely no bubbles of displaced air rise from the paper. Take the sheet out, let the surplus wax drain off it and then let it cool.

Why is it that a lot of trees around a house will make it impossible to receive radio concerts there?

THEY will not make it "impossible." There is a chance that a heavy growth of trees reaching up in the air to a considerable height might decrease the strength of picked-up signals because of the absorptive effect of the trees on the radio waves. This would be the same effect as the absorption of the waves by steel buildings.

What are the "N rays"?

THESE supposed rays were much talked about some years ago as being rays of an unknown variety given off by the human body. Scientific investigation failed to establish their reality. Every few years someone claims to have discovered some new kind of "ray" that is produced by the human body or by the mind. None of these claims has been proved and scientists are very skeptical about the existence of any such human radiation.

What is a thoriated filament?

THIS is the filament used in the dry-battery tubes. The usual tungsten filament is replaced by a filament made of tungsten containing a little of the rare chemical element thorium. This thorium increases the number of electrons given off by the filament, so that the tube will work at a lower filament temperature, which means less filament current.

What is the difference between the "effective resistance" of an electric circuit and the plain, ordinary "resistance" that is described in all the books?

THE simple resistance of a circuit is its resistance for direct current. This depends only on the size of the wire, the material of which it is made (for example, copper) and the temperature. But when you pass a rapidly alternating or pulsating current, like a radio current, through this same circuit the apparent resistance is found to be different from what it was for direct current. The "effective resistance" refers to this resistance for high-frequency currents. For a full explanation of just what the effective resistance is, see the text-books of radio science, for instance Morecroft's "Principles of Radio Communication."

Everyone says that you must scrape the paint off a water pipe before fastening a wire to it to use as a ground. In spite of this I have a ground wire just wrapped around a painted pipe and it works perfectly. Why is this?

DOUBTLESS the paint on the pipe is of a variety that is a fairly good conductor of electricity. Many paints are. If your ground works this way that is all right, but it does not weaken the force of the general rule that a pipe ought always to be cleaned and the ground wire fastened to bright, clean metal. Even your own ground will probably work better if you scrape off the paint and fasten the wire in the more usual way.

Is the so-called fused quartz or fused silica any better for condensers than other materials?

IT is very good for mountings, side plates and the like because it has a very low dielectric loss as well as low surface leakage. It has the disadvantages of being brittle, expensive and not available, up to the present, in thin sheets. So far as we know, it has not been used in making condensers except in laboratory researches. It is possible that the new process developed at the Lynn works of the General Electric Company for making fused quartz in quantity may make it available for the supports and bases of condensers and for other radio instruments, but this is still in the future.

Will metal lath used to support the plastering on the walls of a house make it imposisble to use a loop antenna for reception inside the house?

IT will depend upon how completely the different sections of the metal lath are connected to each other electrically. If they are all connected, so that the house is practically a metal cage, the shielding effect will be considerable. Even then it is probable that a little energy will get in. There will always be some shielding effect, even when the lath is not well connected electrically. Metal lath is no thing to use on a radio laboratory. In no case, of course, will the lath or any other metal in the walls interfere with the working of an outdoor antenna.

What do the readings mean on the stem of the floating instrument used for testing battery acid?

THESE instruments are called hydrometers. The ones used for battery acid read in specific gravities; that is, the weight of the liquid as compared with the weight of an equal volume of pure water. For example, when a storage battery is properly charged the hydrometer reading should be about 1.28. This means that a pint of the acid would weigh 1.28 times as much as a pint of water. Some hydrometers, made for testing wine, vinegar, oil and other liquids, have other scales on them. Do not use these to test battery acid unless you know the scale and how to convert it into the specific gravity scale.

What is the best way to test the polarity of the terminals of a battery or a power line?

THERE are many quick tests but, for continual use in laboratory work where it is really necessary to be right, nothing beats the phenolphthalein test. This is made with a teaspoonful or so of a solution of sodium sulphate (Glauber's Salt) to which you have added a very small bit of phenolphthalein. Both substances are obtainable at any good drug store. Dip the two wires into this solution. The solution around the negative pole will instantly turn red.

What is the chemical principle of the Edison storage battery?

ON one plate of the battery is a mass of powdered oxide of iron. On the other plate is hydrated oxide of nickel. When the battery is charged the water in the battery fluid is decomposed, yielding hydrogen at one plate (where the oxide of iron is) and oxygen at the other plate. The hydrogen changes the oxide of iron into sub-oxide of iron, both in their "hydrated" or water-containing forms. At the other plate, the oxygen changes the hydrated oxide of nickel into peroxide of nickel. When the charged battery is used as a source of current these chemical changes occur in the reverse direction; the sub-oxide of iron goes back to the ordinary oxide and the peroxide of nickel likewise becomes the simple hydrated oxide.

"STATIONS I HAVE HEARD"

CONDUCTED BY JULES WATERSON

If you are getting good results with your receiving set, tell your fellow-readers of POPULAR RADIO *how you get them. Give the call letters of the stations you hear, the locations of them, the type of apparatus that you are using and* HOW YOU ARE USING IT.

TOO MUCH VOLUME FOR HIM

"I HAVE been waiting to see if I could find some fault with the Cockaday Improved Four-circuit Tuner," is the way a letter begins, written by J. C. Luoisi, of no less famous a town than Marion, Ohio; but read on: "And up to date the only fault I have found is that the volume is so great that it will rattle the loudspeaker unless the resistance units are switched in.

"I have received a total of 72 stations on the loudspeaker. Unless I get them on the loudspeaker, I don't count them.

"Situated here in the central part of Ohio, I get everything from ocean to ocean. I pick up 100-watt stations in Oklahoma, and WGY of Schenectady, N. Y., comes in as well in the daytime as at night.

"My receiver is made according to your specifications, except that I use U. S. Tool condensers and General Radio rheostats, and one Thordarson transformer.

"I can cut out WPAL, 286 meters, at Columbus, O., fifty miles distant, and tune in WTAY, 283 meters, at Oak Park, Ill., about 300 miles away, and there is no interference between the two stations."

* * *

THIRTY-FOUR STATIONS ON ONE TUBE

THE Reinartz circuit is defended in King City, Mo., by Carroll M. White, who brings in 34 stations with it. While it is considered to be one of the worst "squealers" when operated improperly, it is highly efficient for distance and is usually bothersome only in congested areas.

With this simple circuit and a single tube of the C-11 type White hears stations from coast to coast. On his list are stations in New York and California, and several from Texas and other distant states.

SIMPLE SET REACHES LONDON

PAUL HAMPDEN, of Ridgefield School, Ridgefield, Conn., claims the record of hearing four English stations and twenty-four others more than a thousand miles away, and his hook-up is nothing more unusual than the tuned-plate regenerative circuit which uses a variocoupler, a variable condenser and a variometer.

His distant stations were received on the detector and one stage of audio-frequency amplification. His antenna is 125 feet long and 50 feet high.

The English stations tuned in were 2LO, 5WA, 5NO and 6BM. On the Pacific Coast he has logged KGO, KHJ and KMO. He also reports hearing CKCK in Saskatchewan and CYB in Mexico City. Altogether he has received 173 stations, according to his letter.

* * *

HOME-MADE SET TRAPS 232 STATIONS

A SET made of three home-made spiderweb coils has picked up 232 stations in Toledo, Ohio, according to Charles T. Kirk of 3441 Island Avenue. The set has two stages of audio-frequency amplification. The antenna is of number eighteen wire, only thirteen feet long, strung directly above the set.

His list includes WKAQ, San Juan, Porto Rico; PWX, Havana, Cuba; KHJ, Los Angeles, Cal.; KFAE, Pullman, Wash.; KGW, Portland, Ore.; KFAF, Denver, Colo.; WFAA, Dallas, Tex.; WFAH, Port Arthur, Tex.; WCAG, New Orleans, La., and CFCN, Calgary, Canada.

* * *

CALIFORNIA SURPRISED HIM

"I HAD a surprise Sunday night," says F. J. Broker of Milwaukee, Wis. "With my Haynes DX receiver, I tuned in at 11:15 P.M. on KHJ of Los Angeles, Cal. I use only three tubes."

FOUR-TUBE NEUTRODYNE PICKS UP 75 STATIONS IN ONE EVENING

A NEUTRODYNE-REFLEX using four tubes is the best set today for both selectivity and sensitivity, writes Lieutenant Francis H. Oxx, of the U. S. Army Corps of Engineers, stationed at Fort Mott, N. J. In one evening he received 75 stations, with a total mileage of 48,720. The average distance of the stations was 658 miles. He also claims a record speed of 6,300 miles an hour.

"As an example of the extreme selectivity," he writes, "I completely tuned out WLW of Cincinnati, O., on 309 meters and tuned in KGO of Oakland, Cal., on 312 meters at 11:10 P.M. I can easily tune out WDAR or WFI, 35 miles away, and tune in WHAS or PWX without interference of any kind whatsoever. I have operated the set while living at a point 13 miles from New York City and have attained the same results there.

"All American transformers give beautiful loudspeaker results, using an M-1 magnavox. My neutroformers are Fada, and my tubes are UV-200 and UV-201A. I have received a total of 138 stations in the two months during which the set has been in operation."

* * *

HE HEARD 2LO, LONDON

"WITH my 'Real DX Receiver,' described in the January issue of POPULAR RADIO, I heard 2LO of London, England," writes Philip Levin of 233 Cross Street, Malden, Mass.

"I heard a voice say, 'Hello, hello, America! This is 2LO, London, England. Stand by for a gramaphone selection.' Then I heard a few notes of this number and code signals, probably from some ship out in the Atlantic, drowned out the programme. A little later it came in again with a piano selection.

"This set uses WD-11 tubes throughout and is home-made. My antenna is made of two wires sixty-five feet long with a lead-in of about seventy feet brought around the outside of the house. In spite of this I can tune as low as 150 meters. I get as far west as CFCN of Calgary, Canada, but there seems to be no limit to the range of this set."

* * *

WHAT HE DOES WITH FIVE TUBES

WSB, ATLANTA, Ga., WLW, Cincinnati, Ohio, and KDKA, Pittsburgh, Pa., are received in Toronto, Canada, without either antenna or ground connection by James D. B. Hatchwell, of 1963 Queen Street East. He uses the five-tube tuned-radio-frequency set described by POPULAR RADIO in August, 1923.

He says he also hears Dallas, Tex., on a four-foot loop with detector only, and that he frequently hears stations on the Pacific Coast.

* * *

A BED SPRING DID IT

WHEN all other means failed to separate two powerful local stations, thirty feet of bell wire connected to a bed spring solved the problem for H. C. Liljefors, of 148 Gunther Street, Corona, N. Y.

"On bad nights I use only the bed spring for an antenna," he says. "It brings in the locals as clear as a bell."

ANOTHER CRYSTAL MYSTERY

Two stations in California can be heard with a crystal detector in Colorado, according to a letter from William Beisel of Loveland, Colo. He says that there is no tube set within three-fourths of a mile from him and that he also hears WFAA, Dallas, Tex.; WHB, Kansas City, Mo.; KFKX, Hastings, Neb., and WJAZ, Chicago, Ill.

* * *

THIRTY STATIONS IN FOUR DAYS

THIRTY stations were received in four days while local stations were broadcasting, is the report from R. E. Holmes of 6342 Kenwood Avenue, Chicago, Ill. He has built the Cockaday four-circuit tuner, with two steps of amplification.

Some of those he records are WGR, Buffalo, N. Y.; WBAP, Fort Worth, Tex.; WJY, New York City; WBAH, Minneapolis, Minn., and WSB, Atlanta, Ga.

Another letter from J. Sanchez, with Los Pinos Land Company in Havana, Cuba, states that with the Cockaday set he hears KDKA of Pittsburgh, Pa., 1,180 miles away. Sanchez hears more than a dozen American stations every evening.

* * *

HE "POUNCED" ON THIS ONE

WILLIAM G. WELT, JR., writes to say how glad he is that he "pounced" on the Haynes DX circuit, for he lives in a poor locality for reception, he says, 655 Thirty-fifth avenue, San Francisco, Cal.

"Last night, in an hour and a half, I brought in KFKX, Hastings, Neb., KDKA, Pittsburgh, Pa., and WDAP, Chicago, Ill., through KPO and much static," he states. "I use a WD-11 for a detector and one UV-199 for an amplifier."

* * *

THESE TWO HEARD INDIA

WITH all due modesty, two readers have come to believe that they really heard India. The first, L. B. Barrett of 103 Howard Street, Bangor, Me., reported the fact to a newspaper which published a note about it. The second, Dr. S. E. Sutherland of Jemptland, Me., heard the same program on the same night, and thought he was mistaken until he read the note in the paper.

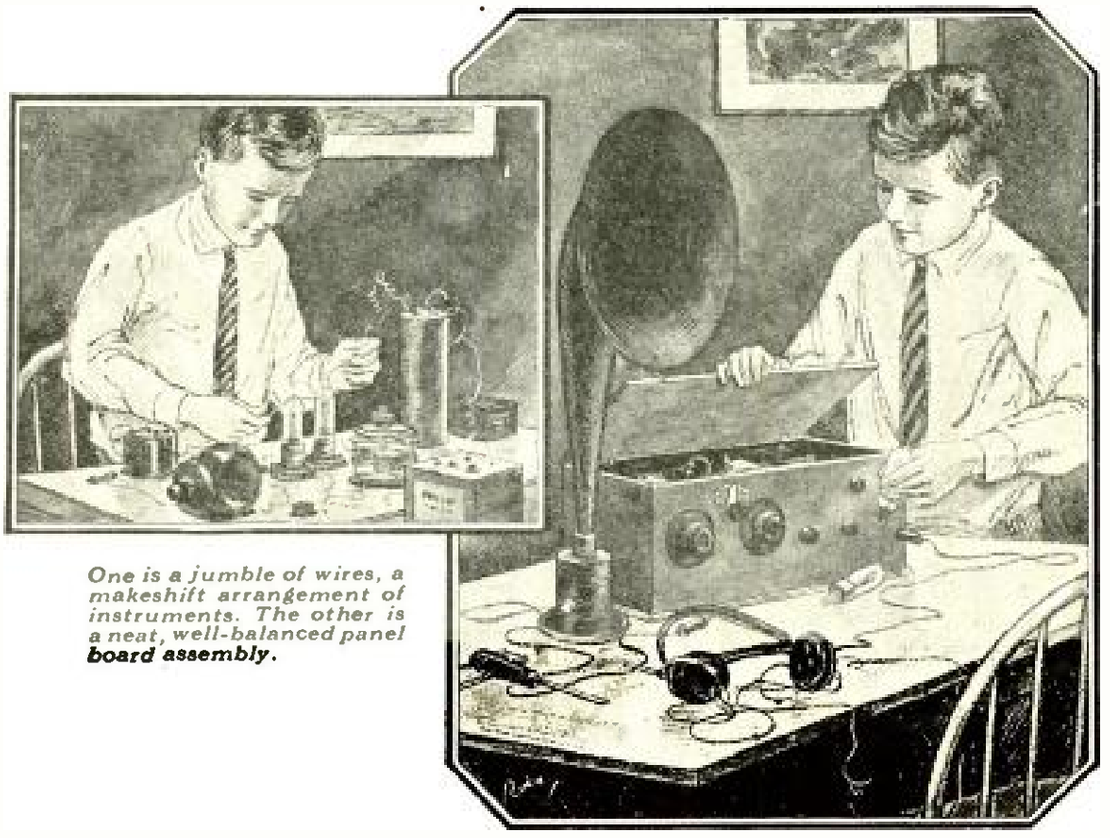
Calcutta, India, came in clear but faint, according to Sutherland. It was audible but of not much volume. Another reason for thinking that he really heard India is that he has reached, with his four-tube set, Paris, Cuba and the Canadian Northwest.

* * *

EIGHTY-FOUR STATIONS ON A LOOP

A REFLEX set, using a loop antenna, three tubes and a crystal detector, brings in 84 stations for C. W. Chisholm of Paynesville, Minn. Most of the stations come in loud enough to operate a loudspeaker, he explains.

Some of his record jumps are KFI, Los Angeles, Cal.; KLZ, Denver, Colo.; KGW, Portland, Ore.; KPO, San Francisco, Cal.; WBAP, Fort Worth, Tex.; WGI, Medford Hillside, Mass., and 6KW, Tuinucu, Cuba.



One is a jumble of wires, a makeshift arrangement of instruments. The other is a neat, well-balanced panel ***board assembly.***

Is your radio set a "potato patch"?

THE "potato patch" set is neither attractive in appearance nor efficient in operation. It is simply a jumble of wires and instruments.

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We have prepared an interesting booklet, "Getting the Right Hook-up with Celoron," which contains many helpful suggestions for building and operating a radio set. Send for your copy now. It is free.

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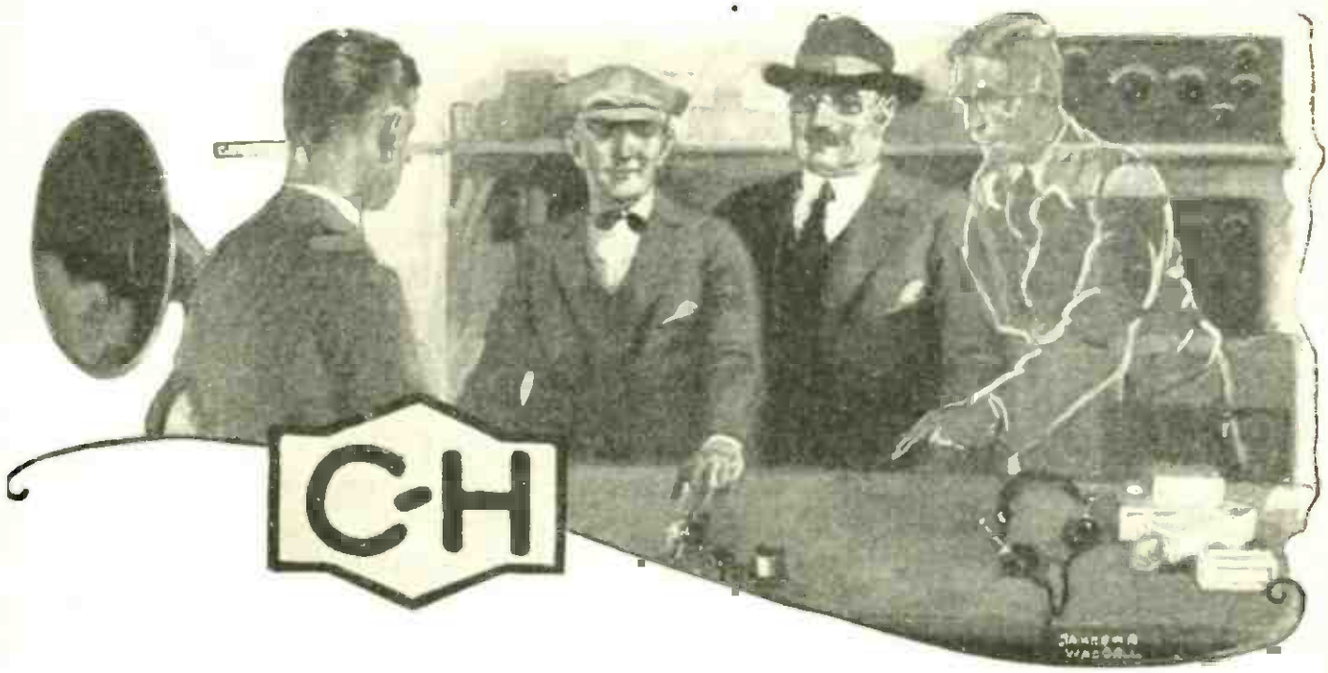


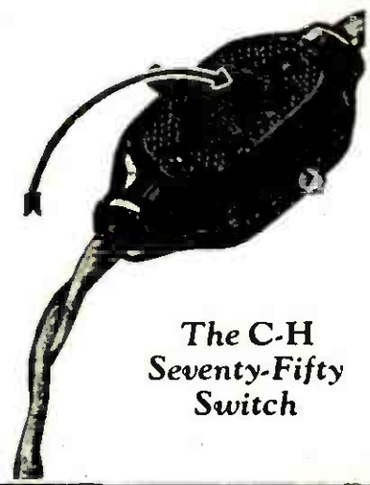
Demanding This Famous Trade Mark Is Like Having an Engineer Buy Your Radio Parts

Built into each Cutler-Hammer radio device is the experience of more than a quarter of a century in electrical control design. When you ask for this trade mark that brings you the best in engineering skill, you are doing merely what electrical engineers in industry have done for several decades.

To thousands of inexperienced radio enthusiasts, this trade mark has been the guide to success in reception — for in demanding it on the apparatus for their sets, they have obtained, without knowing just what to look for, the features and precision that radio engineers recommend.

The Name CUTLER-HAMMER Is Practically a Synonym for Electrical Control

From the large controlling apparatus of giant steel mill machinery to the little 70-50 switch of which more than three million are serving on appliance cords today, the C-H trade mark is a guarantee of satisfaction. Wherever electrical control is required, the name Cutler-Hammer is in evidence.



The C-H Seventy-Fifty Switch

C-H CUTLER-

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

The Secret of Success in Radio Lies in Precise Control

Rheostats may be built down to a size, a price, or any other restriction—but the Cutler-Hammer engineers recognized that quality and precision were the outstanding requirements of apparatus for control of the very heart of your radio set, the vacuum tube. Hence C-H rheostats were conceived in metal, with *real* bearings to give true operation throughout the entire life of the set. They give an even change of resistance, through long, flexible contact fingers that afford constant pressure. You can demand them for the control of any tube—and *be sure* of maximum receiving pleasure.

Buy With Care—Build With Confidence

The C-H Variable Grid Leak, too, is a refinement worth many times its cost. By accurately controlling the discharge of the grid condenser, signals are given a clarity and roundness of tone that adds a new enchantment to every program.

Then the C-H potentiometer with the resistance unit that does not wear and cannot be displaced, even under continuous use, is ideal for the most exacting requirements of radio construction. The C-H Radio Switch, of which more than one-half million are in use today—the switch with the real radio mechanism—affords convenient and quiet control. The new orange-shell socket whose low-loss design has attracted the attention of every radio engineer; all of these will help you to build a better set, and their cost is no higher despite their guaranteed quality. Demand the C-H trade mark and build with confidence!

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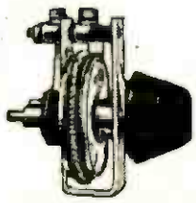
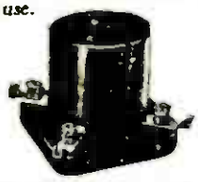


The C-H Radio Rheostat
Furnished in 4 ohm, with or without vernier, 30 ohm, and 125 ohm to provide perfect control for any tube.

The C-H Variable Grid Leak
Mounted on the tube socket-panel controlled. Adjustable for all grid condensers.

The C-H Radio Potentiometer
The potentiometer with the resistance unit that does not wear and cannot be displaced under constant use.



The C-H Radio Socket
The low-loss socket with the orange shell. Perfect design—silvered contacts—attractive appearance.

The C-H Radio Switch
The switch with the perfect mechanism for providing easy control of the most delicate circuit without introducing microphonic noises—one hole mounting.

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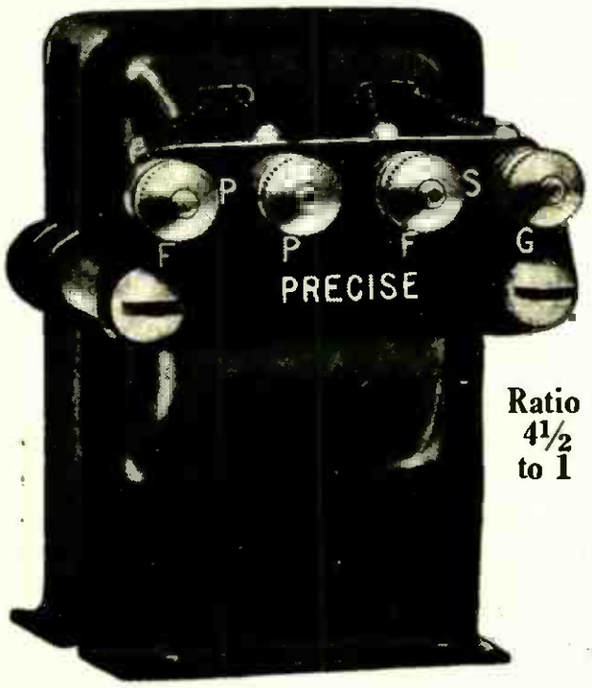

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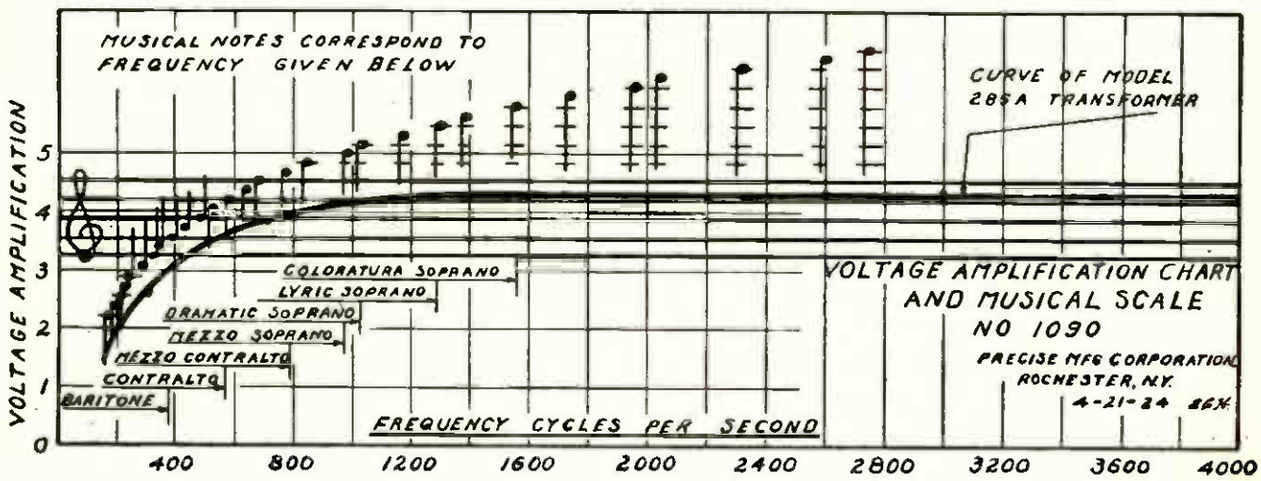

The above chart, No. 1090, gives the results of exhaustive laboratory research, showing the musical scale and corresponding frequencies to the musical notes. The voltage amplification curve parallels the musical notes throughout the entire range, indicating the supremacy of Precise Transformers in tone quality amplification.

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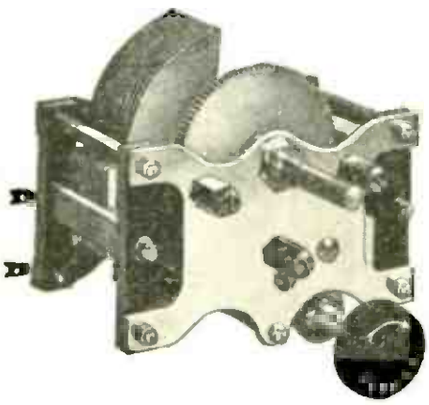

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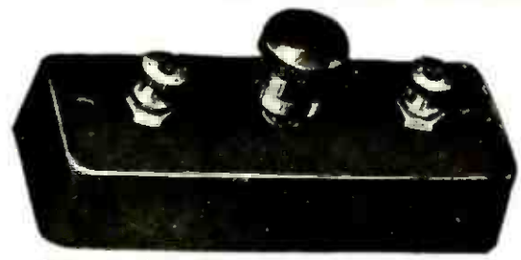

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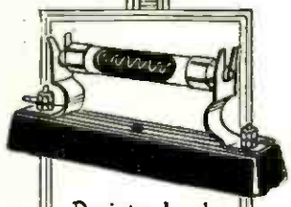
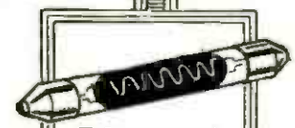
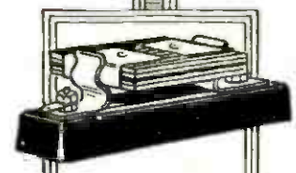
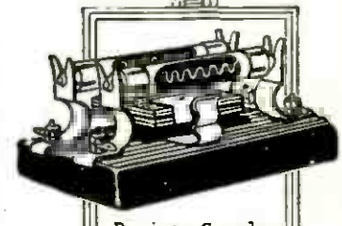

Resistor-Leak Mounting


Combination Gridleak Condenser Mounting


Filament Ballast Resistors


Condenser Mounting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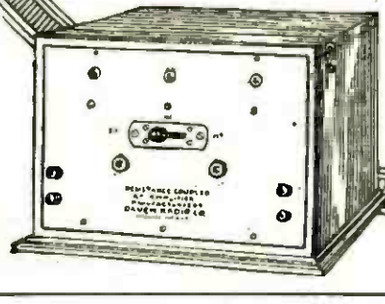
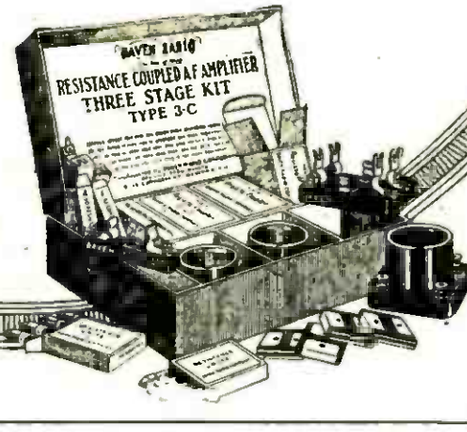
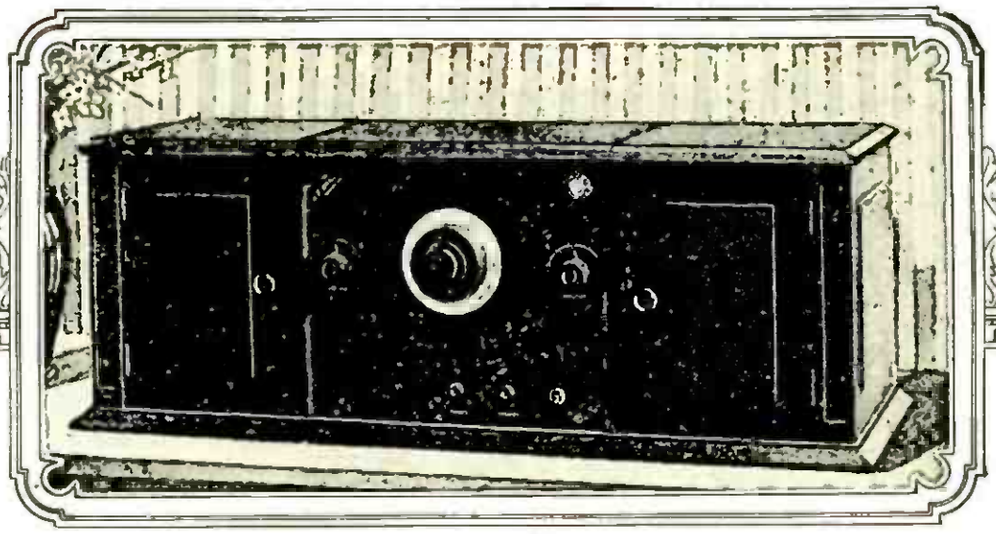

De Luxe Amplifier



Type 3-C Kit



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ONE DIAL — SIX TUBES

THE BRANDOLA is the latest achievement in radio. In its simplicity of control, purity of tone, volume, extreme sensitivity and clear reception of distant stations combined with its very accurate logging, the "BRANDOLA" is far in advance of any Radio receiver now offered to the public.

TONE QUALITY. The newest and most improved method of amplification is employed exclusively in the construction of this wonderful receiver. By the use of Resistance Coupled Amplification, reception of music has been transferred into the realms of higher musical expression.

OPERATION. As you will note in the illustration the "BRANDOLA" has but one dial to adjust—so simple, that a child of six years can tune in local and distant stations with the same ease and confidence as its parents. It is very selective in its operation—a simple adjustment of the one dial and you may choose between the many programs in the air.

LOGGING. The "BRANDOLA" logs perfectly. When you listen in, note the position of the dial, jot it down in your log book for future reference. Because of its simplicity of operation, the number of stations you may listen to in one evening is only limited by the number you may choose to hear. The slightest turn of the dial absolutely eliminates one station and brings in another.

The "BRANDOLA" may be purchased at any first class Radio Store. If you cannot obtain it, write us and we will mail list of nearest dealers.

Any Dealer will be glad to demonstrate the "BRANDOLA" for you—try it yourself and see how simple it is to operate.

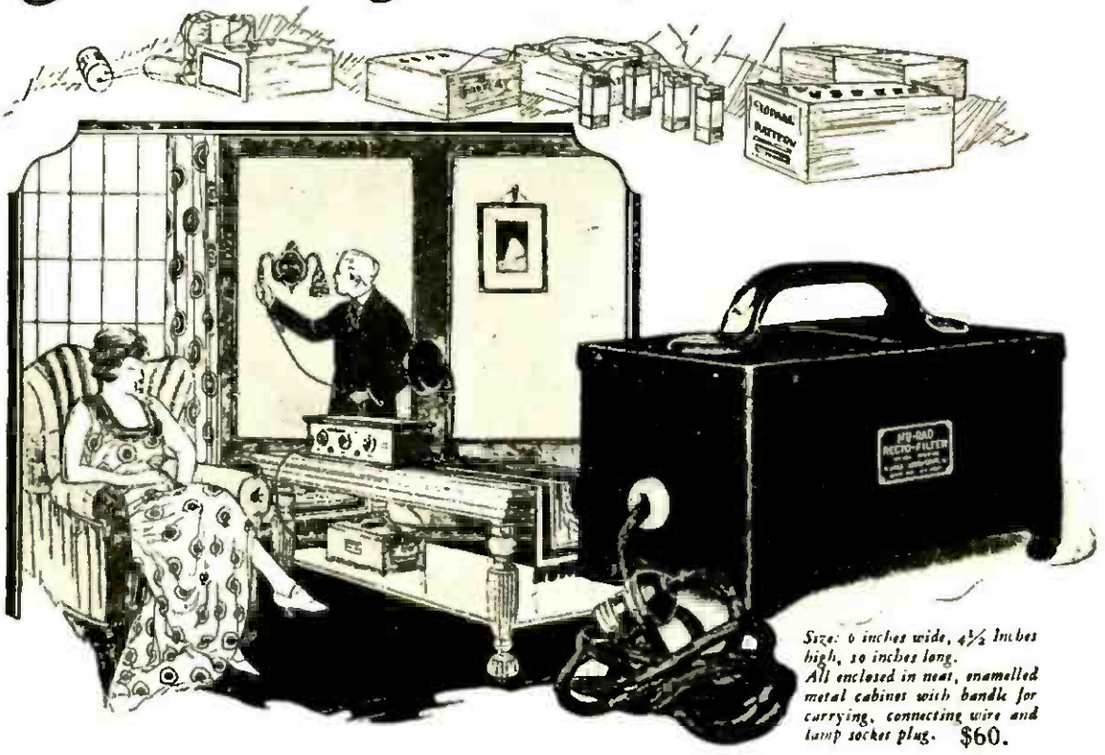
List Price $125.00

The Brandola

The J. F. Brandeis Corp. 36 Oxford St. Newark, N. J.

Good Bye BATTERIES

A New Day in Radio Art



Size: 6 inches wide, 4½ inches high, 10 inches long. All enclosed in neat, enamelled metal cabinet with handle for carrying, connecting wire and lamp socket plug. $60.

"B" BATTERIES banished, outclassed, along with the tin-type and the wax cylinder phonograph record. New power—every required voltage—steady, smooth, dependable, right from the nearest lamp socket through the **MU-RAD RECTO-FILTER.** The final achievement of a long awaited ideal.

Not an experiment—a demonstrated, practical power unit.

Actually smaller than the batteries it displaces. Only six inches wide, ten inches long and four and a half inches high.

Used with the new Mu-Rad Receiver MA-20 also eliminates the "A" battery—a dual power unit.

A Mu-Rad product—that underwrites your satisfaction with the **RECTO-FILTER**—a full surety that it will live up to every claim.

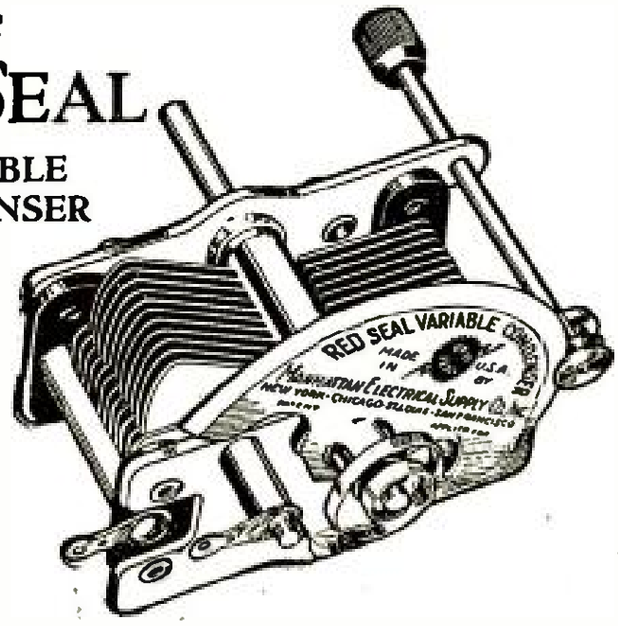
See our advertisement of the* MU-RAD RECEIVER-MA20 *in this issue

Write for Literature!

MU-RAD LABORATORIES, INC.
809 FIFTH AVE., ASBURY PARK, N. J.

The MU-RAD RECTO-FILTER

The RED SEAL VARIABLE CONDENSER



At Last—an ideal vernier to control a low-loss condenser

You have probably often wished for such a combination. Now for the first time the vernier of the Red Seal enables you to easily take full advantage of high condenser efficiency without turning right through the sharp peak of the wave.

No more slipping, lost motion, or tight bearings. No more tuning with one knob and adjusting with another. All the adjusting may be done with the vernier knob alone.

The above does not give you an adequate picture of the Red Seal Condenser. Go to your dealer and ask to see it. As you operate the vernier for yourself, note these six important features which make it the ideal control for this efficient, low-loss instrument.

1. The action of the vernier is *positive*, giving delicate, smooth adjustment.
2. There is no lost motion or play at any point.
3. All tuning may be done with the vernier alone.
4. Only one dial setting—stations easily logged.
5. There is no fibre, rubber, or gears. Nothing to wear or get out of order.
6. Plates turn freely. Balanced vernier eliminates need for friction at bearings.

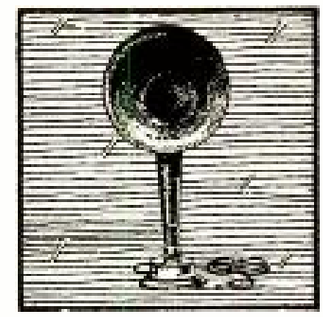
The Red Seal has four other points of note:

1. Plates are of brass and are *soldered*.
2. Spring "pig-tail" connection employed.
3. End plates are grounded, eliminating the effect of hand capacity. For supercritical work, insist on the Red Seal Variable Condenser.
4. To facilitate tuning the movable plates are given a special shape, making the Red Seal of the "straight-line" type.

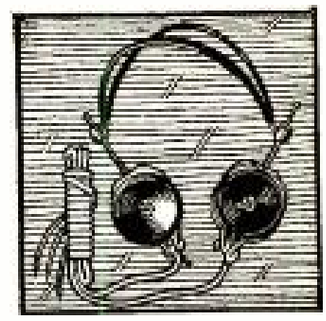
Manhattan Electrical Supply Co.
Incorporated
New York Chicago St. Louis
San Francisco

Manhattan
RADIO PRODUCTS

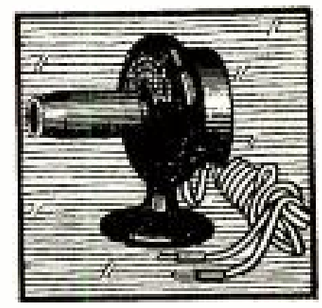
MADE BY THE MAKERS OF THE FAMOUS RED SEAL DRY BATTERIES



Manhattan Junior Loud Speaker—A real musical instrument containing a specially designed reproducer unit for loud speaker work. Not just a headset in a base. Has "Concert Modulator" adjustment giving best results under all conditions—$10.00

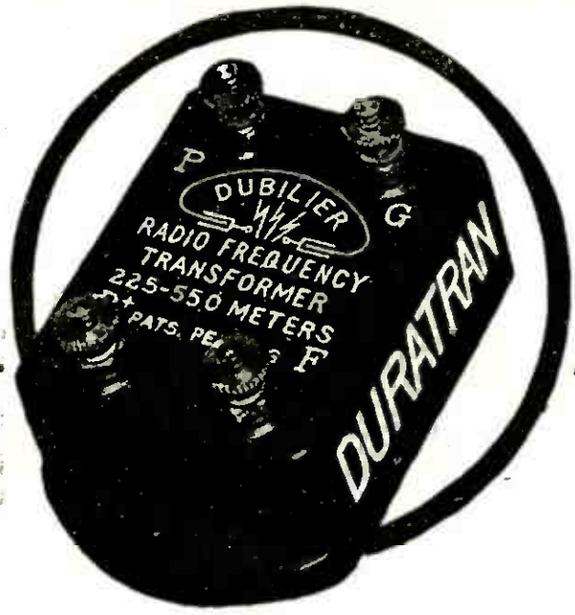


Red Seal Headset—Designed for "DX" work. Tone quality excellent. Workmanship the best. No distortion or chattering. Bakelite case, soft rubber sanitary headband—$6.00



Red Seal Phonograph Attachment—Makes a loud speaker of your phonograph. A high grade reproducer reproducing the work of the broadcasting artists with fidelity—$5.00

Red Seal Batteries—The dependable dry battery for "A" circuits. Long operating life and great recuperative power make Red Seals ideal for radio work. Sold by all classes of dealers. Remember, *fresh* Red Seals bring in fresh stations.



Get those Stations with the DURATRAN!

YOU can get them on your home-made set—even if you are handicapped by an indoor loop. You can get them clear and strong Only one thing is needed—the right radio frequency transformer—the DURATRAN!

Powerful! The Duratran picks up all standard broadcasting wave lengths—not just a narrow band but the entire band of 225 to 550 meters. And amplifies as much as 20 times. Yet the reception is clear, undistorted, full!

Don't discard your one-tube regenerative set because you can't get the distant stations. The Duratran, the wonderful radio-frequency transformer, will bring them in.

For real satisfaction use the DURATRAN $4.00

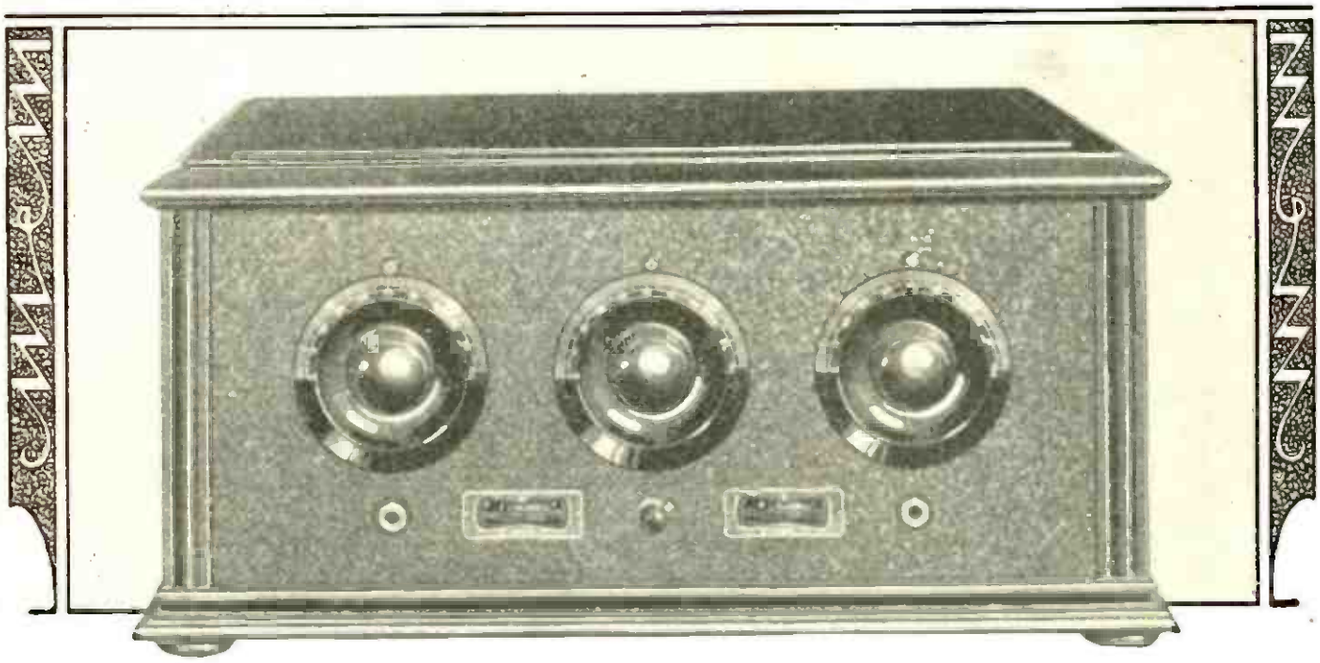
Dubilier

CONDENSER AND RADIO CORPORATION

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

EISEMANN

ELECTRICAL EQUIPMENT



Announcing the 6-D Receiver

TYPE 6-D embodies the most modern developments in radio engineering, together with unusual design and workmanship. It meets exacting requirements of discriminating buyers.

The outstanding characteristics of this new Receiver are extreme selectivity, extraordinary distance range and exceptional clarity. Tuning is very simple. The 6-D is a non-oscillating Receiver, and no potentiometer or stabilizer is employed.

Step into a radio store and examine this new Receiver. Ask for a demonstration, and see for yourself its many superior qualities.

SPECIFICATIONS

Circuit: Two stages of tuned radio frequency amplification, detector and two stages of audio frequency amplification.

Tubes: Five in all. Jacks provided for either five or four tube operation.

Batteries: Either storage or dry-cells.

Cables: Complete set supplied for "A" and "B" batteries.

Aerial: 75 to 125 feet, single wire.

Price, without Tubes & Batteries, $125.00

Wave lengths: 200 to 600 meters, with uniform efficiency of reception.

Panel: Aluminum, with attractive crystal black finish. A perfect body capacity shield.

Dials: Sunken design. Shaped to fit the hand and permit a natural position in tuning.

Rheostats: Adequate resistance for all standard base commercial tubes.

Condensers: Single bearing, low leakage losses.

Sockets: Suspended on cushion springs which absorb vibrations.

Cabinet: Mahogany, with distinctive lines and high finish. Ample space provided for "B" batteries.

For Sale by Reliable Dealers

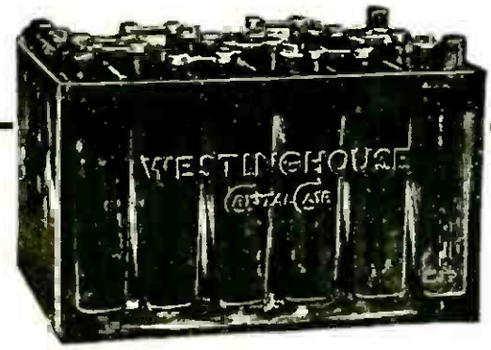
EISEMANN

EISEMANN · MAGNETO · CORPORATION

General Offices: 165 Broadway, New York

DETROIT · SAN FRANCISCO · CHICAGO

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Westinghouse Presents

A *New* "B" Battery

Designed for multi-tube sets, compact in size, large in capacity, this new "B" Battery offers you the following distinctive advantages:

A one-piece crystal glass container affords you at all times a view of the interior.
Easily recharged at slight expense.
No leakage from cell to cell.
Will not pump acid.
Bird cage plates insure long life and steady reliable service.
Large acid space requires less attention.

WESTINGHOUSE UNION BATTERY CO.,
SWISSVALE PENNSYLVANIA

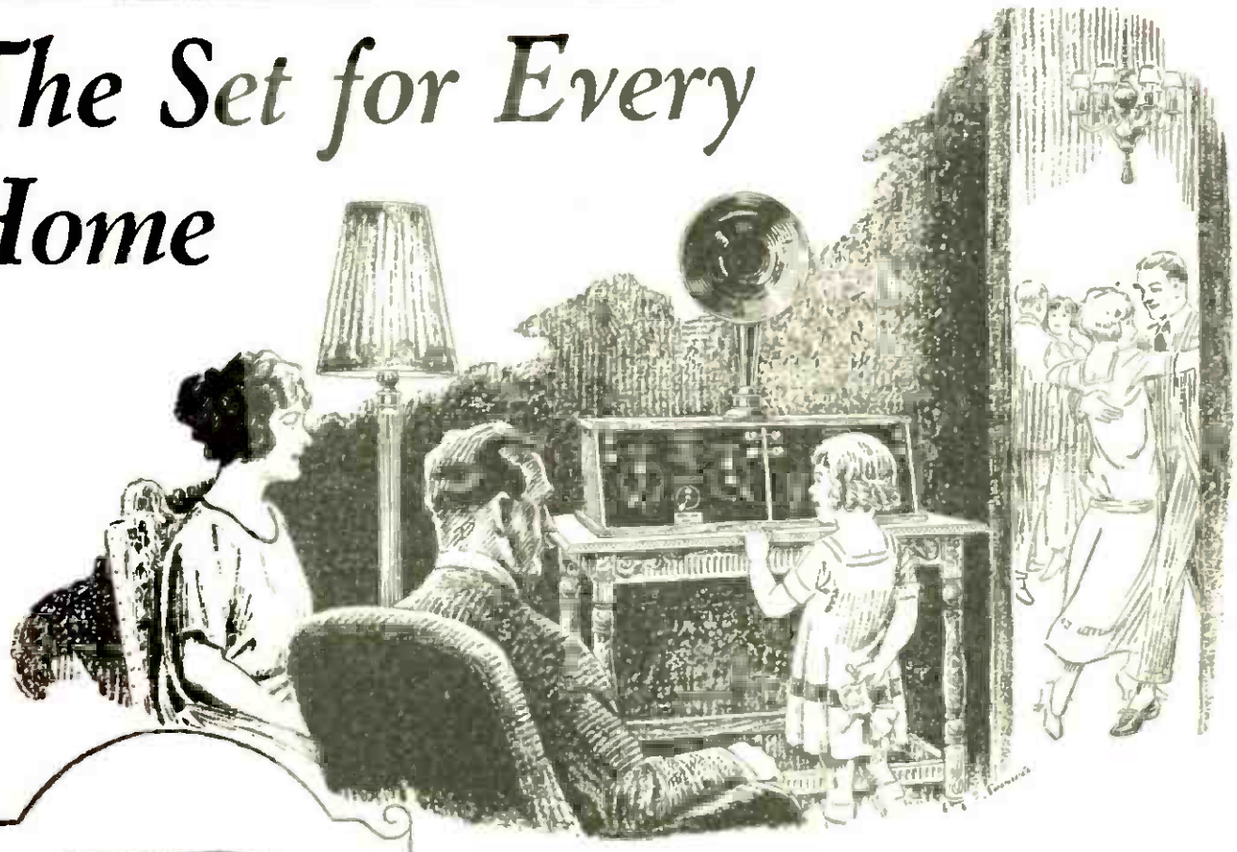
WESTINGHOUSE

RADIO

"A," "B" and "C"

BATTERIES

The Set for Every Home



2 tube Regenerative long distance wonder. MRC 2, $32.50

3 tube receiver in handsome case with inlaid panel door, and compartments for batteries, head phones, etc. MRC 3, $87.50

Michigan "de Luxe" 4 tube receiver. 1 stage R.F. amplification. Built-in adjustable loud speaker. Solid mahogany case. "America's most beautiful set."
MRC 4, $150.00

Michigan 12, $57.00

THOUSANDS of satisfied owners all over America vouch for this three tube, long distance wonder.

No set, regardless of price, has ever outdistanced it. No set will give you greater satisfaction — no set is easier to operate. Michigan lever controls give you vernier adjustment without any additional parts.

Selectivity—stations but a few meters apart are easily separated.

Works equally as well with 6 Volt or Dry Cell standard tubes. Ample space for batteries. Beautiful mahogany finish. A set you can rely on to perform consistently.

Write for illustrated folder. Ask your dealer to give you a demonstration.

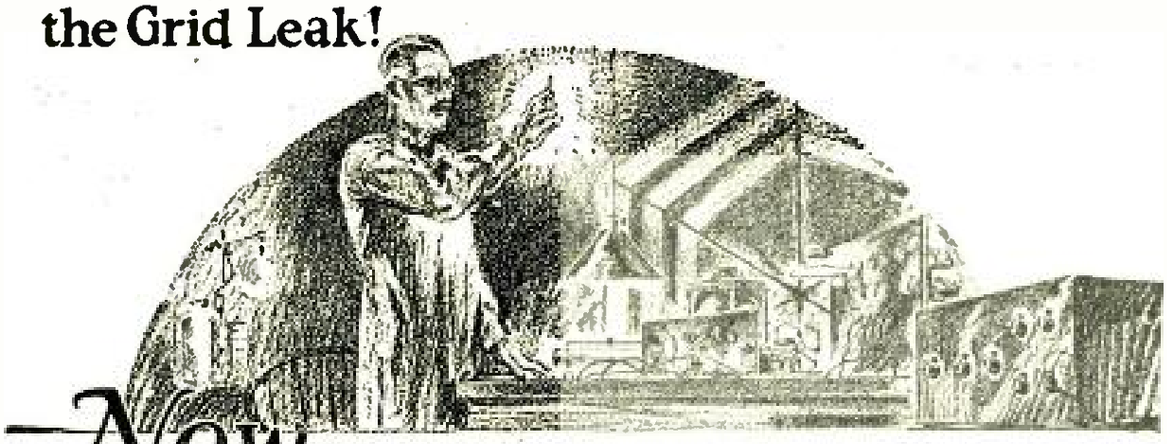
Other Michigan styles and types, from $27.00 up.

Licensed under U. S. Pat. 1,113,149-letter pending 807,388

MICHIGAN RADIO CORPORATION

33 Pearl Street Grand Rapids, Michigan

Science Perfects the Grid Leak!



Now— The Certified Grid Leak

Our Engineers Have Perfected the Grid Leak

ARE there stations you can't get —is your reception ruined by distortion? Nine chances in ten, your grid leak is at fault.

No matter what circuit you have, if you use tubes, the clarity of your reception, the distance you get depend on your grid leak. It must not only be of the right resistance, it must permit the current to flow from the grid smoothly and noiselessly.

For better reception get an Electrad Certified Grid Leak of the proper rated resistance and see what a difference it will make. Price 50c.

Insist on Electrad Parts

When building or rebuilding your set, don't overlook the small parts. Electrad Certified Parts are all guaranteed.

Indorarials, Lamp Socket Antennas, Lightning Arresters, Resistance Coupled Amplifier Kits, Verni-Tuners, Hydrogrounds, Glass Grid Leaks, Variable Grid Leak and Condenser Combined, Grid Leak Mountings, Aerial Outfits, Fixed Resistance Units.

Your dealer has them, or if he cannot supply you, write direct to

ELECTRAD INC.

Dept. "C," 428 Broadway, New York

VARIOHM

A scientific variable adjustable carbon disc grid leak. Any resistance from ¼ to 30 megohms.

Price 75c. Mounted $1.00

LEAD - IN

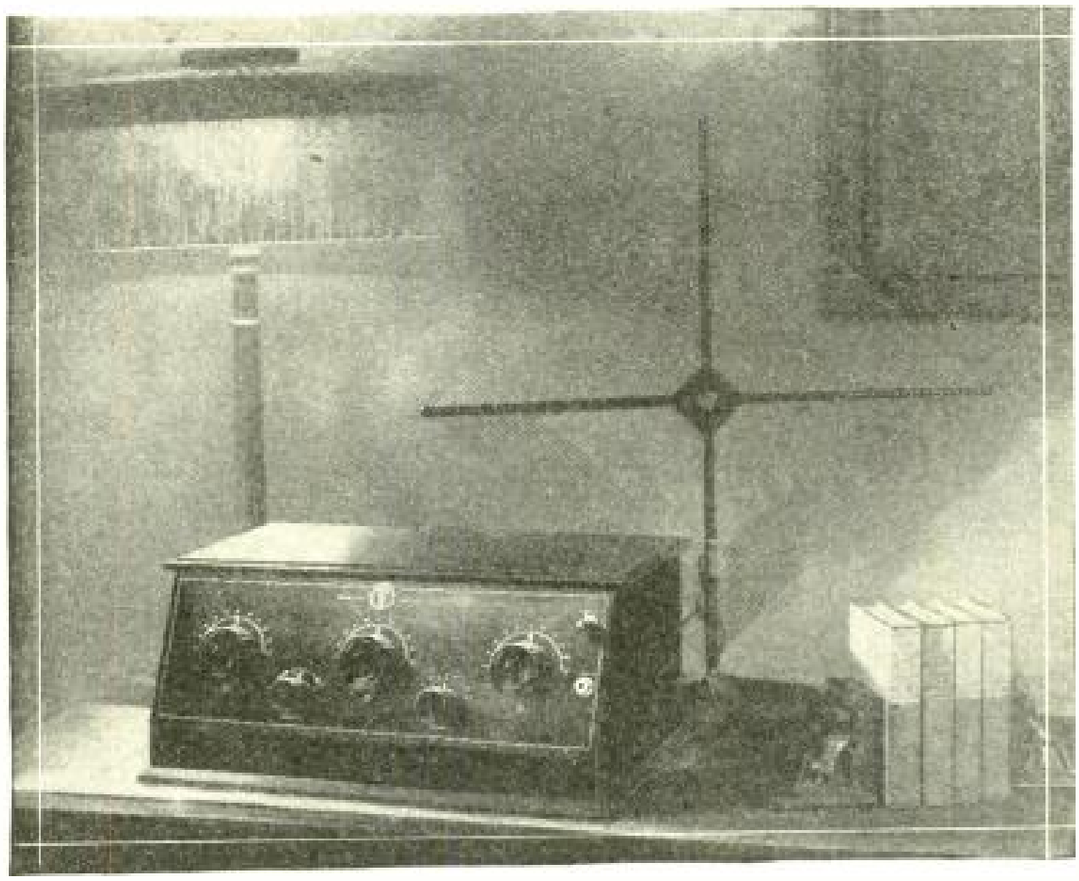
Fits under closed doors or windows, covered with 3000 volt insulation. Soldered connections. Beware of imitations.

Price 40c.

AUDIOHM

Just try an Audiohm across secondary of your transformer.

$1.50 with adjustable bracket



MERCURY Four-Tube Reflex—Equivalent to Six Tubes

The Ear of the Air

JUST as the human ear interprets accurately and clearly the most delicate sound vibrations within its range, so the new MERCURY Receiving Set reproduces with absolute fidelity every feature of modern broadcasting.

The Grimes Inverse Duplex System, with volume control in the input circuit and perfectly balanced audio circuit, insures a NATURAL TONE QUALITY rarely obtained. This, combined with the extreme selectivity so important in these days of increasingly powerful and numerous broadcasting stations, assures, in the new MERCURY Receiver, a set which provides entertainment that satisfies the most critical.

To those living in climates where static is prevalent the year round, the MERCURY Receiver will be of particular interest in that it operates on either loop or antenna. This set can be used with dry batteries enclosed in the cabinet, or with storage batteries.

Price, complete with loop (not including tubes or batteries), $165.00.

The INVERSE DUPLEX
Insures Natural Tone Quality
LICENSED UNDER PATENTS ISSUED AND PENDING

Write now for full information

MERCURY RADIO PRODUCTS COMPANY
50 Church Street **New York, N. Y.**

Licensed under Grimes Patents—issued and pending

Tune in, and end those Super-Heterodyne Blues

Since the close of the great war I have been working on the simplification of Super-Heterodyne.

This done I said to our Laboratory Chief early last Fall, "Meissner, thousands of fans bless us for the Pink-A-Tone crystal sets with which they tuned in for the first time. Let's give them Super-Heterodyne."

So Meissner went to work on "input" and "intermediate frequency." He tried every available type of transformer. After months of costly experimenting he perfected the new Pink-A-Tone 150,000 cycle Transformers and Oscillator Coupler.

When friends hear my Super-Heterodyne they cannot believe their ears. A simple adjustment of two dials and Chicago Grand Opera or Georgia Minstrels are in the next room.

I began to supply hook-up and parts to a friend. He put them together and retailed them for $450.00 to $750.00 each. The other day he bought a Rolls Royce.

"Now, Meissner," said I finally, "how can we give it to the fans?"

"Suppose the fan could have your set on his work table before him," said Meissner, "while he put together the perfectly matched and balanced parts which you supply at cost, plus overhead, plus 10%!"

He had taken life-size photographs, top and rear, and then made blue prints showing each part numbered and in place. From plates costing a round thousand dollars he had made life-size reprints of these photographs and prints, exactly as illustrated, of which a radio publisher said the other day, "I have never seen anything like them in all my life."

You may have a complete set for $2.00—on approval.

AFTER BUILDING

"I have built ten. Yours the best." New York

"It works very fine. The— is not in it." Texas

"Surprised myself and many customers." Louisiana

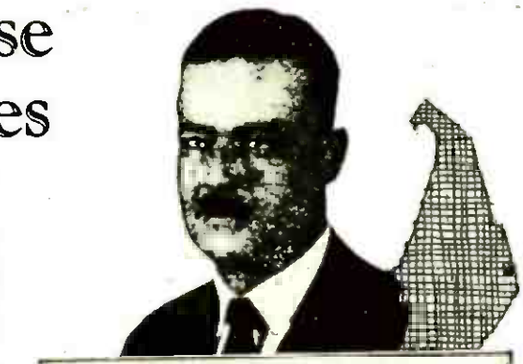
About intermediate frequency transformers. Upon their proper construction and balance depends the "equal amplification in each successive step of the signal as it is passed along from stage to stage," says Captain Robert Scofield Wood in a two-page description of Engineer Meissner's masterpiece in the New York Evening World's Radio Section.

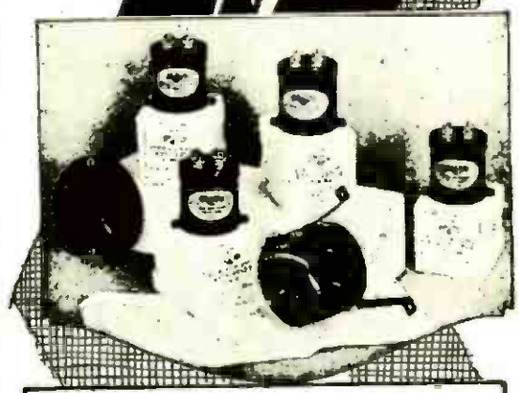
That is why Meissner was not satisfied until he had built and balanced his own "heart of Super-Heterodyne," the wonderful Pink-A-Tone Transformers and Oscillator Coupler — illustrated above — which may be had, carefully matched with life-size plans for $32.50.

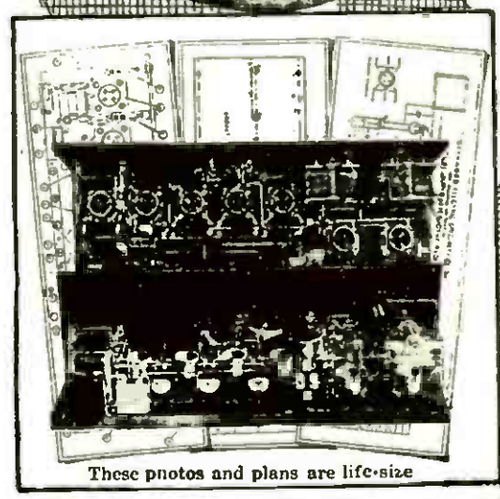
The other parts necessary for the construction of this Super-Heterodyne that will not "repeat" (*no station comes in twice on the dials*) are pictured below. We sell and like Captain Wood urge the use exclusively of the best products of manufacturers like Pink-A-Tone, Bakelite, Paragon, General Radio, Hammarlund, Acme, Dubilier.

We will send all of these parts, carefully matched and balanced in our Laboratories, with life-size plans, complete, for about 10% less than list, or $80.00. Our references are the Publishers or any New York bank.

THOMAS N. PINKERTON.
President.







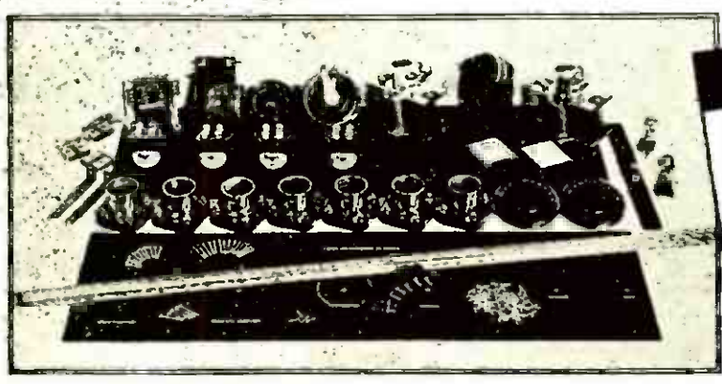
These photos and plans are life-size

Own the best—built with your own hands. Our Service Department will help you out of any little difficulty, by wire if necessary.

But do not make the *fatal* mistake of trying to use any but the best made, matched and balanced parts for Super-Heterodyne.

Pinkerton Radio Corporation
SUPER-HETERODYNE EXCLUSIVELY
1834 Broadway New York City

Dept. 103



RADIOGRAM

Please send Photographs and Blue Prints, complete. On Approval — I enclose $2.00 — Four matched and balanced Pink-A-Tone Transformers and Oscillator Coupler. I enclose $32.50 — Or 25% C. O. D. — Complete Pink-A-Tone Super-Heterodyne Kit at approx. 10% off list. I enclose $80.00 — Or 25% for C. O. D. shipment —

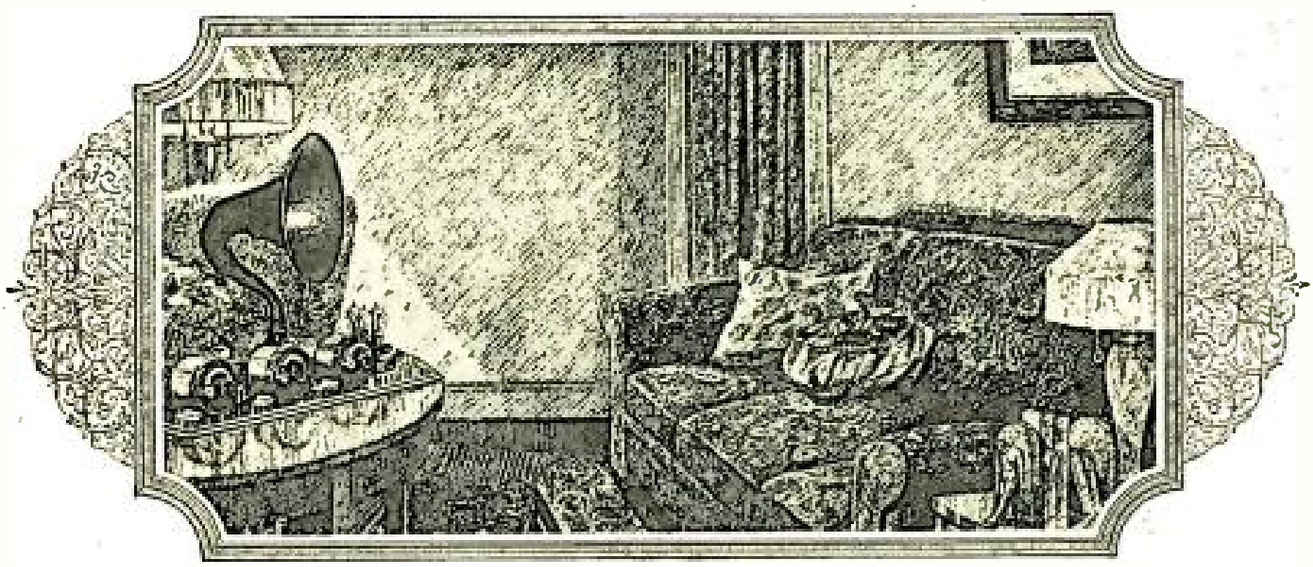
NAME

ADDRESS

Remit by certified check or money order.

ATWATER KENT

RADIO



"Mine is ATWATER KENT"

—a simple statement often made by proud owners with the assurance that elaboration is not necessary—

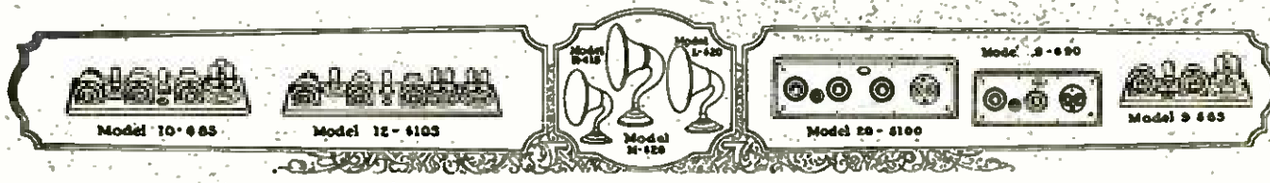
They know that their radio equipment is distinctive—Precision is its dominant characteristic — That it is made for those who demand not only quality and unusual performance in radio reception, but distinction as well.

In selecting your radio, remember that ATWATER KENT standards in design, construction and manufacture are the result of the accumulated experience of more than a quarter of a century in the making of scientific electrical instruments.

Comparison is the basis on which ATWATER KENT Radio is sold — go to your regular store, examine ATWATER KENT Receiving Sets and Loud Speakers and you will appreciate their value.

ATWATER KENT MANUFACTURING COMPANY, 4933 *Stenton Ave.*, PHILADELPHIA, PA.

THINK OF WHAT IS BACK OF IT



New complete line of radio batteries

AN even better battery and at a much lower cost! That is what you will say when you examine the new Exide "A" battery.

The composition case including handles is moulded in one piece, beautifully stippled and finished in glossy black—an ornament to any room.

Many refinements have been made but you will find the same wonderful Exide plates, the same separators and the same electrical efficiency as the old battery—yet lower in cost!

The Exide two-volt and four-volt "A" batteries for low voltage tubes are midgets in size but giants in power.

New "B" Battery in glass jars

With the increase in popularity of the many-tube sets has come the need for a "B" battery of greater capacity than the twenty-four volt, 4000 milliampere hour, rubber cell Exide used with smaller sets.

To meet this need the new Exide "B" batteries in glass jars were designed. They are made in two sizes—twenty-four and forty-eight volts but with larger plates and greater space for electrolyte, they have a capacity of 6000 milliampere hours.

The new Exide rectifier

With this attractive and compact rectifier, your "B" battery can be recharged from your regular alternating house current, at a cost that is insignificant.

Whatever the size of your set, all of your battery needs can be filled from the complete Exide line. Exide Radio Batteries are sold by Exide Service Stations and Radio Dealers. Ask to see them.

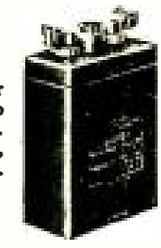
THE ELECTRIC STORAGE BATTERY CO., Philadelphia

In Canada, Exide Batteries of Canada, Limited, 133-157 Dufferin St., Toronto

The beautiful new Exide 6-volt "A" battery in one-piece case. Many new refinements but the same old rugged power, $14.60 up f.o.b. Philadelphia.

Exide

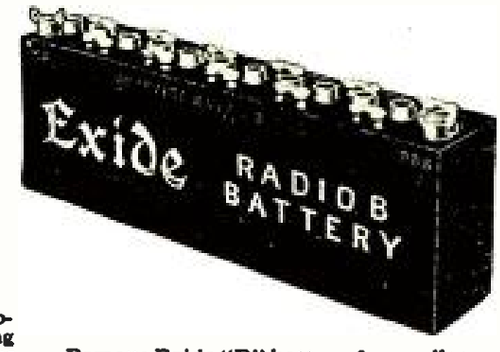
RADIO BATTERIES



2-volt "A" battery for low-voltage tubes. Also made in 4-volt size. Prices $5.40 and $7.30, respectively, f. o. b. Philadelphia.

New 24-volt Exide "B" battery in glass jars, 6000 milliampere hours capacity. Also made in 48-volt size. Prices $12.00 and $23.30 respectively, f.o.b. Philadelphia.

New Exide Rectifier. The economical device for recharging your "B" battery from your house current. $2.00 f. o. b. Philadelphia.



Famous Exide "B" battery for smaller sets. 24-volt, 4000 milliampere hours capacity. $10.00 f. o. b. Philadelphia.

For better radio reception, use storage batteries

Boys Are the Backbone of the Radio Business

The President speaks, and all over the country millions of radio sets are tuning in to catch his words. Four years ago a favored few, living near by, might have listened in. Now the whole country listens. Radio has captured the home, and the conquest was only made possible by the tremendous energy, ingenuity and curiosity of boys.

Boys' imaginations were caught by the lure of radio. They pioneered with their home-made sets. They spent their hard-saved nickels for parts. They enlisted the interest and roused the enthusiasm of their parents. They opened the family coffers. Dad went out to get his son the best he could afford, with son acting as advisor, buyer and constructor-in-chief. And today, the vast majority of radio sales are made to boys, or to parents buying for boys or with the boys' advice.

THE AMERICAN BOY goes right to the heart of the boy market. It is the favored magazine of 500,000 radio-inoculated boys averaging 15½ to 16 years old—sons of well-to-do parents. Its stories and articles deal with radio authoritatively. All its contents hold their interest and confidence.

Always striving to improve their sets, indefatigable in insistent wanting, commanding their parents' enthusiastic co-operation in their radio activities—these youths are the backbone of the radio business; the radio manufacturer's greatest market.

Copy reaching us by November 10th will catch the January issue.

The American Boy
"The Biggest, Brightest, Best Magazine for Boys in All the World"

Detroit **Michigan**

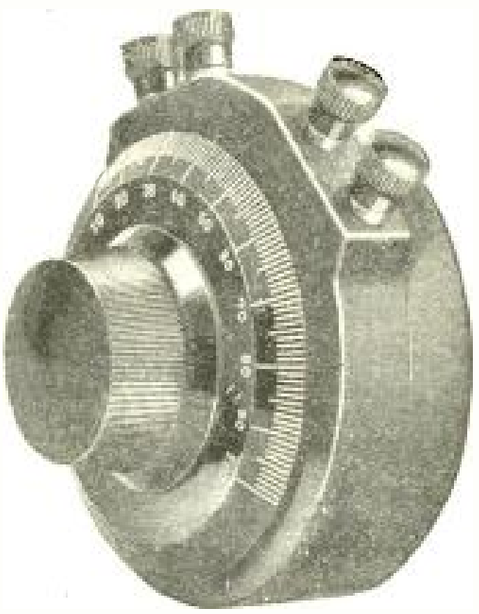
Build Any and All Sets With this Remarkable Unit!

FIFTY or more circuits built with *DeRoy Phusiformers* without discarding any parts. From the simple crystal set, right on up through the reflex, inverse duplex, neutrodyne, ultra audion circuits to the famous 5 Tube Phusiformer Circuit—all can be made with *DeRoy "No-Los" Phusiformer Units.* The easiest and most economical way to increase the range and efficiency of your set. Eliminates use of condensers, variometers, couplers and radio frequency transformers.

DeRoy Phusiformer "NO-LOS"

Re-PRODUCES the Original Music and Speech Perfectly!

The fundamental principle of *DeRoy Phusiformers* is a self-supporting series of coils telescopically arranged, lying in a non-inductive field. Far more sensitive than any radio tuning instrument ever perfected, bringing in programs from great distances clear and natural. Distortion is unknown in any circuit using *DeRoy Phusiformers.* The original music and speech is the only real rival of the DeRoy re-PRODUCTION. Highly selective, positive as a micrometer. Stations can be logged—always found at the same points on the dials. Non-radiating and non-oscillating.



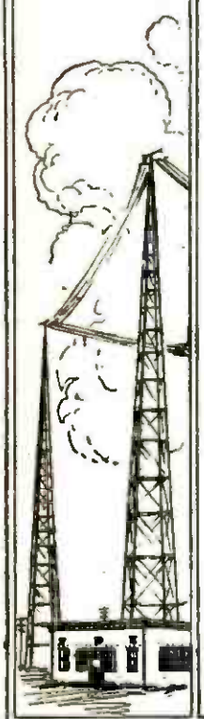
A set that can be built free from all external noises, squeals, howls, and whistles is worth your consideration. We guarantee you these advantages.

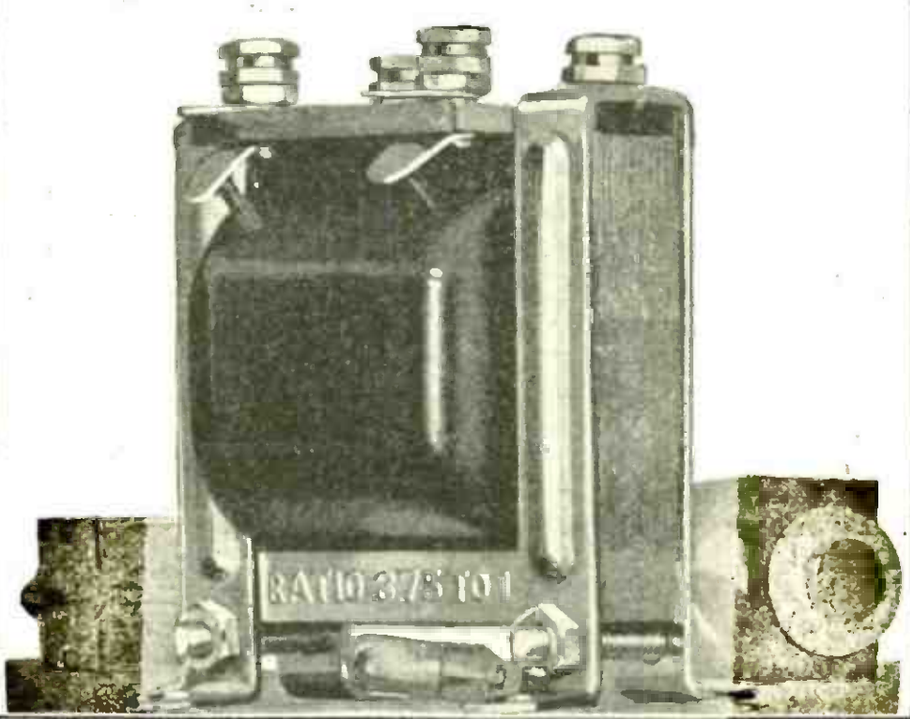
LIST PRICE $9.00
Complete with dial

Write for literature, mentioning the name of your dealer

Watch for Announcement of the New DeRoy "No-Los" Phusiformer Receiver

DeROY RADIO CORP.
36-42 Belleville Ave. Newark, N. J.





Tone Quality

PERFECT reproduction is not just a matter of having a good loud speaker—it's more the result of proper amplification. Jefferson Transformers reproduce the voice and instrument perfectly, giving the tone just as it left the microphone in the radiocasting station.

Jefferson Transformers allow full amplification without howling or distortion. Have you tried Jefferson No. 41 in three-stage audio amplification?

Jefferson Transformers meet matched construction specifications. Jefferson Transformers are the result of over twenty years of experience in the design and manufacture of transformers. Before being shipped every Jefferson Transformer is subject to a series of exacting mechanical and electrical tests which it must pass. Thus Jefferson quality is maintained.

And in all these years we have never been guilty of manufacturing a high ratio transformer—there's a reason.

Note how Jeffersons are being chosen by leading radio authorities for their circuits—an indication of Jefferson leadership in performance.

Write for our new booklet, now on the press, containing complete diagrams of the newer hookups and big improvements on the old ones. It's free.

JEFFERSON ELECTRIC MFG. CO.
427 SOUTH GREEN ST. CHICAGO, ILLINOIS

JEFFERSON TRANSFORMERS

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Make the World of Music Yours

WHEN a famous soprano sings the Gypsy Song from Carmen, hear it in your home exactly as she sings it.

Through MUSIC MASTER, the musical instrument of radio, let her voice be crystal clear. MUSIC MASTER gives to radio life and beauty, lending a wholly new charm to the wonders of the air.

MUSIC MASTER is not just a loud speaker —it is a *true* speaker, a *clear* speaker, a pleasing musical instrument.

Radio impulses entering the sensitive precision instrument in the base are translated into sound waves, undistorted and faithful to the original voice or instrument. In the tapered tone chamber of cast aluminum these sound waves grow clear and bell-like and, finally, the full, mature tones pour forth in rich resonance through the MUSIC MASTER amplifying bell of natural wood.

Your dealer knows. Have him send you a MUSIC MASTER to be proved with your own set.

Dealers everywhere

Music Master Corporation

Makers and Distributors of High Grade Radio Apparatus

10th and Cherry Street

Chicago PHILADELPHIA *Pittsburgh*

Music Master

RADIO REPRODUCER

Connect MUSIC MASTER in place of headphones. No batteries required. No adjustments.

14-inch Model, for the home $30

21-inch Model, for Concerts and Dancing $35

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Amazingly Different!

Music lovers from coast to coast have learned to divide all Radio Reproduction into two broad classes.

One class is the reproduction supplied by The Superspeaker.

The other is the wide variety that comes from all the rest of the so-called loud-speaking devices.

Between these two classes yawns a veritable Grand Canyon of Acoustics—the difference between real music and mere noise. Such is the verdict Jewett owners everywhere proclaim.

We can easily understand this verdict, for we know the reasons which cause this amazing difference.

These reasons have their beginnings in such fundamentals as dimensions, materials, workmanship and the application of acoustical engineering, available only to experienced musical-instrument men.

Not in even one of these fundamentals does the market include a duplication of The Superspeaker. Until the advent of some other instrument which can duplicate our product not in one but in every fundamental, the present chasm cannot be bridged.

No extra batteries—nothing to get out of order—Each Superspeaker shipped in individual carton—

Vemco Reproducing Unit also furnished separately for Phonogragh Adaptation.

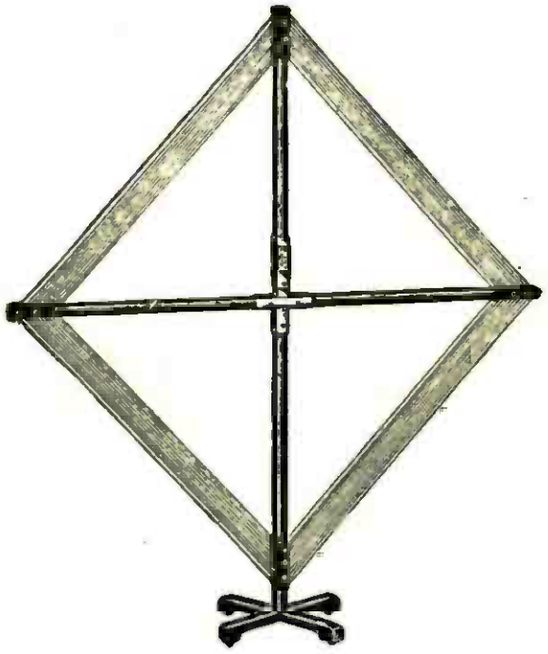
Get our dealer proposition in time to cash in with Fall Demand.

JEWETT Quality Products

THE JEWETT RADIO & PHONOGRAPH CO.
5680 Twelfth Street Detroit, Michigan

The Superspeaker,

THE POLLARD LOOP



Distance and Clarity of Reception
Elimination of Interference
Convenience in Transportation
Operates on all Broadcasting Wave Lengths
Braided Pure Copper Wire Gives Maximum Efficiency
With Super Heterodyne—Reflex and Radio Frequency Amplification

Some POLLARD Points

Solidly constructed brass hinge with slip joint held in place by automatic latch to insure proper tension of wire when in use and relieve strain when folding for transportation or setting up.

Wires pass through hard rubber— no contact with the wood; consequently perfect insulation and no current losses.

Double spiral winding insures maximum efficiency and directional qualities.

Frame and base satin finished mahogany. All metal parts heavily nickel plated.

Retail Price $10.00

Sold to the trade through recognized jobbers.

Dealers *write for circular and terms, and if your jobber cannot supply you, we will serve you direct.*

Radio Fans—*If you want the best loop you ever saw and your dealer is not sufficiently wide awake to supply you, send us your order with check or money order and we will mail direct, charges prepaid, to any point in the U. S.*

POLLARD BROS.
4040 N. Tripp Ave. Chicago, Ill.

FREE

Greatest Catalog of Radio Bargains

Send for It Today

It contains a thousand bargains of everything in radio: parts, supplies, complete parts for sets, complete sets, etc., also a mine of very latest information on all different circuits, complete list of broadcasting stations and other valuable data. Send your name and address and we'll send FREE catalog.

American Bell Loud Speaker

$3.95 without unit
$6.95 with unit

With American Adjustable Unit. Wonderful volume, clear reception. Speaks for itself without coaxing. 10-inch bell—made of non-vibrating material.

$2.65

HEADPHONES "RandolphSpecial"

2200 Ohm moulded headset, properly designed to give strong and clear reception. Biggest headphone value ever offered.

Hundreds of Other Bargains

Our catalog is filled with bargains like these. Order direct from this ad. We prepay charges. Don't buy anything in radio before you see our catalog. FREE Service Dept.

RANDOLPH RADIO CORP.
159 N. UNION AV. DEPT. 28 CHICAGO, ILL

Our newest and best radio antenna wire

Braided Flat Ribbon

Contains over one-half mile of wire strands. For out door or indoor use. In Copper—Tinned Copper—Enameled Copper. We also make round antenna wires in all types and metals. Loop wires, Litz wires, Cotton covered wires.

Ross Antenna Co.
9 Charles St., Providence, R. I.

WE REPAIR The Following RADIO TUBES

WD-11	$2.50	DV-6A	$2.50
WD-12	2.50	UV-199	2.50
CV-200	2.50	C-299	2.50
UV-201	2.50	UV-201A	2.50
C-300	2.50	C-301A	2.50
C-301	2.50	Marconi	2.50
DV-6	2.50	Moorhead	2.50
DV-1	2.50	UV-202 Transmitter	4.00
DV-2	2.50	C-302 Transmitter	4.00

Postage Paid
Mail orders solicited and promptly attended to.
Dealers and Agents Write for Special Discount.

H. & H. RADIO COMPANY
Clinton Hill Sta. P. O. Box 22-E. Newark, N. J.

RADIO FOR EVERY PURPOSE AND ANY PURSE—$5 TO $32.50

KODEL Model C-14 Four Tube Receiver, with battery compartment and loud speaker. Price $32.50. (Without battery cabinet, loud speaker or accessories). Battery cabinet can be furnished with any KODEL set at slightly additional cost.

Kodel--an astonishing new receiver that will make radio history

Kodel S-1 KODEL crystal Set. Sensitive, selective, low priced—Price $5.00.

Model P-11 One Tube Portable—the Camera of Radio—Price $18.00 without accessories. Tube, batteries, headphones, antenna, and ground wire all self-contained. Weight, 4¼ lbs. complete.

Model P-12 Two Tube Portable. (Model P-11 with additional tube added, which increases distance and volume many times)—$22.50.

KODEL is the name of a circuit discovered by an independent experimenter. So wonderful is the KODEL circuit that it picks up stations 1,000 miles away, using only one tube, and *no antenna*, when conditions are right. Add tubes and you increase distance and volume until you succeed in covering 3,000 miles on the loud speaker. All this with only a single dial to turn!

If you travel—KODEL Portable. If you cannot erect an antenna—KODEL. If you want distance and quality—KODEL. If you want simplicity—KODEL. If your pocket-book is limited—KODEL. Even if you want results regardless of cost—KODEL.

See the KODEL line at your dealer's. If he cannot supply you, send us his name and address with check or money order and we will ship direct to you. Money returned if any KODEL set does not more than satisfy you.

ALL KODEL sets use the unique KODEL circuit and may be operated from either storage or dry batteries at will, and without an outdoor antenna if desired.

FREE! Write for instructive KODEL Catalog, entitled, "Radio for Every Purpose and any Purse". FREE!

DEALERS: the KODEL is a sensation wherever introduced. Write for terms.

Kodel Manufacturing Company

Under same Management that made the Homcharger famous

132 West Third St. Cincinnati, O.

Model C-11 One Tube Receiver—The biggest value in a one tube radio set today. Price $10.00.

Model C-12 Two Tube Receiver—$18.00. A great distance getter: puts local stations on the horn; single dial tuning.

Model C-13 Three tube Receiver—$28.00. Gives five tube volume with only three tubes due to resistance amplification.

RADIO FOR EVERY PURPOSE AND ANY PURSE—$5 TO $32.50

A MICADON —it's the condenser

There is a Micadon for every possible requirement, price 35 to 75 cents.

The Micadon is the standard fixed condenser of radio! Extremely accurate because only the very best materials are used and because Dubilier condenser craftsmen assemble and inspect them. Simple to install because equipped with extension tabs for soldering and eyelets for set-screw assembly. Different capacities for different requirements. More than 90% of all sets made—by manufacturers and amateurs—use Dubilier Micadons.

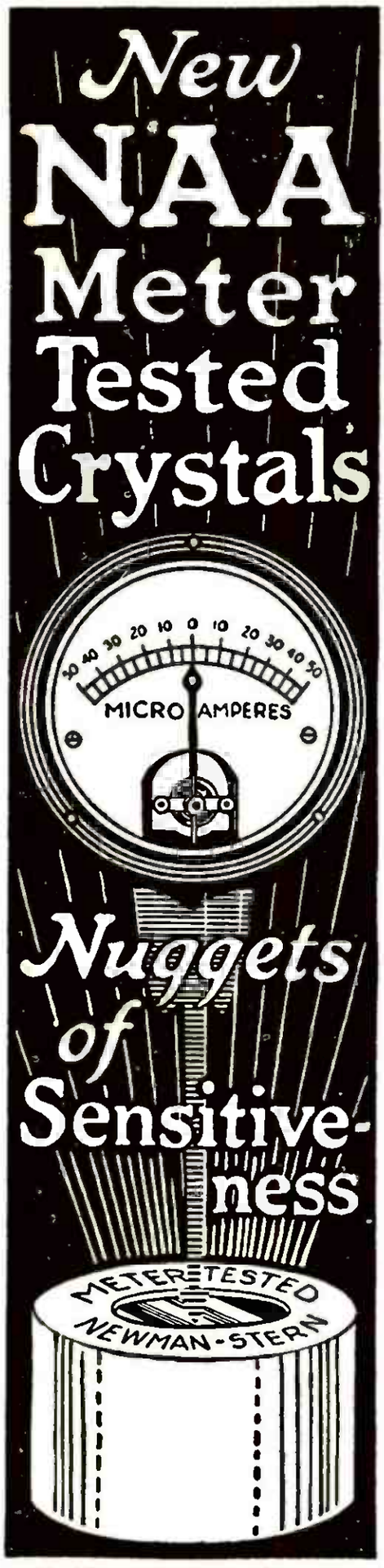
The preference of all these fans and experts has made Dubilier Micadons the standard.

Sold by all good Dealers

Dubilier

CONDENSER AND RADIO CORPORATION

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Big Leap Forward in Crystals

SUCCESS in Radio depends so much upon extremely fine values that there is no room for guesswork. Ten years ago we pioneered the way by testing NAA crystals for *quality.*

Now we go farther and test them also for *quantity* of quality. Our specially designed instruments tell us more than the fact that a crystal is good—they tell us exactly *how* good, by true measurements.

We use actual, controlled radio impulses which are detected individually by one crystal at a time, with a separate reading in microamperes for every crystal. Only crystals that go away beyond the point of normal sensitivity can be passed under this test.

We Reject—You Receive

With the return of the crystal to a position of great importance in Radio reception, this scientific test gives you a calibrated article and eliminates the "neck of the bottle".

Perfect for Reflex

To enjoy the sharp, clear, steady, full-throated volume of speech, music or spark reception, with or without amplification, tip your whisker to an N A A meter-tested crystal and hear what happens. You'll get more than "spots" of sensitivity—you'll get rich spaces that will save you time in both finding and keeping the best adjustment.

We Improved the Holder Cup, Too


PAT. PEND.

In addition to effecting a remarkable advance in crystal quality and quantity, The Newman-Stern new crystal mounting is a great improvement over other methods. Every N A A crystal is cold mounted. This avoids the partial or complete destruction of the detecting qualities by hot alloys, and makes the crystal removable for reversal or refilling. Finally, the crystal is recessed as a protection in handling.

N A A perfected meter-tested crystals are sold by best jobbers and dealers, or sent postpaid by mail for 60 cents. Send name of your dealer.

The Newman-Stern Co

1748 East 12th Street Cleveland, Ohio

Originators of tested crystals in 1914. Oldest and largest producers. Pioneers in Radio Equipment in Ohio.

Genuine Newman-Stern Meter-Tested Crystals are Sealed in this Style Wood Box

An Innovation in Tuners

For Broadcast or Short Wave

No Wonder

The B-T Low Loss Tuner scored an instant success. It had the merit, otherwise it would never have appeared.

Consider: 1st, A development in coil winding and arrangement so effective that the full broadcast range is covered with an 11-plate B-T Condenser—Results: Louder signals, more distant stations and greater selectivity.

2nd, An adjustable untuned primary, one of those things so simple no one thought of it—but it solves the problem of varying local conditions.

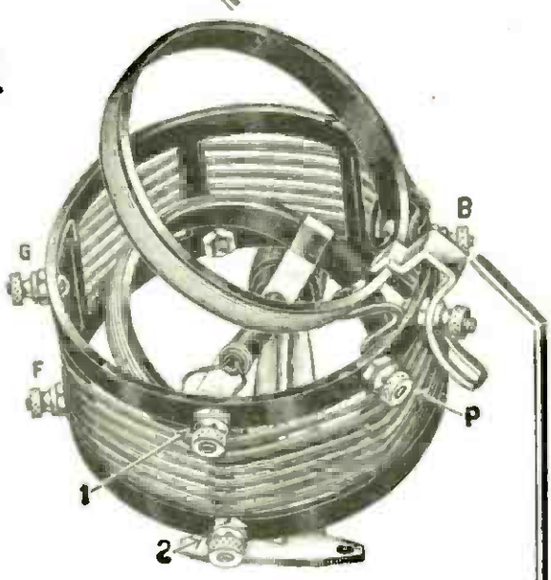
3rd, An equally simple but efficient loss-proof frame.

4th, A family history beginning with the first 3-circuit coupler and including nothing but original parts —all leaders.

5th, A record of its own of being the first LOW LOSS Broadcast or SHORT WAVE TUNER on the market.

You can't beat it For Broadcast 200–565
For Short Wave 50–150

Price $5.00



Broadcasting 200 to 565 meters. Short wave work 50 to 150 meters.
(These ranges covered with B-T 11-plate "Lifetime" Laboratory Condenser.")

$5.00

P. S. If it's a 5-tube set you want, read what George Colman, Kedvale Ave., Chicago says: "Am getting wonderful results with the B-T 'Nameless.' With four Chicago stations and Elgin going full blast, I am pulling in such stations as Louisville, Philadelphia, Detroit, Cincinnati, Davenport, Pittsburg, Iowa City, etc. Have had as many as 14 outside stations in an evening, regardless of Chicago. The "Nameless" is all that's claimed for it. Write for descriptive folder.

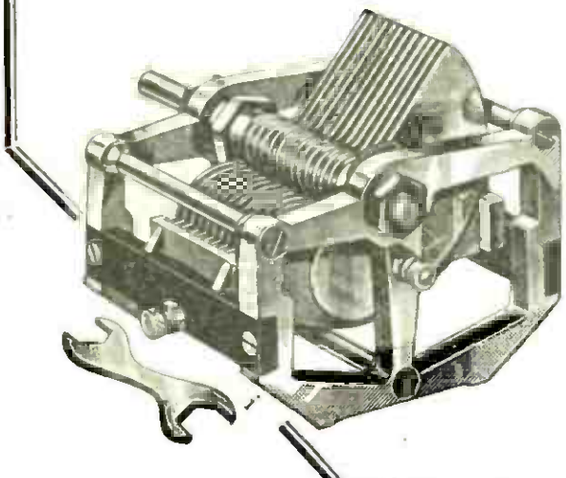
Bremer-Tully "Lifetime" Condenser

Electrically Superior—Mechanically Beyond Comparison

150 m.m.f.	7 plates	$4.25
250 m.m.f.	11 "	4.50
520 m.m.f.	23 "	5.00
800 m.m.f.	35 "	6.50

If you don't find this condenser better—send it back.

"20 Point" Folder tells the details. Write for it.



The only Low Loss Straight line wave length condenser.

Grounded rotor and frame.

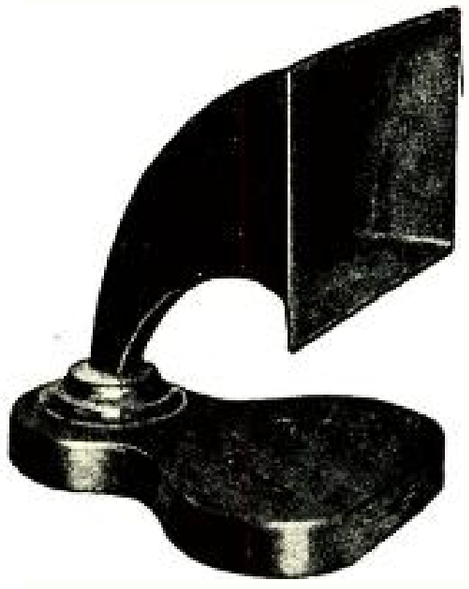
Light—compact.

A bearing that has no equal in radio. It can be adjusted without disturbing plate alignment or changing capacity.

Exclusive B-T method of die casting insures perfect contacts and spacing to within 1/1000 of an inch.

"Better Tuning" (now in 6th edition) tells you why and shows you how. Complete instruction and diagrams for progressive construction from crystal to Reflex and Radio Frequency circuits. Sent on receipt of 10c.

Bremer-Tully Mfg. Co.
534 S. Canal St. Chicago



WITH the October POPULAR RADIO there is issued a protective buying insurance that the Radio Public cannot fail to appreciate.

Those of you who have spent good money on an inferior article know well what it means to see advertised in a reliable magazine an article which has been tested and approved by experts—the fact that it appears in this magazine proves it to be of merit.

We are proud to say that TIMBRETONE, "The loud speaker that does what the others advertise," has met this test and been approved.

We back the stand taken by POPULAR RADIO and go it one better. If, after buying a TIMBRETONE Speaker, you are not satisfied, return it and your money will be refunded.

TIMBRETONE will be on display at Booth 44, Third National Radio Exposition, Grand Central Palace, November 3–8, 1924.

Made in Hoosick Falls, N. Y., by the Timbretone Mfg. Co.

TIMBRETONE is the result of an investigation instituted to determine whether or not it was possible, in view of the electrical characteristics, to produce a Radio Loud Speaker or Reproducer based on correct acoustic principles.

ELECTRICALLY

Exhaustive tests made during the investigation established the fact that the "Baldwin Unit," as employed in Timbretone, is unequaled for sensitivity and stability.

ACOUSTICALLY

The acoustic principles embodied in Timbretone are as old as musical instruments, and new only as applied to a Radio Loud Speaker, Timbretone. Every curve, line and opening of Timbretone and the manner of applying the Electrical Unit to a sound chamber is a revolution in Radio Loud Speaker construction.

This construction eliminates all metallic noises and produces instead that mellow quality which is possible only by the use of wood of which Timbretone is constructed throughout.

The thousands of tests made show conclusively that acoustic principles hold first place in a satisfactory Radio Loud Speaker, and that the quality and characteristics of the electrical unit are of vital importance.

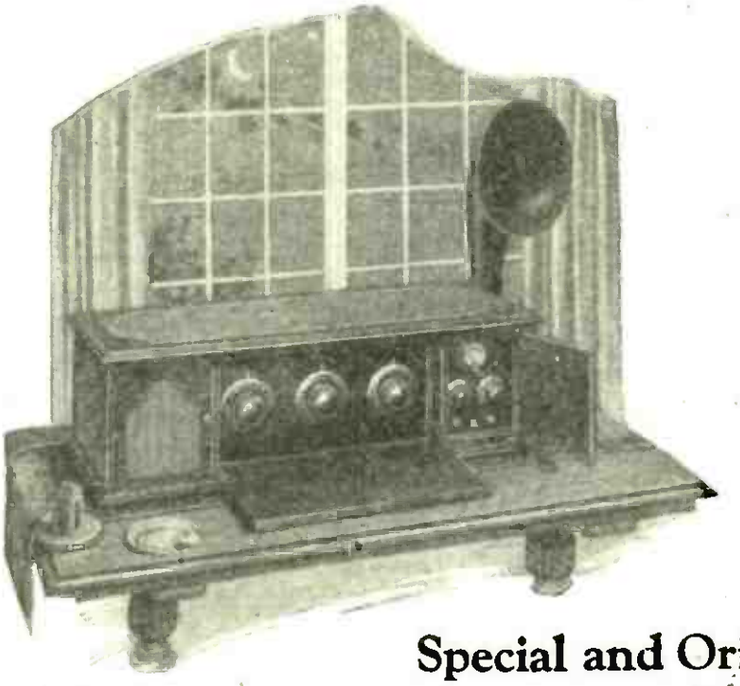
By combining these necessary principles and qualities, the manufacturers of Timbretone have placed on the market a real musical instrument; a Radio Loud Speaker that will win its way into every home where Radio Reception at its best is sought; not only for its attractive appearance, but because it is a quality product and an instrument that reproduces sound correctly—It is TIMBRETONE.

Sometimes changing the terminals will improve reception.

Timbretone is guaranteed to be mechanically perfect in every way and will be replaced when this is not the case.

Packed in a specially made carton, it will stand the trip through the mails.

GILFILLAN NEUTRODYNE



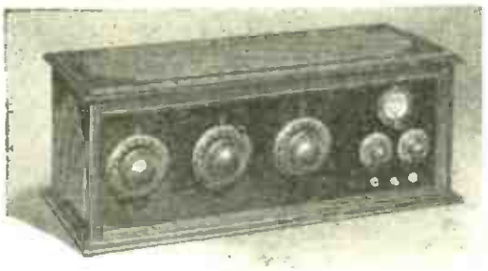
STYLE GN-1

in an artistic two-tone American Walnut cabinet harmonizing with any interior. Price without loud speaker, phones, tubes or batteries **$175**

Special and Original Features

The handsome cabinet of the GN-1 has space for the "B" battery and may be entirely closed when not in use. The essential parts are segregated into three panels with a door to each. It is a "straight line" set, with loud speaker Jack and ground antennae and "A" battery Posts at the rear. It has a two-scale Voltmeter and low loss Condensers of special design.

Parts for these sets are made in Gilfillan factories, and assembled under supervision of Gilfillan engineers. The Gilfillan reputation assures a balanced neutralized circuit of superior workmanship, giving clear and delightful reproduction of speech and music from Radio Stations far and near. Literature on request.



Style GN-2 has the same NEUTRODYNE construction and features in a smaller cabinet. Price without loud speaker, tubes, phones or batteries..... **$140**

Jobbers and dealers write for special sales proposition

GILFILLAN BROS. INC.

KANSAS CITY
2525 W. Penn Way.

1815 W. 16th St., Los Angeles, Cal.

NEW YORK CITY
225 W. 57th Street

GILFILLAN RADIO CORPORATION
LICENSED BY
Independent Radio Manufacturers Inc
Reg. U.S. Pat. Off. NEUTRODYNE Reg. U.S. Pat. Off.
Pat. Mar. 27, 1923 and Apr. 1, 1924
Interfering Pats. Nos. 1,450,080 - 1,489,216
Other Patents Pending

Users call it—

"The most sensitive and most perfectly stabilized set" . . .

FOR nearly three years, the Telomonic circuit has remained basically unchanged. It is the only important circuit which has proved itself over such a period of years.

The first to build Telos sets were engineers and experienced fans who make it a point to build *every* kind of set. These authorities call the Telosset "the most sensitive and perfectly stabilized set in the market to-day."

And yet, their experience with Telos has been limited to two stages of Telos tuned R.F. amplification.

Now, with the new Telos kit, it is possible for anyone with the slightest mechanical bent to build a set, in one afternoon, that far exceeds anything these first users could do.

The new Telos Kit gives you: (1) *three* stages of Telos tuned R.F.; (2) two stages of resistance coupled A.F.; (3) either crystal or V.T. detector. Either U.V. 199 or D.V.3 tubes may be used. And an important refinement has been introduced that greatly simplifies tuning—the "UNICONTROL" (patents pending). This is a device whereby all tuning dials may be operated simultaneously to *get* your station; then independently for the finer adjustments.

The Telos Kit is thoroughly described and illustrated in the new booklet just off the press. It is free, but distribution is limited to those who really want to build a better set. Use the coupon below for your copy.

Telos Radio

Danziger-Jones, Inc.,
Dept. A, 25 Waverly Place,
New York, N. Y.

Send me a copy at once of your new booklet describing the Telos Kit.

Name .....

Address .....

.....

Bestone

V-60

"The Aristocrat of Radio"

PERFECT TONE

VOLUME—DISTANCE

SIMPLICITY OF OPERATION

NO WHISTLE—NO DISTORTION

5 TUBES NON-REGENERATIVE

Write for Particulars

Manufactured and Guaranteed by

Henry Hyman & Company, Inc.

476 Broadway
New York

212 W. Austin Ave
Chicago

Manufacturers of the Complete Bestone Line of Quality Parts

In beautiful distinctive cabinet, with built-in loudspeaker and battery compartments.

$165

Same receiver in other cabinet without loudspeaker.

$115

In the Better Homes

The First Set to Operate Without Batteries

Radio as Convenient as Your Telephone

THE first receiver to operate at maximum efficiency without "A" and "B" batteries—**THE MU-RAD MA-20.**

Just plug into your electric light socket. Avoids the heavy expense, unsightliness and inconvenience of "A" and "B" batteries and battery chargers. The **MA-20 RECEIVER** with the **MU-RAD RECTO-FILTER** does away with these former handicaps.

The ultimate in simplicity. Especially designed for *high selectivity* so that powerful local stations can be tuned out while receiving distant programs. Tuning on all three dials *always* the same. Where alternating current is not available batteries can be used as with any other set.

A new circuit—new in all its principles. Five tubes, non-oscillating, non-radiating. $185

See our advertisement in this issue of the **MU-RAD RECTO-FILTER**—*a power unit.*

Write for Literature!

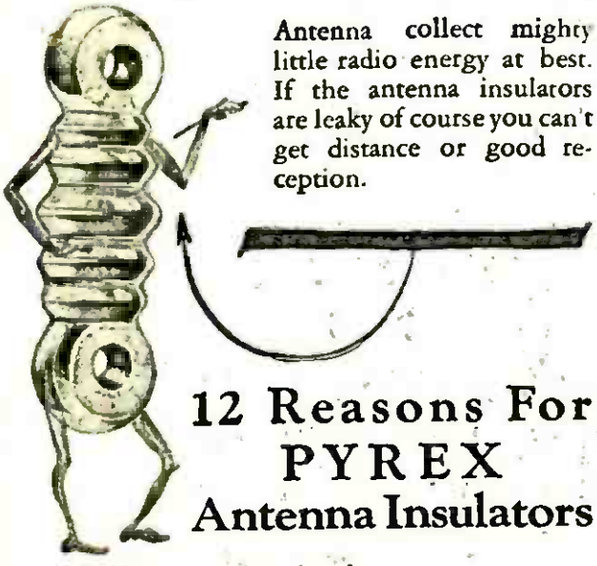
MU-RAD LABORATORIES, INC.
809 FIFTH AVE., ASBURY PARK, N. J.

The New

MU-RAD RECEIVER

MA-20

PYREX *All-Weather* Insulators



Antenna collect mighty little radio energy at best. If the antenna insulators are leaky of course you can't get distance or good reception.

12 Reasons For PYREX Antenna Insulators

1. Give stronger signals.
2. Bring in greatest distance.
3. Insure no leakage losses.
4. Have strain resistance over 450 lb.
5. Have super-smooth surface.
6. Collect no dust or soot.
7. Rain can wash thoroughly.
8. Absorb no water.
9. Retain no surface moisture.
10. Small phase angle difference (0.25°)
11. Made stronger to stand rough handling.
12. Used by the Navy and other Government Departments.

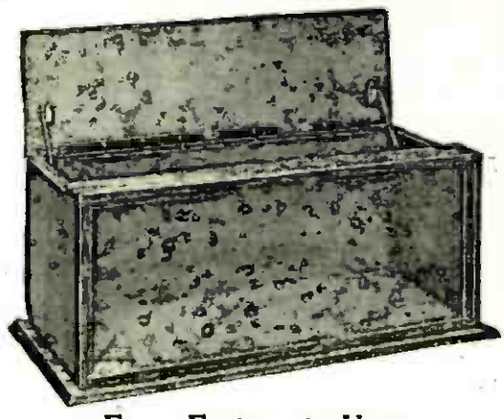
PYREX Antenna Insulators are used under severest conditions by United States Coast Guard Service. Their phase angle difference does not change appreciably with various wave lengths. Their structure is continuously uniform, not relying on a glazed surface for insulating properties.

To insure best results make sure your set is equipped with PYREX Broadcast Antenna Insulators. Retail at 45c.

Inquiries from jobbers invited

CORNING GLASS WORKS
Industrial Division
CORNING - - NEW YORK

UTILITY SUPPLY COMPANY



From Factory to User

High Grade Radio Cabinets, sturdy built and fine looking. Built from select genuine black walnut or birch. Elegantly finished. Tops on all cabinets hinged. Fronts of cabinets are rabbeted to take panel. Walnut cabinets have continuous piano hinges and lid holders. Birch cabinets have regular hinges. (No lid holders.) Walnut cabinets finished in French walnut. Birch cabinets finished in Adam brown mahogany. (Panels not included.) Money back if not satisfied.

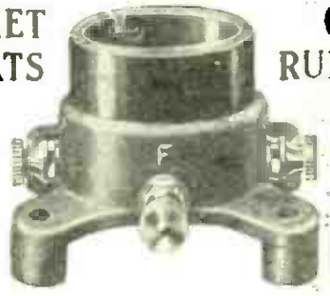
For Panel	Deep	Birch No Base	DeLuxe Black Walnut	Monarch Black Walnut
6 x 7	7"	$1.75	$3.75	$4.40
6 x 10½	7"	2.25	4.65	5.35
6 x 14	7"	2.75	5.45	6.20
6 x 21	7"	3.25	5.90	6.80
7 x 12	7"	2.80	5.50	6.50
7 x 14	7"	3.00	5.80	6.70
7 x 18	7"	3.25	6.00	6.80
7 x 21	7"	3.60	6.50	7.40
7 x 24	7"	4.10	7.25	8.00
7 x 26	7"	4.75	7.80	8.50
7 x 27	7"	5.00	8.50	9.00
7 x 28	7"	5.25	9.50	10.00
7 x 30	7"	6.00	10.00	11.00
7 x 24	10"	5.60	9.25	10.00
7 x 26	10"	6.25	9.80	10.50
7 x 27	10"	6.50	10.75	11.50
7 x 28	10"	6.75	11.50	12.00
7 x 30	10"	7.00	12.00	12.50
8 x 40	8"	6.00	11.50	12.50
9 x 14	10"	3.95	6.40	7.00
9 x 21	10"	5.00	7.70	9.25
9 x 24	10"	6.00	9.50	10.50
12 x 14	10"	4.25	7.00	8.00
12 x 21	10"	4.75	9.50	10.50

Mounting Boards all sizes in stock.
F. O. B., Milwaukee, Wis.
Circular showing our complete line sent on request.
Our Utility Beauty Cabinets are really beautiful.
Our Monarch cabinets are the best obtainable.

UTILITY SUPPLY COMPANY
439-443 27th Street, Milwaukee, Wis.

ILLINOIS "199" CUSHION SOCKET

SOCKET FLOATS ON RUBBER



Rubber Cushion Base

PATENTS PENDING

MODEL B "199"

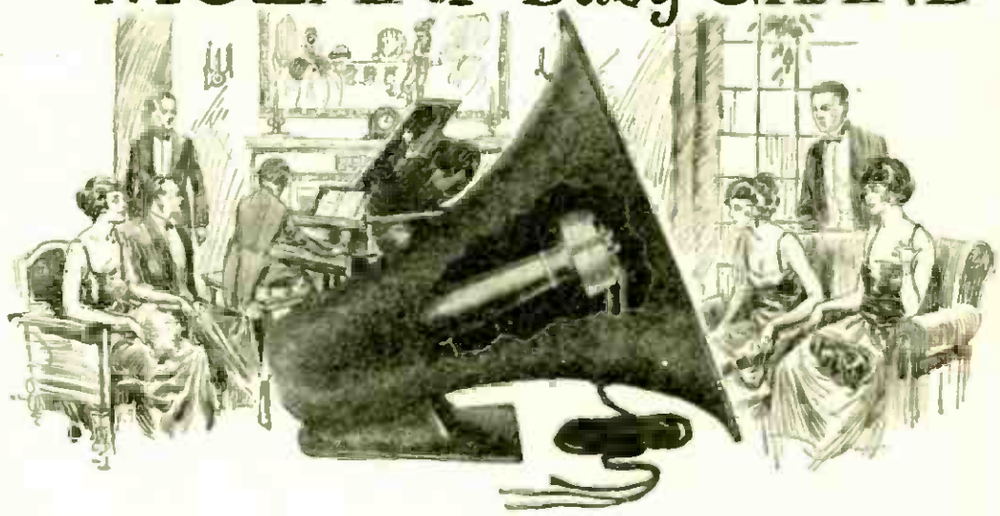
This final improvement in Vacuum Tube Sockets is to protect Tubes from **mechanical vibrations** and **shocks**, which cause distortions and many of the noises in phones, especially when amplified. Furthermore, a sudden **jar** or **shock** has caused the **parting** of many an incandescent filament.

Model A for Standard Base Tubes, $1.25; Model B for Small Base Tubes UV-199, $1.00 postpaid. Send checks or money orders.

DEALERS—Write for circular and discounts.

ILLINOIS RADIO CO. **Springfield, Illinois**

Editorial Friends *of* The MOZART *Baby* GRAND



THROUGH the radio business we have made a host of new friends in almost every part of the world and naturally none of these are more highly esteemed by us than those editorially associated with this country's newspapers, and other publications. May we quote from another letter received just prior to going to press with this ad:

> "The reproducer ordered from you arrived in good shape and I desire to express my surprise at the results. Have had little trouble getting stations in Chicago, New York, St. Louis, Cincinnati, Pittsburgh, Dallas, Miami, Tampa, Charlotte, Milwaukee, Jefferson City, Davenport, Atlanta, Havana, and others on the loud speaker which reproduced the music and human voice almost perfectly."
>
> (Signed) J. P. Leggett, in charge Sports and Radio Dept., The Macon News, Macon, Ga.

PRICES F. O. B. Factory.

Reproducer complete in black and gold crocodile finish with (gold plated) unit and polarity indicating cord	$12.00
New Model in black rubber finish with nickel plated unit as above	10.00
Unit only with polarity-indicating cord, gold plated	5.00
Unit only with polarity-indicating cord, nickel plated	4.00

Shipping weight of reproducer, 8 lbs. (approx.)
Dimensions—Diameter of bell 12". Length and height over all; 12½".
No extra Batteries required.
Direct from the factory or through your dealer.

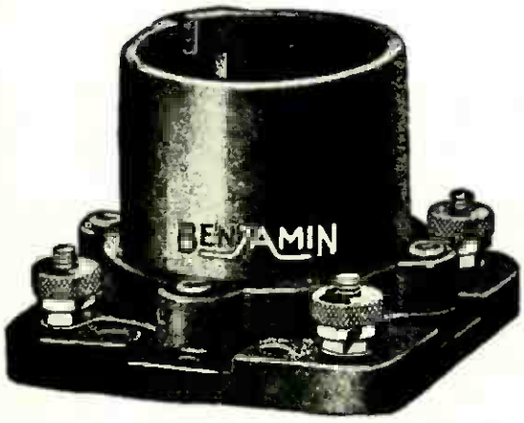
(Radio Division)

The MOZART GRAND CO.

Manufacturers of Fine Instruments

Newark, N. J. U. S. A.

Stop Tube Noises



BENJAMIN CLE-RA-TONE SOCKET
CLEARER RADIO TONE

Shock absorbing. Tube holding element "floats" on perfectly balanced springs. Takes up all jar and mechanical vibrations which interfere with clear reproduction. A vital necessity for and used by leading makers of portable sets. Made of molded Bakelite. Underside of base provided with smooth bosses for accurate mounting. Contact springs keep tube prongs clean. In two sizes, for standard and UV-199, etc., tubes.

Benjamin RADIO-BATTERY SWITCH

Lightest and neatest switch made. Requires only ¼-inch hole in panel. Requires no washers. Only one adjustment necessary. The push-pull single contact features give positive contact. When it's in it's off, avoiding accidental cutting in of battery.

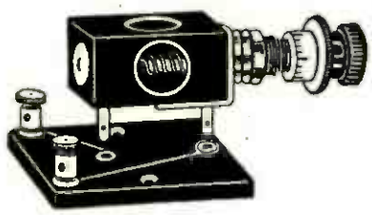
Ask your dealer, or send us his name and address and we will supply you through him

BENJAMIN ELECTRIC MFG. CO.
847 W. Jackson Blvd., Chicago.
247 W. 17th St. New York — **580 Howard St. San Francisco**

THE UNIVERSAL *RADJO* CRYSTAL DETECTOR

The LAST WORD for *Crystal* and *Reflex* circuits

Screen—prevents losing sensitive spot.



Micrometer feature permits finest adjustment.

Dustproof Casing—Window allows inspection of mineral

(Pat. Pending)

Can be mounted on table; on front of panel; or INSIDE of panel with only knob projecting

Furnished in either Cat-whisker or Zincite-Tellurium type

PRICE (either type) **$1.50**

Crystal—mounted in cup with screen—25 cents

At your Dealer or direct from us

Jobbers write for attractive proposition

ELECTRIC CITY NOVELTY & MFG. CO.
SCHENECTADY NEW YORK

SIMPLEX D-X TUNER

180° **NEW 1925 MODEL**

Spiral Wound Moulded Rotor

A high quality tuner specially designed for the *Three-Circuit Untuned Primary Circuit*. Unexcelled for *long distance* and *extremely selective*. Good volume. No soldering required.

$3.50—at Reliable Radio Stores

SIMPLEX RADIO CO. (Mfrs.) PHILADELPHIA, PA.

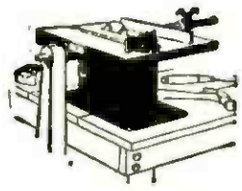
SAW YOUR OWN PANELS

Cut them accurately to size in a few seconds with a

Boice-Crane Junior Saw

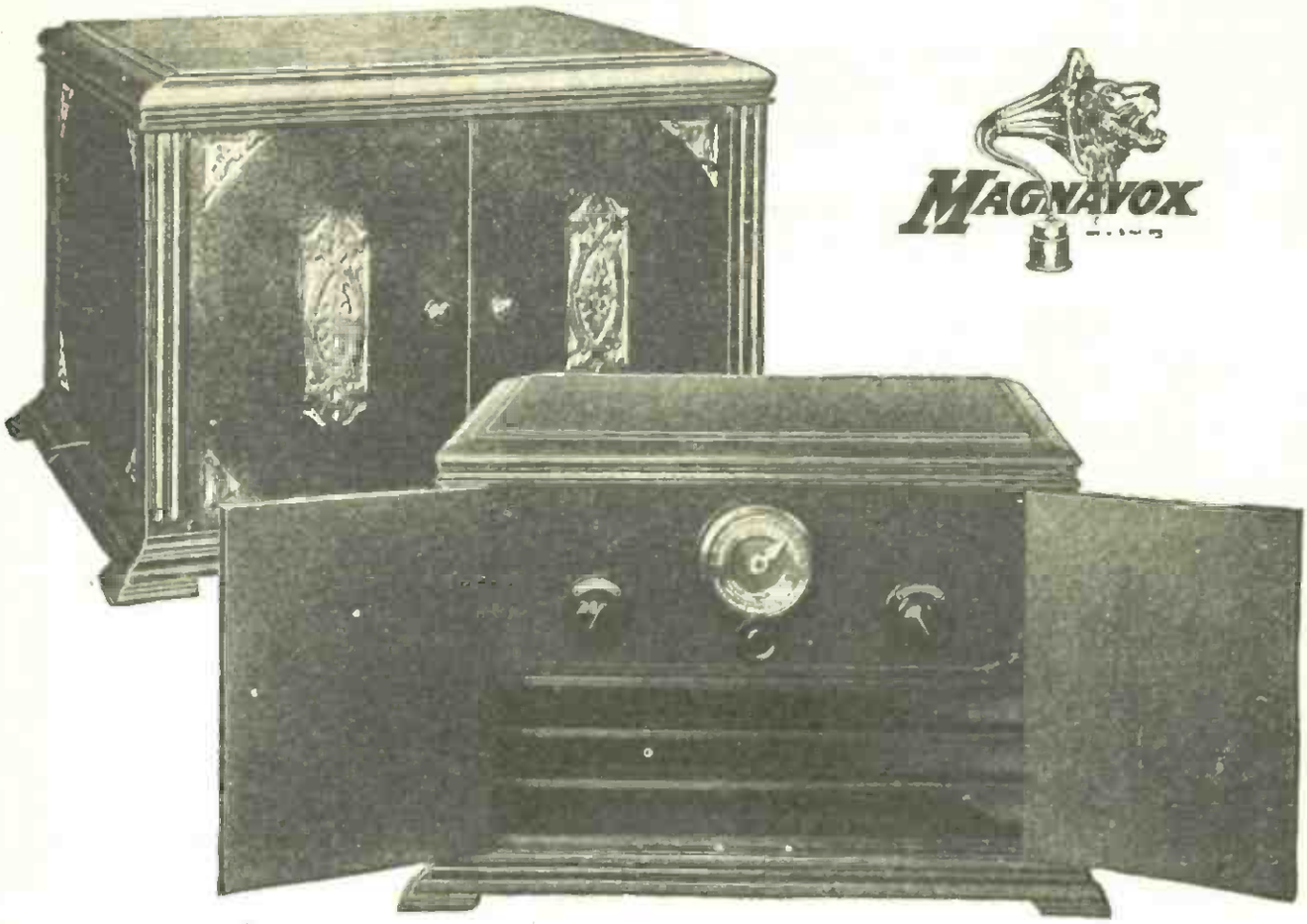
Saws, sands, grinds, tenons, rabbets and many other operations with ease and accuracy. Saws 1½" stock. Special blades cut bakelite. Extension guide accommodates panels 24" wide. Driven by ¼ or ½ h.p. motor attached to any light socket.

Write for descriptive folder on bench saws, drills, band saws, jointers and motors.



W. B. & J. E. BOICE
Dept. 910 Toledo, O.

Only $30.25



TRF-50
(as illustrated)

A 5-tube tuned radio frequency receiver with built-in Magnavox Reproducer unit which consumes no battery. Cabinet measures: height, 14¾ in.; length, 20½ in.; depth, 18¾ in.

Without tubes or batteries . . $150.00

TRF-5

This is identical with the above but encased in smaller cabinet without built-in Reproducer. Cabinet measures: height, 9⅝ in.; length, 20½ in.; depth, 14¾ in.

Without tubes, batteries or reproducer $125.00

MAGNAVOX

New Broadcast Receivers combining supreme efficiency, convenience and beauty

HERE at last is the perfected instrument permitting you to enjoy *simultaneously* the most desirable elements of broadcast reception.

Three decisive advantages go with the Magnavox: unequalled simplicity of control, reproduction of exceptional clearness—handsomely carved period cabinets.

Magnavox Radio Receivers, Vacuum Tubes, Reproducers, Power Amplifiers, and Combination Sets are sold by reliable dealers everywhere

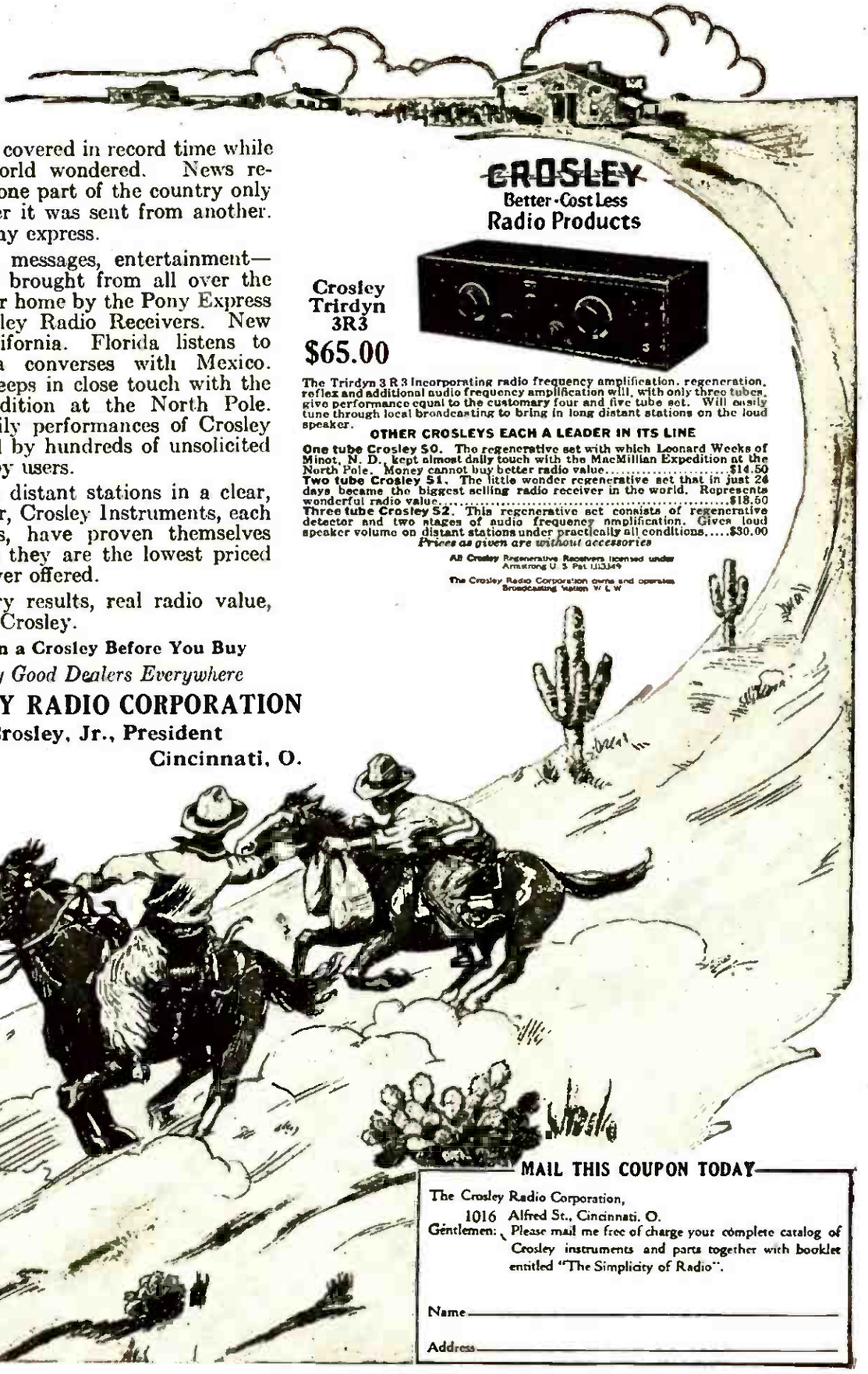
THE MAGNAVOX CO., OAKLAND, CALIF.

New York: 350 W. 31st Street ***San Francisco:*** 274 Brannan Street

Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

10R

The PONY EXPRESS OF TODAY



DISTANCE covered in record time while all the world wondered. News received in one part of the country only a few weeks after it was sent from another. That was the pony express.

To-day, news, messages, entertainment—all are instantly brought from all over the land right to your home by the Pony Express of the air—Crosley Radio Receivers. New York hears California. Florida listens to Hawaii. Canada converses with Mexico. North Dakota keeps in close touch with the MacMillan expedition at the North Pole. Such are the daily performances of Crosley Receivers as told by hundreds of unsolicited letters from happy users.

At bringing in distant stations in a clear, enjoyable manner, Crosley Instruments, each in its own class, have proven themselves unexcelled. Yet they are the lowest priced radio receivers ever offered.

For satisfactory results, real radio value, you can't beat a Crosley.

Listen In On a Crosley Before You Buy

For Sale By Good Dealers Everywhere

THE CROSLEY RADIO CORPORATION

Powel Crosley, Jr., President

1016 Alfred St. Cincinnati, O.

CROSLEY

Better-Cost Less

Radio Products

Crosley Trirdyn 3R3

$65.00

The Trirdyn 3 R 3 incorporating radio frequency amplification, regeneration, reflex and additional audio frequency amplification will, with only three tubes, give performance equal to the customary four and five tube set. Will easily tune through local broadcasting to bring in long distant stations on the loud speaker.

OTHER CROSLEYS EACH A LEADER IN ITS LINE

One tube Crosley 50. The regenerative set with which Leonard Weeks of Minot, N. D., kept almost daily touch with the MacMillian Expedition at the North Pole. Money cannot buy better radio value.....$14.50

Two tube Crosley 51. The little wonder regenerative set that in just 24 days became the biggest selling radio receiver in the world. Represents wonderful radio value.....$18.50

Three tube Crosley 52. This regenerative set consists of regenerative detector and two stages of audio frequency amplification. Gives loud speaker volume on distant stations under practically all conditions.....$30.00

Prices as given are without accessories

All Crosley Regenerative Receivers licensed under Armstrong U. S. Pat. 1113149

The Crosley Radio Corporation owns and operates Broadcasting Station W L W

MAIL THIS COUPON TODAY

The Crosley Radio Corporation,
1016 Alfred St., Cincinnati, O.

Gentlemen: Please mail me free of charge your complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio".

Name_____

Address_____

Ah! That's a different Condenser

Dear Bill:
Glad to know that you finally fell in love with Radio but is my to hear that you are not getting real results. Why all the gloom?

Listen Bill. I checked up the diagram that you sent me. You neglected to follow my instructions while purchasing one very important part. The Rathbun Original single-hole mounting Superior Condenser. See attached folder. Buy that and everything will be O.K.

Your friend
Fred

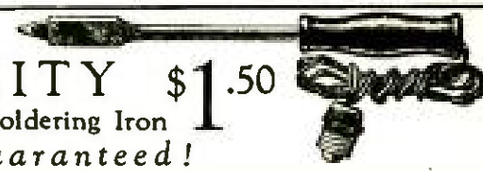
LOOK FOR THIS

Moulded Seal appearing on every original singlehole mounting, low-loss, unconditionally guaranteed Condenser

Remember folks, with Rathbun Condensers you drill one hole only. You can't ruin the panel. They eliminate the possibility of mounting screws, pulling plates out of alignment. They are interchangeable in the same hole, except the No. 3 Plate Vernier. So alterations in the circuit are made very easy.

Examine them at your dealers or write (mention POPULAR RADIO) for complete details. Prices "3 to 43 Plates"—$1.00 to $6.00. Rathbun Manufacturing Company, Inc., Jamestown, N. Y.

RATHBUN
SINGLE-HOLE MOUNTING
SUPERIOR CONDENSERS



UNITY $1.50
Electric Soldering Iron
Guaranteed!

100 HOURS of continuous service have failed to overheat the new Unity Electric Soldering Iron. It's built on the same principle as a flat-iron. Heating element (in tip—not behind it) is air-tight compressed—can't burn out. Light weight, well balanced, specially designed for difficult intricate wiring.

—And just look at the price!

UNITY VERNIER RHEOSTAT
With Switch!

THE only continuous-wire vernier rheostat—unique cut-out switch permits tube being turned on or off at any point without changing adjustment. **All Resistances $2.00**

Write for FREE BOOKLET

On "Tube Control" prepared by J. E. Jenkins, engineer station W. G. N. Shows what proper *tube control* means to the selectivity and quality of a receiving set.

UNITY MFG. CO. 224 N. Halsted St., CHICAGO
New York Office, C. M. HUNT, 50 Church St.

UNITY
Vernier Rheostat

Standard Radio Tube Co.

The "Standard" guarantee is your protection.
All types of Radio Tubes repaired.

W. D.-11 or 12
U. V.-199 or C.-299
C.-11 or 12
U. V.-210A or C.-301A
D. V.-1 or D. V.-2
U. V.-200 or 201
C.-300 or 301

$2.25

Every Tube Guaranteed
New Standard Tubes $3.00
Discounts to Agents and Dealers
Orders Mailed Parcel Post C. O. D.
STANDARD RADIO TUBE CO.,
273 Plane St., Newark, N. J.

CRESCENT LAVITE RESISTANCES

12,000
48,000
50,000
100,000
Ohms.

LIST $1.50

Special Sizes to Order

When better resistances are made they will bear the Crescent label.
Dealers write for discount.
CRESCENT RADIO SUPPLY CO. 1-3-5 Liberty St., Jamaica, N. Y.

Ask Your Dealer to show you the Remarkable
HOWARD NEUTRODYNE RECEIVER
Licensed under Hazeltine Patents
Send for Illustrated Folder
HOWARD RADIO CO.
4248 N. Western Ave. Chicago, Ill.

Sterling METERS

Pocket Type and Panel Type

You may have exercised extreme care in the selection of your radio apparatus, but have you thought of the importance of dependable meters?

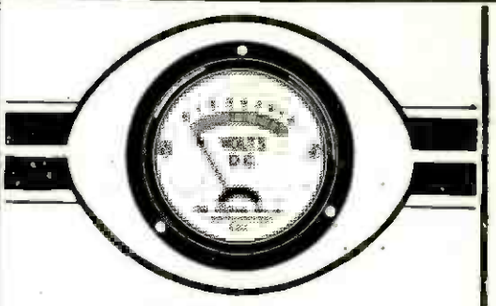
Think what it would mean to drive a car not knowing whether your generator was charging. It's just as important—and more so—in the radio field, to know conditions of your set and batteries.

Protect your tubes from premature burn-outs with Sterling Panel Type Meters. Movement is of magnetic type. Flush Mounted. Very attractive. Ammeter and Voltmeters.

For radio "A", "B" and "C" batteries, dry or storage, there is a specific Sterling pocket meter in which you can place explicit confidence.

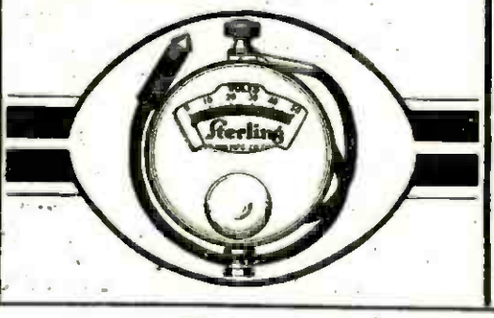
Look for the name Sterling

The STERLING MFG. COMPANY
2843 Prospect Ave. Cleveland, O.



Panel Type Meter
Ammeters $4.00
Voltmeters $4.00 and $5.00

Pocket Meter
A type for every need—
a need for every type.
Prices $1.00 to $4.00



12 Cells
24 Volts
Solid
Rubber
Case

$4.00 C.O.D. **SPECIAL**

INTRODUCTORY PRICE

For a limited time *only*, and to introduce this new and superior Storage "B" Radio Battery to the Public, we are selling it for $4.00. Regular Retail Price is $6.00. You save $2.00 by ordering NOW. A finer battery cannot be built than the

World Storage "B" Battery

(12 CELLS—24 VOLTS)

To ten million homes with Radio Sets—and to countless millions of prospective buyers—this WORLD Storage "B" Battery brings a new conception of battery economy and performance. Here is a battery that pays for itself in a few weeks—will last for years and can be recharged at a negligible cost. *And you save $2.00 by ordering now.*

A *Superior* Battery Equipped With Solid Rubber Case

Has heavy duty 2 1-8 in. x 1 in. x 1-4 in. plates and plenty of acid circulation. Extra heavy glass jars allow ready observation of charge and prevent leakage and seepage of current. It holds its charge, while idle, at constant voltage. You will find this battery a boon to long distance reception. It does away with a great many noises so often blamed on "static." Mail your order today.

SEND NO MONEY

Just state number of batteries wanted and we will ship day order is received. EXTRA OFFER: 4 batteries in series (96 volts), $15.00. Pay Expressman after examining batteries. 5 per cent discount for cash in full with order. Send your order NOW and save $2.00.

WORLD BATTERY COMPANY
Makers of the famous World Radio "A" Storage Battery
1219 S. Wabash Ave., Dept. 77, Chicago, Ill.

SAVE $2.00 BY ORDERING NOW

FREE Complete FREE

RADIO CATALOG

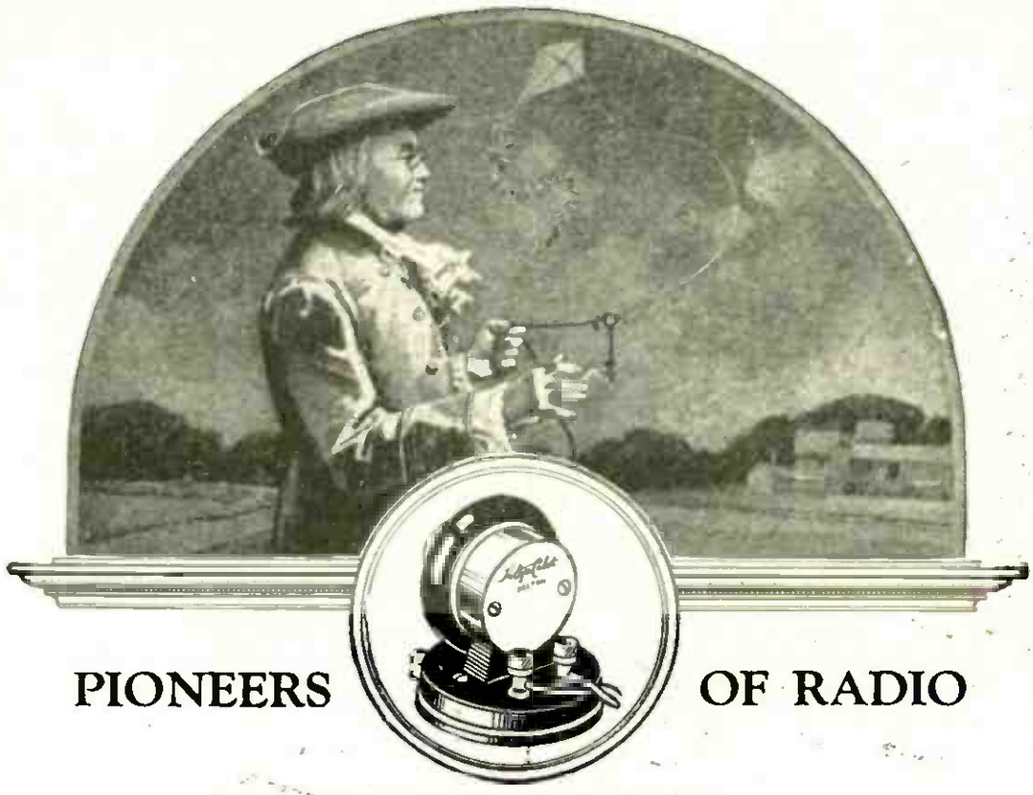
Just send your name. No postage. Let us surprise you with our amazing values of all the up-to-date radio apparatus.

We specialize in all COCKADAY hook-ups. Our kits are made up of the parts exactly as specified by Mr. Cockaday. We carry in stock the Cockaday improved four-circuit tuner with push-pull amplifier, one, three and five tube kits.

Also super heterodyne, neutrodyne Reinartz, Erla, Acme reflex and other circuits.

Get your radio apparatus at our wholesale cut-rate prices.

WHOLESALE RADIO SERVICE CO.
9 Church St., Dept. P.
New York City



PIONEERS OF RADIO

BENJAMIN FRANKLIN
JUNE, 1752

FRANKLIN by his famous kite experiment, proving lightning an electrical phenomena, and conceiving the idea of plus and minus charges, was an important contributor among the many discoverers who paved the way for RADIO.

Holtzer-Cabot, over a period of thirty-five years has made many advancements in the development of intricate electrical apparatus for reproducing sound waves.

Holtzer-Cabot Loud Speakers and Headphones have many superior technical features not found in other makes which become quite apparent when you make a comparison test.

Ask your dealer to let you try Holtzer-Cabot Loud Speaker, Phonograph Attachment or Headset. The results will speak for themselves.

Holtzer-Cabot Loud Speaker
Loud Speaker Phonograph Attachment
No. 2 Universal Head Phones
No. 4 National Head Phones
WRITE FOR BOOKLET **Department P. R.**

THE HOLTZER-CABOT ELECTRIC CO.
125 Amory Street, BOSTON, 6161-65 South State St., CHICAGO

Holtzer-Cabot
BUSINESS ESTABLISHED 1875

Anyone can use a storage battery now

CHARGING a storage battery ten years ago was a task needing expensive apparatus and the services of a specialist. Today, anyone can do it in the home. No knowledge of electricity is needed. It can be done economically, simply, automatically, with

The New Silent GOLD SEAL HOMCHARGER

just as more than 200,000 satisfied users of Homchargers are doing right now.

If you are one of the many who envy the results of storage battery tubes but think you can't enjoy them unless you are a battery expert, go right out now and buy these tubes, a battery and a Gold Seal Homcharger.

Here's all you have to do to maintain a storage battery: add a little water once in a while (your eye will tell you when); charge it regularly. To use the Homcharger, screw a plug in any lamp socket, slip two spring clips over the battery terminals, go to bed and forget about it. Next morning the battery is charged. What could be easier?

The Gold Seal Homcharger—simple, efficient, dependable, quick. Cannot injure battery, furnishings, anything or anybody. Handsome, finished in mahogany-red and gold. Approved by Fire Insurance Underwriters. Unqualifiedly guaranteed. Only one moving part, replaceable for $1 after thousands of hours of use. Silent—its faint hum cannot be heard in the next room.

Popularly priced; buy it at your dealer's for $18.50 complete; $26.00 in Canada. For radio at its best, use storage battery tubes, any good battery and the Gold Seal Homcharger.

FREE! Send for our interesting free booklet, "The Secret of Distance and Volume in Radio," containing valuable information on this subject and fully describing the GOLD SEAL HOMCHARGER.

THE AUTOMATIC ELECTRICAL DEVICES CO., 132 West Third St.
Cincinnati, Ohio

Largest Manufacturers of Vibrating Rectifiers in the World

Under same Management as the Kodel Mfg. Co.

Clear and distinct

Indistinct, hazy

It's a Difference of *Clearness*

HOW often when listening in, you've tuned and tuned and still have not been able to get the voice or instrument to sound clear, distinct and natural.

The real big difference between the N & K Imported Loudspeaker, Type W, and ordinary speakers lies in the fact that N & K reproduces *all there is to the music*, bringing out delicate high tones as well as deep low ones, clear and distinct, exactly as the musician sings or plays them. There is no exaggerated loudness, no blurring, twanging, rasping, droning, rattling, disagreeable tone.

This is a loudspeaker of an entirely new type. The shape and finish are new and artistic, harmonizing with any style of home furnishing. The material is new—*burtex*, a lightweight rigid substance made scientifically to eliminate counter-vibration. And the speaker is so skilfully designed that it fills the entire room with its music instead of concentrating in one favored direction.

This new type of speaker bids fair to revolutionize every idea the public now has on speakers. So confident are we that it is the speaker the public has been waiting for, that we authorize dealers to allow responsible customers to try out the N & K Imported Loudspeaker with their own sets, in their own homes,

FREE OF CHARGE FOR 5 DAYS

Ask your dealer to let you hear the new N&K Imported Loudspeaker, Type W. If he is not supplied, write us. We'll tell you where you can see this new invention.

THE N & K LINE

N&K Imported Loudspeaker Type W, $27.50

N&K Imported Phones Model D, 4000 ohms, $8.50

N&K Imported Phono Unit. Attaches instantly to any phonograph, $7.50

TH. GOLDSCHMIDT CORPORATION
Dept. P 10, 15 William St., New York
41 Common St., Montreal

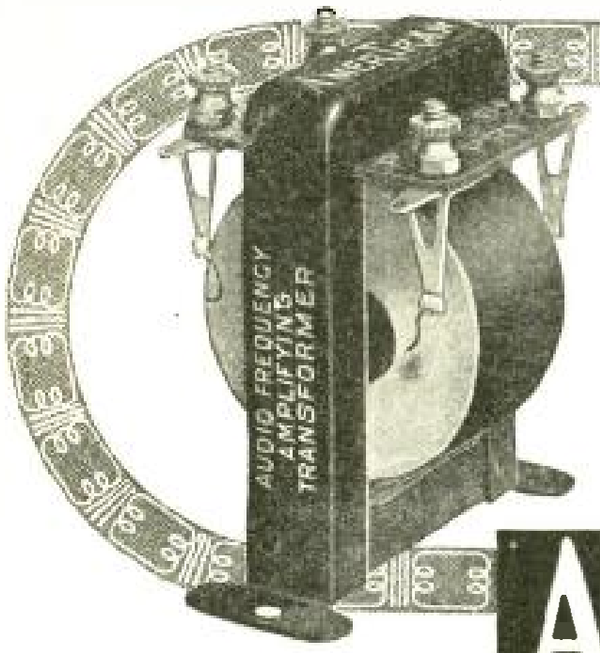
Stands 14 in. high. Choice of handsome color schemes. Send for free folder, "The Speaker You Have Waited For."

N&K *Imported*

LOUDSPEAKER

TYPE W

An audio frequency amplifier is no better than the transformer it employs



—you are sure of the best results only by using the best transformer—

AMERTRAN
TRADE MARK REG. U.S. PAT. OFF.

Made in two types:

AmerTran AF-6 (Turn ratio 5) for use in the first stage.

AmerTran AF-7 (Turn ratio 3½) for use in further stages when AF-6 is used in the first stage.

Price, either type, $7.
At Your Dealer's

"A CHAIN is no stronger than its weakest link"—the proverb applies with particular force to radio receiving sets. The design of an audio transformer, for example, offers almost endless possibilities for faultiness in operation, ranging from unsatisfactory reproduction of certain parts of the musical scale to complete failure.

The external appearance of a transformer tells practically nothing as to its worth. The purchaser has got to buy something *behind* that—the manufacturer's reputation for technical skill in design and his ability to execute that design with absolute uniformity in quantity production.

Twenty-three years' experience is built into the AmerTran—experience running back to the pioneer days when we built the large transmitting transformers for the Marconi Company's first commercial transatlantic wireless communication.

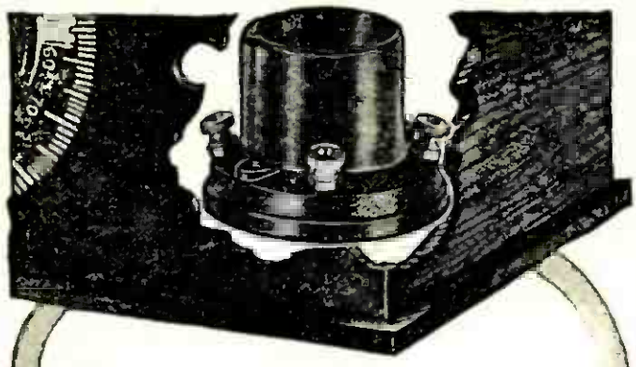
We are making the best transformers that engineering skill and this wide experience can produce, and we intend to maintain the AmerTran as the Standard of Excellence. Your insistence upon having it in your receiving set will save all further worry as to this very important link in the chain.

"Improve your set with an AmerTran"

American Transformer Company

175 Emmet Street, Newark, N. J.

Designers and builders of radio transformers for over 23 years



Get Directly at Them

Are the contacts in the sockets of your radio set easily accessible for ordinary and necessary cleaning?

With Na-ald De Luxe Sockets in use you need neither sandpaper or an extra reach to keep contact strips and tube terminals bright and clean.

Just rotate the tube three or four times. Instantly the dual-wipe laminated contacts remove corrosion, making a bright perfect connection. This action is on the side of the tube terminals away from the soldered ends. *"Its the contact that counts."*

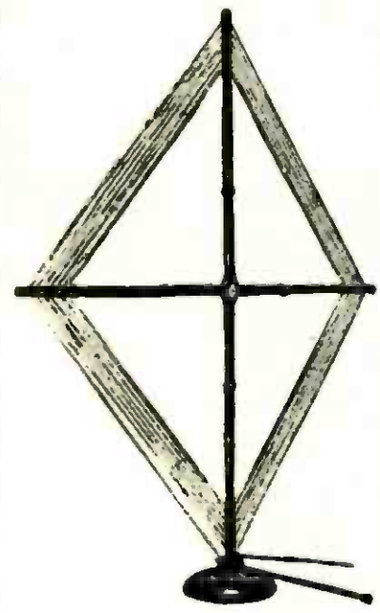
Make your Superheterodyne set free from socket trouble by using Na-ald De Luxe Sockets.

Sockets and panel mounts for all tubes. Prices 35c to 75c.

Send for Catalogue

ALDEN MANUFACTURING CO.
Dept. C.
Springfield, Mass.

NA-ALD



For Better Results from All Loop Circuits!

The BODINE

Basket-Weave Folding Loop Aerial

Collects those faint impulses from far-off stations and delivers them without loss to your receiver. The new bank-wound basket-weave winding makes the Bodine Loop remarkably superior in sensitivity and directional effect. Use this loop to bring in those distant stations that you could not get before.

Two feet square when erected, yet folds to fit into a compact carrying box. Beautifully finished in English mahogany and satin-silver. Equipped with a graduated dial and an adjusting handle for your convenience.

Most attractive in appearance—most effective in design

PRICE ONLY $8.50 PREPAID

Ask Your Dealer or Write Us

BODINE ELECTRIC COMPANY
Quality Electrical Products for Eighteen Years
2256 W. Ohio St. Chicago, Ill.

AMPERITE

The "SELF-ADJUSTING" Rheostat

An automatic filament Control which is Perfect for every Circuit and for every Type of Tube.

—Simplifies wiring
—Eliminates hand rheostats
—Prolongs life of tubes

AMPERITE MOUNTS INSIDE THE SET—NO KNOB—AUTOMATICALLY GIVES PERFECT FILAMENT CONTROL. PERMITS COMPACTNESS.

—Manufactured by—

Radiall Company
50 Franklin St., New York

$1.10
Everywhere

Write Dept. PR-1 for free hookups.

'No liquid in it now'

Dear Jim:

I saw a new stunt pulled yesterday.

Happened to be standing side of a chap who was buying some storage batteries for his radio set when the salesman turned one of them upside down.

What do you think? It was bone dry—not a drop of solution in it.

"There's the battery for you—and it's specially built to do a radio job," he said. "It is one of those new Willards—charged but bone dry and it is ready to use as soon as it is filled. Lasts you longer, because its term of life doesn't start until it is filled."

That's a real idea Jim—starting the life of the battery after the owner buys it; but I don't think you can wear out Willards anyhow. Mine are four years old now, and they are as good as the day I got them.

Willards for economy and clear reception.

Signing off

. . . . — — —

(SAM)

Now it's a live battery

WILLARD RADIO BATTERIES

Write to WTAM *for these two booklets*

[The Voice of the Storage Battery]

WTAM is the Radio Research Laboratory and Broadcasting Station of the Willard Storage Battery Company, Cleveland, Ohio.

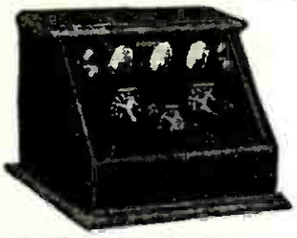
Write for WTAM'S booklets, "Better Results from Radio" and "The Proper Use and Care of Radio Storage Batteries." They will be mailed to you with our compliments.

Tear me off the page and mail me to WTAM. I'll bring you "Better Results" and "Proper Use and Care."

Name .....

City and State .....

Street Address P.R.-2



Echophone "3"

A 3-tube regenerative. Tunes in on loud speaker stations 1,500 and 2,000 miles distant. Two-dial tuning control. Operates on dry cells—very economical. Without tubes and batteries **$50**

Echophone "4"

The last word in radio receivers. An extremely selective and powerful 4-tube regenerative. Operates on dry cells or storage batteries. Without tubes and batteries **$125**

Echophone "5"

A 5-tube receiver employing both radio and audio frequency amplification. Operates on loop, small indoor or outdoor aerial. Assures exceptional volume, selectivity and tone quality. Without tubes and batteries . . **$110**

[Echophone Regenerative Receivers are licensed under Armstrong Patent No. 1,113,149]

Three Sizes — Three Prices

One Quality

THE MAKERS of Echophone Receivers put their first sets on the market more than ten years ago. The reputation their receivers have won they naturally cherish very highly and will spare no efforts to maintain.

Have your dealer demonstrate an Echophone for you today. There is one that will exactly meet your needs.

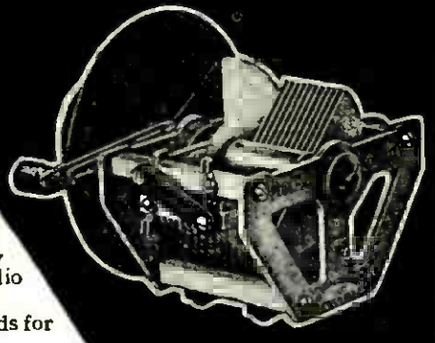
If you want a powerful yet low priced receiver of exceptional tonal quality there is the $50.00 Echophone "3." For keener selectivity, longer range and still greater volume the Echophone 4 and 5 tube Receivers offer the *ultimate* in *radio reception.*

Descriptive folders on each of these popular receivers furnished on request. Write the Armac Radio Company, Agents, 1120 No. Ashland Ave., Chicago, Ill.

Manufactured by **THE RADIO SHOP**
1120 N. Ashland Avenue, Chicago, Ill.
Long Beach, Calif. Sunnyvale, Calif.

ECHOPHONE
Radio Receivers

DUPLEX



Series "FR"

Condenser tests made during May, 1924, at Yale University are classics in Radio History.

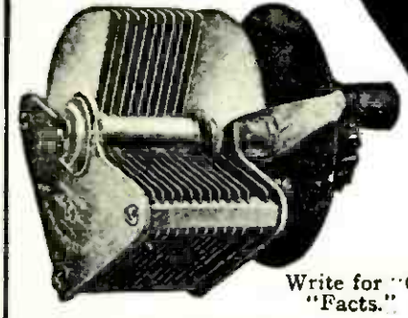
They are standards for your guidance.

The "DR" Compact Precision condenser has forged ahead rapidly due to its performance and price.

PATS. APPL'D FOR

TRADE MARK

NONE OTHER



Write for "Cons" and "Facts." It's free

The Duplex Engine Governor Co., Inc.
SPERRY BUILDING
50 Flatbush Av. Ext. Brooklyn, N. Y.
Some valuable distributors' territory still open.

AMPLEX

GRID-DENSER

INCREASES RANGE and POWER of ANY SET!

A turn of its knob gets you the exact capacity necessary for Greatest Distance, Louder Clearer Signals.

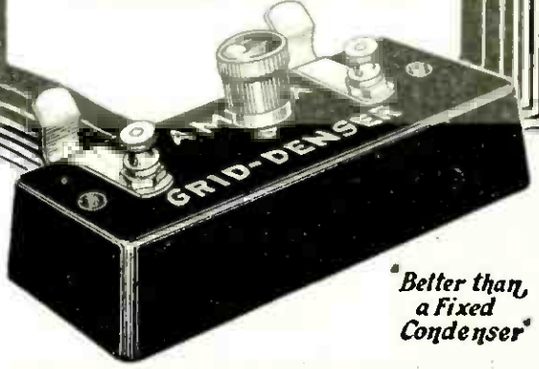
That is why *Cockaday, Haynes, Sleeper, Greiff, Crosby* and others specify it in ALL their circuits.

Whether it's the Super-Het, Cockaday, Superdyne, Neutrodyne or any other—replace your fixed condensers with GRID-DENSERS and see the difference.

In either the .0005 or .001 type with or without gridleak clips **$1.25**

FREE: Hook-up Booklet, P. 10.

AMPLEX INSTRUMENT LABS.
88 W. Broadway, New York, N.Y.



"Better than a Fixed Condenser"

Ward's Radio Catalogue

Write for your FREE *copy*

We want you to have a copy of Ward's new Radio Catalogue.

You will find it a storehouse of information — a dependable guide to the newest and most important radio developments.

It shows all improved parts and diagrams of the best hook-ups for the man or boy to build his own set, as well as the very best ready-built sets at surprisingly low prices.

Montgomery Ward & Co. are Headquarters for *everything* in Radio. And this Catalogue shows complete — everything in Radio equipment. Remember we sell only standard goods — direct to you by mail, and without the usual Radio profits.

For 52 years, "Satisfaction guaranteed or your money back," has stood behind every Ward sale. At Ward's, quality is never sacrificed to make a low price.

Write for your copy of this 68-page Radio Catalogue. See for yourself the low prices. You may as well profit by the savings it offers.

Address our house nearest you: Dept. 38-R.

ESTABLISHED 1872

Montgomery Ward & Co.

The Oldest Mail Order House is Today the Most Progressive

Chicago Kansas City St. Paul Portland, Ore. Oakland, Calif. Ft. Worth

Earn $5.00 to $20.00 a Day in RADIO

You can! Hundreds of ambitious men are already earning thousands of dollars in this wonderful new industry—many working only in their spare time. Mail coupon below for Free Book which describes fully the amazing money making opportunities in Radio and tells how YOU can earn from $5,000 to over $10,000 a year.

THE astounding growth of Radio has created thousands of big money opportunities. Millions of dollars were spent during the past year on Radio, and thousands of young men are needed right now to meet the ever increasing demand of work.

Men are needed to build, sell and install Radio sets—to design, test, repair—as radio engineers and executives—as operators at land stations and on ships traveling the world over—as operators at the hundreds of broadcasting stations. And these are just a few of the wonderful opportunities.

Easy to Learn Radio at Home in Spare Time

No matter if you know *nothing* about Radio now, you can quickly become a radio expert, by our marvelous new method of practical instruction—instruction which includes all the material for building the latest up-to-date radio apparatus.

Scores of young men who have taken our course are already earning from $75 to $200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% *even while taking our course!* Emmett Welch, right after finishing his training started earning $300 a month and expenses. Another graduate is now an operator of a broadcasting station PWX of Havana, Cuba, and earns $250 a month. Still another graduate, only 16 years old is averaging $70 a week in a radio store.

PAY INCREASES OVER $100 A MONTH

I am averaging any where from $75 to $150 a month more than I was making before enrolling with you. I would not consider $10,000 too much for the course.

(Signed) A. N. LONG,
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Greensburg, Pa.

DOUBLES SALARY

I can very easily make double the amount of money now than before I enrolled with you. Your course has benefited me approximately $3000 over and above what I would have earned had I not taken it.

T. WINDER,
731 Belford Ave.,
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Wonderful Opportunities

Hardly a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer" — "We want men with executive ability in addition to radio knowledge to become our local managers"—"We require the services of several resident demonstrators"—these are just a few small indications of the great variety of opportunities open to our graduates.

Take advantage of our practical training and the unusual conditions in Radio to step into a big paying position in this wonderful new field. Radio offers you more money than you probably ever dreamed possible—fascinating easy work—a chance to travel and see the world if you care to or to take any one of the many radio positions all around you at home. And Radio offers you a glorious future!

Our course is the only absolutely complete one now being offered which qualifies for a government first class commercial license. It gets you the bigger paying jobs in Radio.

Send for FREE BOOK

Learn more about this tremendous new field and its remarkable opportunities. Learn how you can quickly become a radio expert and make big money in Radio.

We have just prepared a new 32-page booklet which gives a thorough outline of the field of Radio —and describes our amazing practical training in detail. This Free Book. "Rich Rewards in Radio," will be sent to you without the slightest obligation. Mail coupon for it *now!*

For a short time we are offering a reduced rate to those who enroll at once. Act promptly and save money.

National Radio Institute
Dept. 32KA Washington, D. C.

NATIONAL RADIO INSTITUTE
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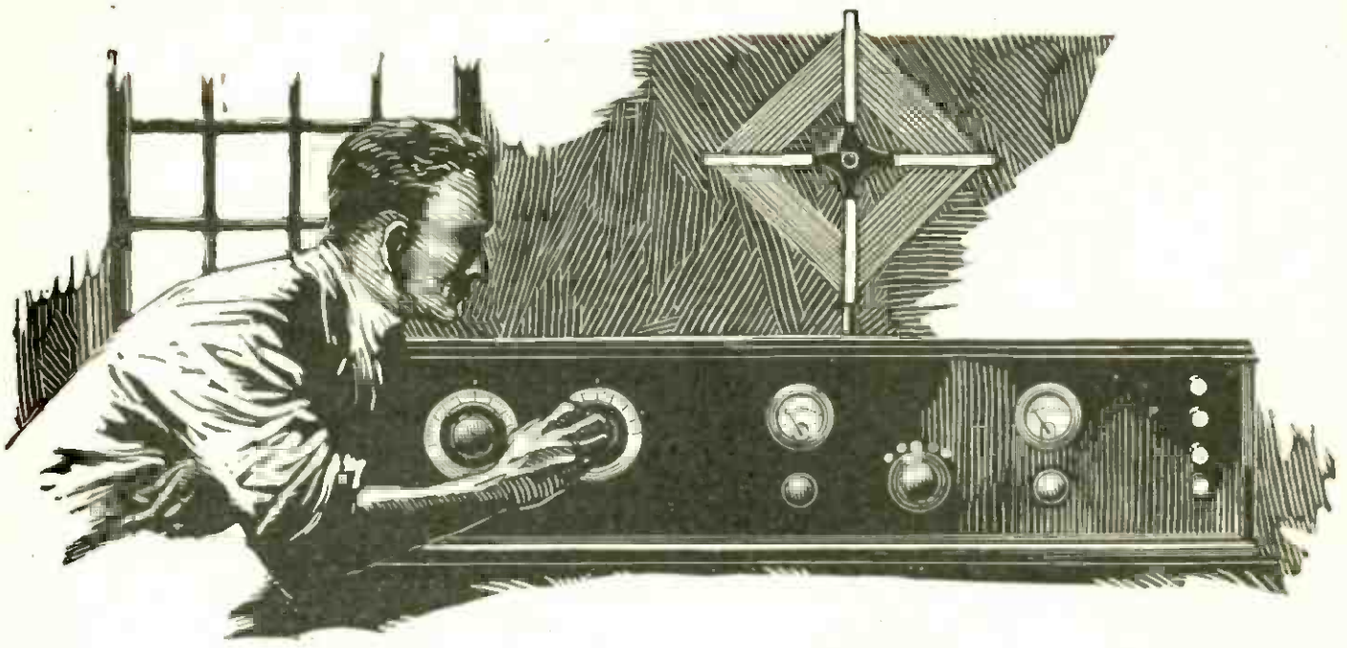
Please send me without the slightest obligation your Free Book, "Rich Rewards in Radio," and full details of your special Free Employment Service. Please write plainly.

Name.....Age.....

Address.....Occupation.....

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



Mechanical Quality and Insulation Value

THE mechanical qualities of Formica have as much to do with the preference of the 125 leading independent radio manufacturers for Formica, as its high dielectric strength.

These makers want to know that their panels are not going to sag and curl, and that the screws and binding posts will not loosen up because the material is so elastic it flows out under pressure.

They build for permanence. They want fine finish—and lasting finish. They want a material that will work well in their factories. And they get it all in Formica!

This year there will be scores of sets that carry a Formica front panel, Formica base panel, Formica terminal strips, Formica transformer cases, Formica jack washers—and many other parts. That stops losses and gets more distance and volume.

Be sure to use a Formica base panel in your Neutrodyne or Super-hetrodyne.

Dealers: The standing of Formica as radio insulation is well known by most amateurs and they want it. It is a satisfactory line that moves in good volume.

THE FORMICA INSULATION COMPANY

4641 Spring Grove Avenue, Cincinnati, Ohio

Sales Offices

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419 Ohio Bldg., Toledo, Ohio
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1026 Second Ave., S. Minneapolis, Minn.
585 Mission St., San Francisco, California
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FORMICA
Made from Anhydrous Bakelite Resins
SHEETS TUBES RODS

we had to have it
to keep up our standard of service for both new and old customers

DISTRIBUTORS FOR
Radio Corporation of America
RCA
Westinghouse General Electric
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Homecharger
Remler Rhamstine
U. S. Tool Western Electric
Workrite
And other
leading manufacturers

The new
LUDWIG HOMMEL BUILDING
is a monument to Radio Jobber Service

It is the culmination of years of ceaseless striving to better serve HOMMEL dealers.

Our new home, with its added facilities and advantageous location, will enable us to co-operate with our dealers even more intensively than heretofore.

HOMMEL has always interpreted "jobber service" from the point of view of the dealer. All consumer inquiries received from their national advertising are promptly forwarded to the HOMMEL dealer in that territory.

Only the most reputable lines of radio equipment are carried, and all radio apparatus is sold 100% through dealers—we do not compete with our dealers in any way.

Now is the time for you to tie up with a wide awake radio jobber. Check up your requirements to-day—there's going to be a radio shortage again this year—get in on the ground floor now, and be sure of ample stocks and deliveries by aligning yourself with the HOMMEL organization.

Write for your copy of HOMMEL Encyclopedia of Radio Apparatus, 256-P.

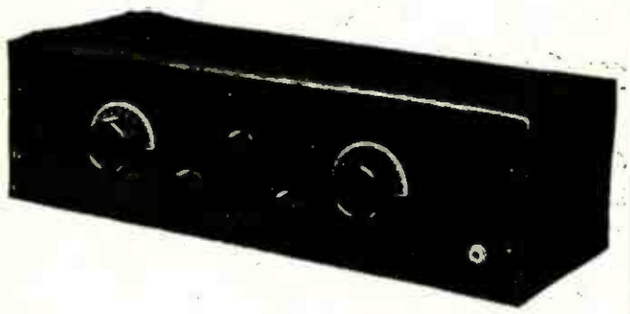
HOMMEL
not only the name of an organization but the name of a service

WHOLESALE EXCLUSIVELY

LUDWIG HOMMEL & CO

929 PENN AVENUE — LUDWIG HOMMEL & CO. — PITTSBURGH, PA.

BAKELITE



Crosley *and* Bakelite

The Crosley Radio Corporation of Cincinnati produces radio sets at reasonable prices, with no sacrifice of quality.

The use of Bakelite not only provides dependable insulation but simplifies quantity production.

Bakelite is mechanically strong, impervious to moisture and its color does not fade.

Its properties are unaffected by climatic conditions and it does not deteriorate with age or use.

In both the laminated and molded form, Bakelite is standard insulation for radio.

Write for a copy of our Radio Booklet K

BAKELITE CORPORATION

247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22d Street

BAKELITE
Condensite
REDMANOL
are the registered Trade Marks for the Phenol Resin Products manufactured under patents owned by
BAKELITE CORPORATION

Send for our Radio Map

The Bakelite Radio Map lists the call letters, wave length and location of every broadcasting station in the world. Enclose 10 cents to cover the cost and we will send you this map. Address Map Department.

THE MATERIAL OF A THOUSAND USES

KING QUALITY

ALL THE SAME IMPLIES

RADIO APPARATUS

Potentiometer

THE KING QUALITY LINE:

Adapters	Contact Points	Plugs
Bakelite Dials	Inductance-	Potentiometers
Bakelite Knobs	Switches	Rheostats
Binding Posts	Jacks	Switch Levers
Condensers	Panel Mountings	Tube Sockets

KING MANUFACTURING CORP.
BUFFALO NEW YORK

KING QUALITY (K) BUFFALO

FORE'S

MASTER FORE BATTERY CHARGER

Charges Radio A6 Volt and 22 ½ Volt B Batteries

Charges 6 Volt Automobile Batteries

The Fore Battery Charger will make anyone proud of his radio set.

Call at your jobber or dealer for them or write either address below for advice as to where they can be obtained.

Manufactured by
Fore Electrical Mfg. Co.
5255 N. Market Street
St. Louis, Missouri

Sales Department
The Zinke Company
1323 S. Michigan Blvd.
Chicago, Illinois

When the votes are counted— be there with a Murdock Neutrodyne

THIS is going to be the most bitterly contested presidential election in years. The dominant issues will be fought out by radio. It's really going to be a radio election. When the "big guns" turn loose their battery of eloquence—get it all with a Murdock. Keep on the firing line. Feel all the thrill of it. Be there when the votes are counted.

Hear the real voice of the nation. To hear it full and clear—you want volume. You want selectivity. You want distance. You get all this with the Murdock. Volume that floods your room. Selectivity that enables you to tune out local stations and tune in distant stations—without interference. Distance that permits you to listen-in on the best radio programs of the country.

Radio at its best

THE unfailing resources, skill and experience of a pioneer manufacturer, who has been making radio equipment of the highest engineering standard for 20 years enter into the construction of the Murdock Neutrodyne.

The Murdock is the ideal receiver for home use. It meets the most exacting tests of sound reproduction. It is so simplified and sensitive that no technical knowledge is necessary for its operation. You can place the Murdock in your home with full assurance that it will retain its efficiency for years.

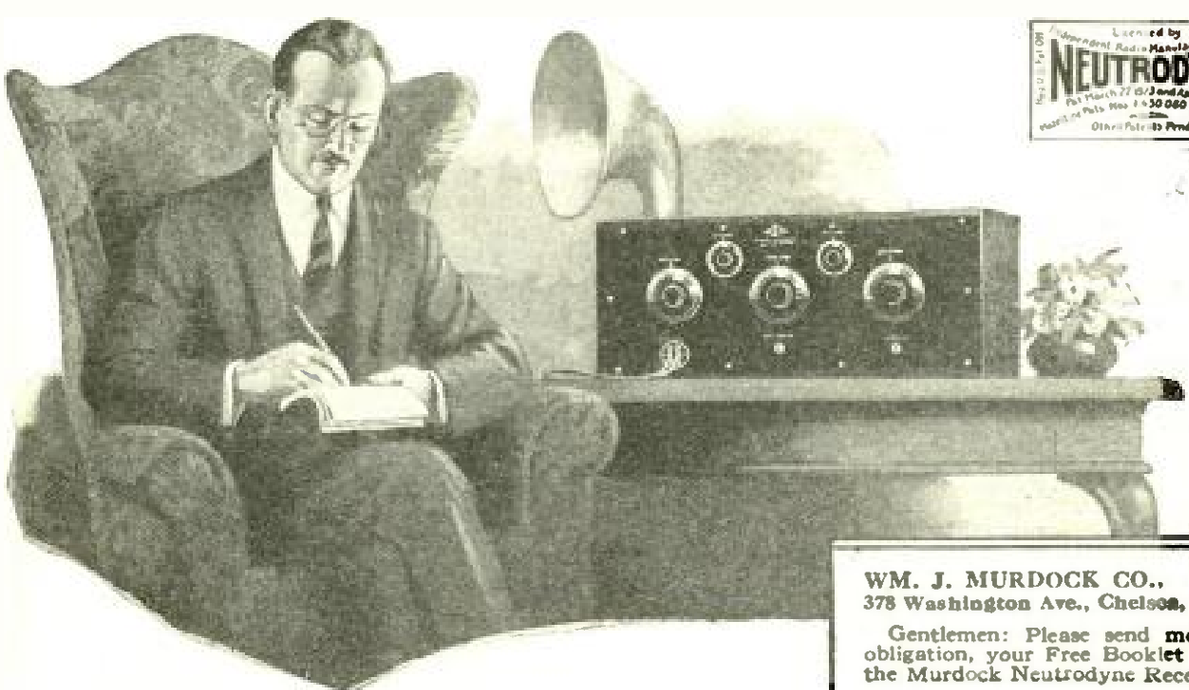
Go to your dealer and let him demonstrate the Murdock Neutrodyne for you. He will arrange for installation. Our trade-mark symbol is your guarantee of complete satisfaction.

WM. J. MURDOCK COMPANY
378 Washington Ave. Chelsea, Mass.
Branch Offices: New York, Chicago, San Francisco

MURDOCK RADIO PRODUCTS

Standard since 1904

RADIO MURDOCK



Mail coupon for free booklet today

WM. J. MURDOCK CO.,
378 Washington Ave., Chelsea, Mass.

Gentlemen: Please send me, without obligation, your Free Booklet describing the Murdock Neutrodyne Receiver.

Name .....

Address .....

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

A New BATTERY SWITCH

with enclosed positive contacts

The contacts of the new Centralab Battery Switch are enclosed for protection from dust and mechanical injury, and are firm and positive, of the quick make and break type. The switch is small and compact so as to occupy the minimum of panel space, the only part that protrudes from the panel being the switch knob. It has two knurled nuts for adjustment to any thickness of panel. Both binding posts and lugs for permanent soldering are provided. Substantial and neat, all metal parts nickel plated, single hole mounting.

No. 300—**50c**

Centralab
ADJUSTABLE GRID LEAK
No. 106—**$1.25**
No. 107—(*with .00025 condenser*), **$1.60**

Centralab
NON-INDUCTIVE POTENTIOMETER
No. 110—400 *ohms*, **$1.50**
No. 111—2000 *ohms*, **$1.75**

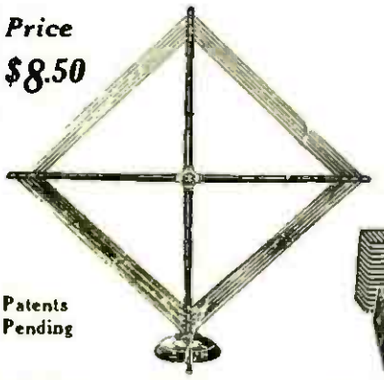
Centralab
RHEOSTAT
No. 206—6 *ohms*, **$1.25**
No. 230—30 *ohms*, **$1.25**

TO JOBBERS AND DEALERS: *The trade mark of products of the Central Radio Laboratories has been changed from* **CRL** *to* **Centralab.** *Write for literature.*

Centralab
CENTRAL RADIO LABORATORIES
293 Sixteenth St. Milwaukee, Wis.

Duo-Spiral *Folding Loop*

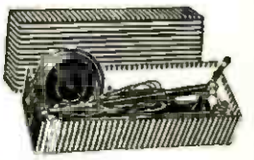
***Price* $8.50**



Reduces Static

Increases Selectivity

Easily Portable



Patents Pending

The highest development in a portable aerial. Compact, convenient and self-contained. Rotates on base, which is provided with silvered dial graduated for calibration. Handle permits adjustment without body capacity effects. Handsomely finished in silver and mahogany. Can be used *anywhere*.

TINY-TURN

A superior vernier control which makes perfect tuning easy. Has a gear ratio of 30 to 1. Rotates in same direction as dials. Easy to install. Fits any standard panel. Handsome nickel and ebony black finish. Price 75c If you cannot secure DUO-SPIRAL and TINY-TURN at your dealers, write us direct.

Radio Units Inc.
Maywood, Illinois
1301 First Avenue Maywood, Ill.

MODERN "Push-Pull" TRANSFORMERS

Were First

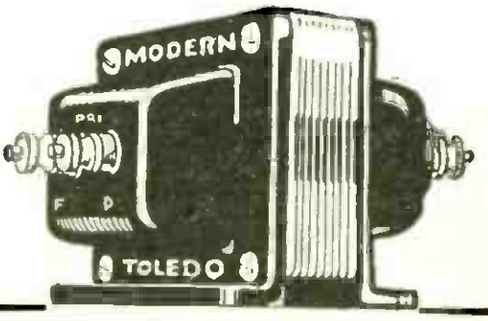
—to be offered the Radio public. Today they are recognized as the last word in "push-pull" amplification.

The MODERN 4-TUBE REFLEX is the peer of all Reflex circuits. Write for new simplified wiring diagram of this circuit.

MODERN 30 K.C. TRANSFORMERS for use in Super-Heterodyne and Ultradyne assure better-than-ordinary results from these circuits.

Dealers everywhere sell Modern Transformers. If yours can't supply you, write us giving dealer's name and requesting bulletin on the circuit you are interested in.

The Modern Electric Mfg. Co.
Builders of Transformers Exclusively
Toledo, Ohio



THIS BATTERY WILL MATERIALLY REDUCE YOUR OPERATING COSTS ON HEAVY CURRENT SETS

NEW!

Eveready Heavy Duty "B" Battery. 45 volts. Three Fahnestock Clips. Length, 8 5/16 inches; width, 4 7/16 inches; height, 7 5/16 inches; weight, 13 3/4 pounds.

New low price, $4.75

New Heavy Duty 45-volt "B" Battery No. 770

Extra large cells—extra long service

For maximum "B" Battery economy, use this *New Eveready Heavy Duty* 45-volt "B" Battery, in the following general cases:

1—On all receiving sets operating at 90 volts or more, having four tubes without a "C" Battery, and all sets having five or more tubes, with or without a "C" Battery.

2—On all power amplifiers.

3—On all sets that pull heavy currents from the "B" Battery.

Under the above conditions, the *New Eveready Heavy Duty* 45-volt "B" Battery will give much longer service than the 45-volt "B" Battery of usual size.

If your receiving equipment falls under any of the above classifications, you can make a big saving in "B" Battery costs by using this *New Eveready Heavy Duty* 45-volt "B" Battery No. 770. Buy it and you get the biggest battery value on the market to-day!

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, Inc.

Headquarters for Radio Battery Information

New York—San Francisco

Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY
Radio Batteries
—they last longer

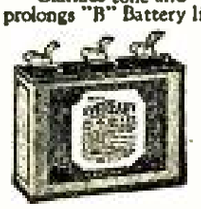
No. 7111
Eveready Radio "A" Dry Cell
Specially manufactured for use with dry cell tubes

Eveready 6-volt Storage "A" Battery

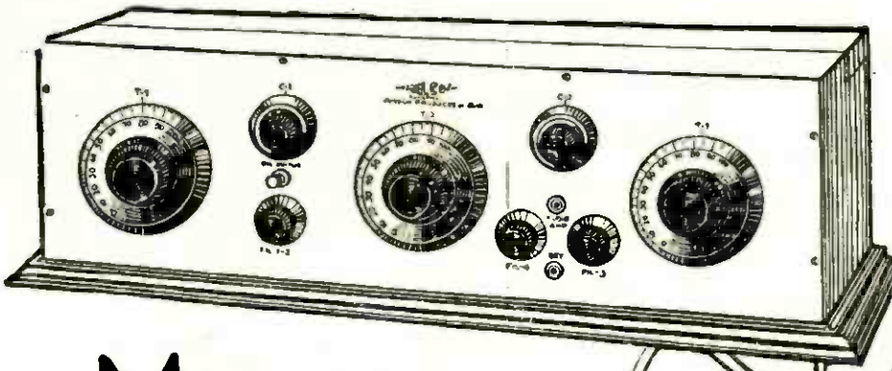
No. 766
Eveready "B"
22½ volts. Six Fahnestock Spring Clip Connectors

No. 772
Vertical 45-volt, large size "B" Battery

No. 771
Eveready "C" Battery
Clarifies tone and prolongs "B" Battery life



No. 764
Vertical 22½-volt "B" Battery



MELCO-SUPREME RECEIVER

Tuned Radio-Frequency

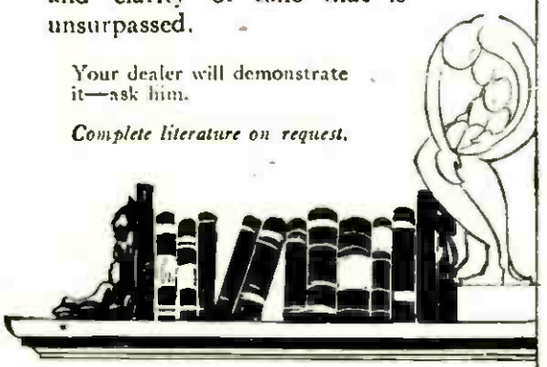
"Satisfies Every Radio Wish"

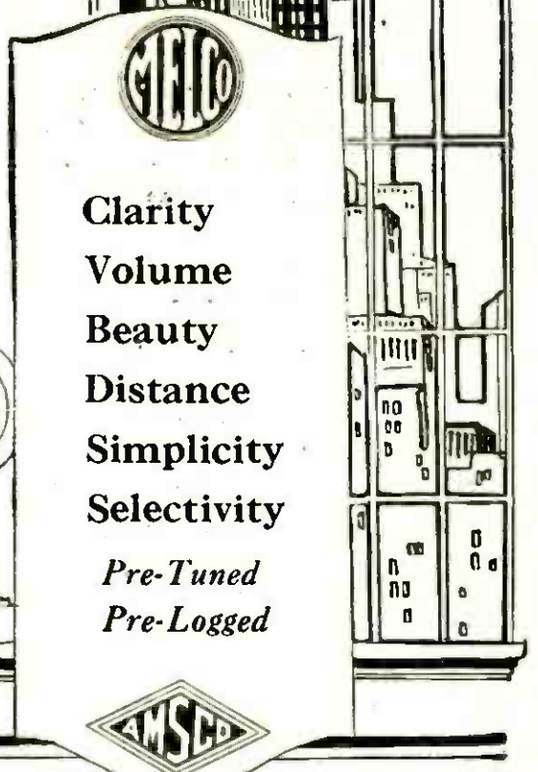
Just open the window and have all the worth while events of the country brought to your living room. The Melco-Supreme Receiver is the lock—open it—turn the dial—that's the handle—and you will never want for entertainment in vain.

To really appreciate radio there is only one choice, the Melco-Supreme—the set that brings you the most distant stations consistently, with a mellowness and clarity of tone that is unsurpassed.

Your dealer will demonstrate it—ask him.

Complete literature on request.





Clarity
Volume
Beauty
Distance
Simplicity
Selectivity

Pre-Tuned
Pre-Logged

AMSCO

AMSCO PRODUCTS INC

Broome & Lafayette Sts. *New York*

FADA Radio

FADA Neutrola Grand
No. 185/90-A

This is the five-tube Neutrola 185-A mounted on FADA Cabinet Table 190-A. Price (less tubes, batteries, etc.) $295.

The high, sweet notes of the violin—the low, rolling bass of the organ

TONE quality—true reproduction of voice and music without distortion—is one of the outstanding features of the new FADA Neutrodyne. You hear the music just as it is played or sung.

FADA Neutrodynes can be depended upon at any time, anywhere, to give you the utmost in radio. They operate on a simple indoor or outdoor aerial and use the types of powerful tubes which give maximum results. Each bears the stamp of FADA engineering skill plus the artistry of master cabinet designers.

You who have deferred buying a radio set—waiting for someone to produce just your combination of price, performance, cabinet design and finish—need wait no longer. In the new complete line of FADA Neutrodyne receivers you can find exactly what you want.

See your dealer. He will show you a FADA Neutrodyne that will delight you—in appearance, performance and price.

You have a range from $75 to $295 from which to select—six models, each a remarkable value.

F. A. D. ANDREA, INC., 1581 JEROME AVENUE, NEW YORK

FADA Neutroceiver
No. 175-A

Mahogany cabinet. Inclined panel and roomy battery shelf. Five tubes. Price (less tubes, batteries, etc.) $160.

FADA Neutro Junior
No. 195

Three-tube Neutrodyne. A wonderful performer. Price (less tubes, batteries, etc.) $75.

NEUTRODYNE

Police Sergeant Charles E. Pearce who erected and operated the first successful police radio station in the world — a former student of the Radio Institute of America.

Radio- your chance

From no knowledge of radio—to licensed operator. From operator up the opportunity ladder to the big job at the top. And a life of fascinating interest, well paid. That is every man's chance now that the famous course of America's oldest radio school is offered for *home study.*

The Radio Institute of America is conducted under the auspices of the Radio Corporation of America, the greatest radio organization in the world. This insures the most thorough and up to date instruction and therefore means preference for positions when you earn your government license.

The demand for trained men is great—and growing. Now, no matter where you live you can *study at home* under the best instruction. Write today! Get your start—and grow with radio.

Write for information today

Advanced Radio Course

Great popular demand by the advanced student, experienced amateur, and wireless operator has led to the opening of an ADVANCED HOME STUDY RADIO COURSE, specializing in C. W., I. C. W., telephone and radio measurements. Investigate!

Radio Institute of America

(Formerly Marconi Institute)
Established 1909

328 Broadway, New York City

Indicate by across X the course you are interested in:

Radio Institute of America.
328 Broadway, New York.

Please send me full information about radio opportunities today, and your

COMPLETE RADIO COURSE ☐
ADVANCED RADIO COURSE ☐

Name.....

Address .....

.....

DONGAN

Transformer **Voltmeter**

TWO *Superior Products*

Type C, Audio Frequency, Transformer will bring out the very best in any set.

Designed by Dongan engineers and manufactured exclusively in Dongan's own factory. No finer transformer can be made.

For all types of hook-ups Ratio 3½ to 1 and 6 to 1 Bakelite panel.

Nickel plated trimmings.

$3.50 List

For consistently good performance from your set you must have a high grade voltmeter. Definite and accurate readings are essential.

Dongan High Resistance Voltmeter is guaranteed for accuracy.

$2.75 List

JOBBERS

We want the best jobbers and really co-operate with them. Get our proposition.

Attractive booklets on request. Special proposition for Manufacturers

DONGAN ELECTRIC MANUFACTURING CO.
2983 Franklin St. : : Detroit, Mich.

Transformers of Merit for 15 Years

Type B

Extra!

When the conventions were waxing hottest, DE-TEC-TONE was proving its superiority, both on Reflex and Crystal Sets.

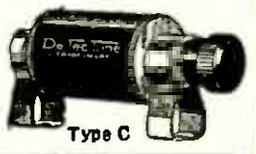
DE-TEC-TONE

Crystal Detector

At Dealers or Direct

Type "B" (above) $1.60
Type "C" (below) $1.50
Jobbers: Discounts and Literature on request.

PYRAMID PRODUCTS COMPANY
117 N. Dearborn St.
Chicago



Type C

The Traffic Cop of the Air

FERBEND *Wave Trap*

Add a Ferbend Wave Trap to your set and "Police" your reception. Regulate the Traffic! Guaranteed to tune out any interfering station. Sent postpaid on receipt of $8.50, or C. O. D. plus postage.

Send for *free* booklet.

Ferbend Electric Co.
21 E. South Water St., Chicago

O'NEIL AUDIPHONE

All music and speech re-vivified by "laminated voice-core." Complete with connecting cord **$30**

O'NEIL MFG. CO.
714 Palisade Avenue West New York, N. J.

What kind of a Radio have you?

Made it yourself?
Would you brag about its looks?
And, honestly now, does it *really* perform?
We mean, is it utterly simple?
Is it absolutely quiet in operation?
Can you depend upon it, unfailingly?

• • •

ALL these questions are answered "Yes" by the new FREED-EISEMANN Radio Receiver. And it is mighty fine-looking: not a wire in sight—no ugly horn necessary—positive absence of squeals. In every way it is the radio entertainer of the home—fit for the finest room—and enjoyed by the most exacting listeners.

The day of the home-made set is done. Radio is now in the drawing room. *Enter* FREED-EISEMANN!

FREED-EISEMANN RADIO CORPORATION
Sperry Bldg., Manhattan Bridge Plaza Brooklyn, N. Y.

NEUTRODYNE

Freed-Eisemann

NEUTRODYNE

RADIO RECEIVERS

WHEN you own a Radiodyne you can listen in on programs thousands of miles away. Jazz music from Chicago—speeches from Washington—opera from Boston—"Hits" from Broadway—news from "The Coast"— your Radiodyne brings them to you no matter where you live.

Radiodyne

Gets Wonderful Results With 60 Foot Aerial

"I am using a 60 foot outside aerial and the results are wonderful. I use no ear phones. Am reaching from coast to coast with a loud speaker."

Harry Herz, Milwaukee, Wis.

Works Just As Well Without Loop or Aerial

"With a 30 ft. wire lying on the floor we heard 32 stations in one night including Omaha, Newark, Atlanta and Ft. Worth on loud speaker, clear and distinct."

H. N. Walker, Detroit, Mich.

Write for illustrated folder which describes the Radiodyne in detail. Every radio fan will be interested in this new type receiver.

Western Coil & Electrical Co.
308 Fifth St., Racine, Wis.

"Take No Chances—Use Como"

COMO DUPLEX

The World's Standard Push Pull Transformer

PRICE $12.50 per pair
For maximum volume without distortion

What Prominent Writers on Radio Subjects say About Como.

Lewis B. Hagerman, Technical Editor, *Chicago Post:* "Actual Tests show this transformer to be far superior to any others of similar makes."
R. J. Robbins, *New York Sun:* "After consideration of several well-known makes of push pull transformers which are available "COMO DUPLEX" was selected as most satisfactory."
C. White, *Radio World:* "COMO DUPLEX" is infinitely superior — most other push pull transformers seem to be ordinary transformers with a center tap brought out as a makeshift."
E. P. Gordon, *Open Road:* "A system of audio-amplification which is becoming increasingly popular. Its use . . . . will give surprising results in both quality and volume, and is thoroughly recommended by this department."

NEED WE SAY MORE?

COMO APPARATUS COMPANY
446 Tremont St. Boston, Mass.
For Sale at Leading Dealers

EBY +

There is only one

GENUINE

EBY Binding Post

"With Tops which Don't Come Off"

Eby Posts are scientifically designed, beautifully finished and their price is right.

EBYS are Binding Posts PLUS

H. H. EBY MFG. CO. : Philadelphia

AMPLION

The World's Standard Loud Speaker

Radio HARTMAN Products

HARTMAN ELECTRIC CO.
MANSFIELD, OHIO.

---

19 IMITATIONS!

A RECORD COMPLIMENT

We have counted 19 imitations of our products. But the imitator cheats by offering the exterior likeness only. SCIENTIFIC ACHIEVEMENTS DEFY IMITATION. General Instrument Corporation eliminates and reduces losses in its condensers by scientific means available only to manufacturers with laboratory facilities equal to those of General Instrument Corporation.

Air, Isolantite, Pyrex, Corantum and Quartz are the only recognized zero or minimum loss insulations in existance.

GENERAL INSTRUMENT CORPORATION INSULATES WITH AIR, ISOLANTITE, PYREX, CORANTUM AND QUARTZ.

The embodiment of this scientific principle in General Instrument Condensers makes a certainty of GREATER DISTANCE, INCREASED SELECTIVITY AND CLEARER RECEPTION. By eliminating energy waste these genuine condensers overcome losses.

IMPORTANT: Pigtails introduce variable inductance and variable resistance, defeating accuracy and creating losses. The Bureau of Standards does not use pigtails on their standard variable air condensers. Neither does The General Instrument Corporation.

THE GENUINE

COST A LITTLE MORE BUT ARE

WORTH INFINITELY MORE

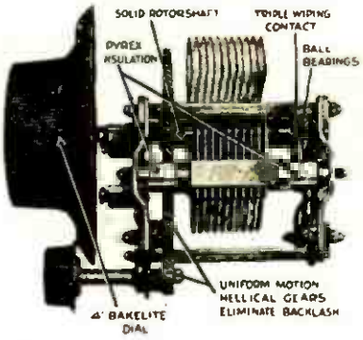
NOLOSS

TYPE 51 TYPE 52

INSULATED WITH

PYREX

TYPE 52



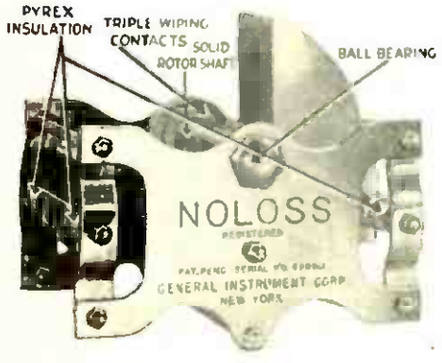
LOW LOSS

TYPE 46 TYPE 47

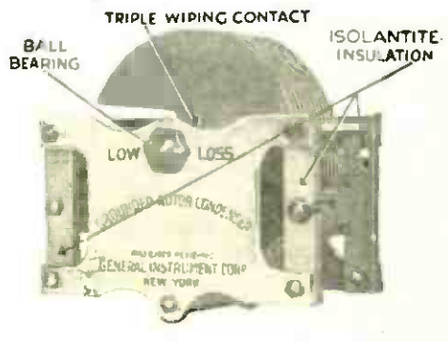
INSULATED WITH

ISOLANTITE

TYPE 51



TYPE 46



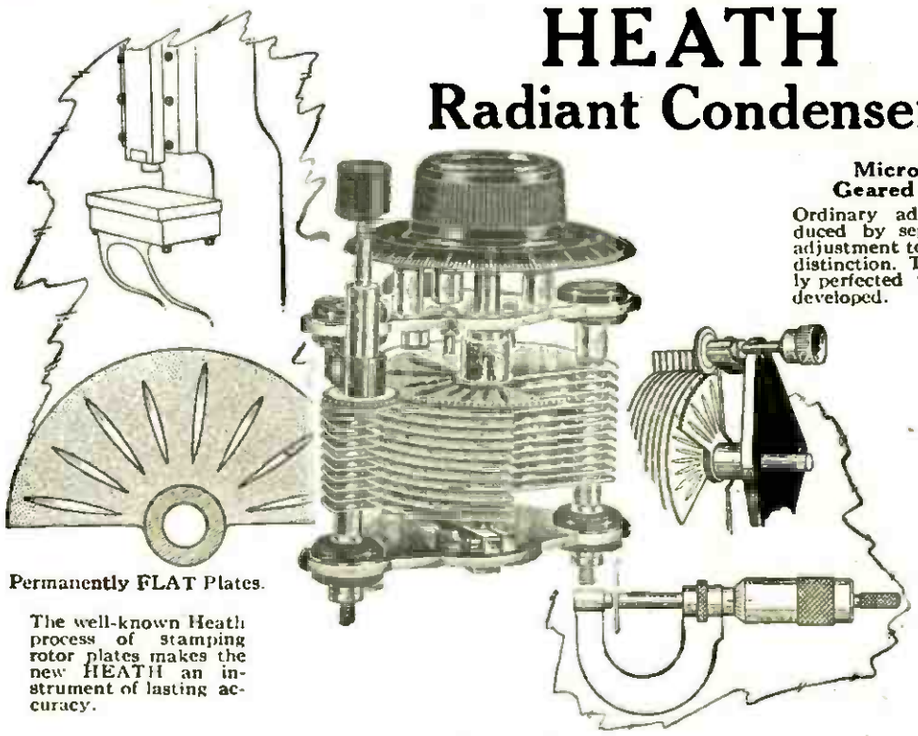
GENERAL INSTRUMENT CORPORATION

MANUFACTURERS OF LABORATORY EQUIPMENT

423 Broome Street, New York

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

HEATH
Radiant Condensers



Micrometer Geared Vernier

Ordinary adjustments reduced by separate geared adjustment to hair-breadth distinction. The most highly perfected vernier so far developed.

Permanently FLAT Plates.

The well-known Heath process of stamping rotor plates makes the new HEATH an instrument of lasting accuracy.

Non-Dielectric Condensers

A NEW all-metal condenser. A new rigidity! A shaft perfectly centered in accurately machined bearings—true-running—for smoother operation. No contacts through bearings. Of only 0.1 ohm and a phase difference of less than one minute—the very peak of condenser efficiency. Use Heath Condensers in your new set or hook-up

PRICES OF MODEL "A" VERNIER TYPE WITH DIAL

No. 12 A.V.	12 plate	$5.00	No. 44½A.V.	44 Plate	6.50
No. 24 A.V.	24 Plate	5.50	Plain Types in all sizes.		

New HEATH *Products*

HEATH Bakelite Dials

Specially designed easy grip-knob, beautifully proportioned, highly polished and clearly incised. Brass bushing centered by precision machinery to positive accuracy for perfect balance. Made in two (2) inch, three (3) inch and four (4) inch diameters. A typical HEATH product.

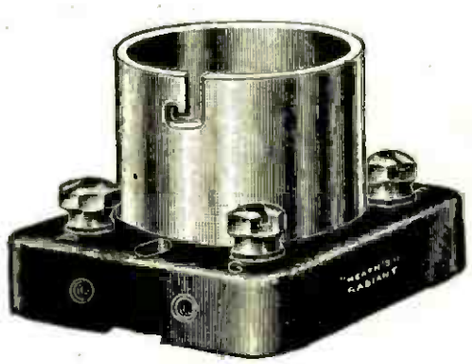
PRICES

No. 101—2"	dial for	¼"	shaft	50 cts.
No. 103—3"	" "	¼"	"	65 "
No. 105—4"	" "	¼"	"	80 "

HEATH Sockets

With the Exclusive Shock Absorber Feature

Bakelite base into which re-enforced phosphor bronze, self-cleaningl contacts are securely embedded. Binding posts are slotted hexagon nuts. HEATH Standards of material and workmanship.....Price 75c.



Write today for Literature

Heath Radio & Electric Mfg. Co.
208 First Street, Newark, N. J.

Exclusive Canadian Distributor, MARCONI WIRELESS TELEGRAPH CO., Ltd., Montreal, Canada

Atlas

TRADE MARK

RADIO REPRODUCTION *speaker*

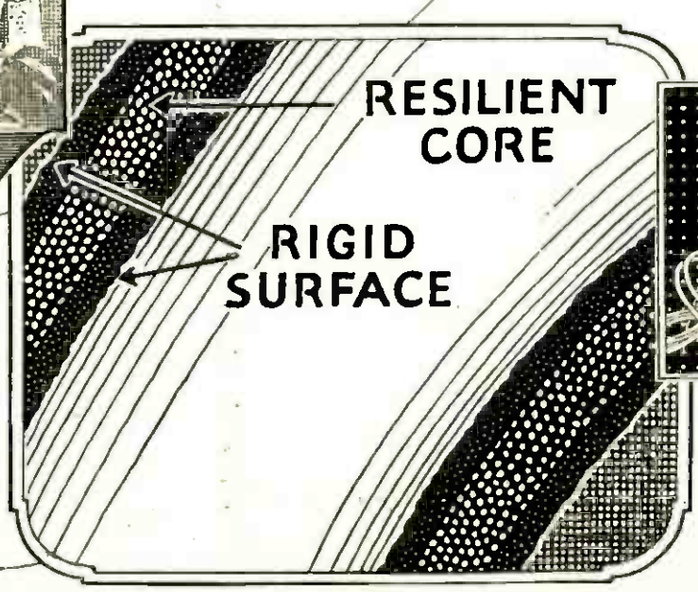
THE material of the horn itself plays an important part in the faithfulness of Atlas Radio Reproduction. The magnified cross-section below shows how the resilient core absorbs the vibrations of the horn material; while the rigid surface conserves the sounds you *ought* to hear —*as* you want to hear them.

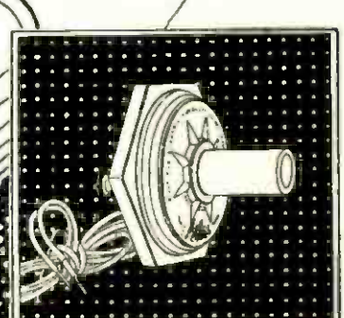
Multiple Electric Products Co., Inc.
36 Spring St., Newark, N. J., Dept. B

New York, Boston, Philadelphia, Baltimore, Pittsburgh, Detroit, Chicago, St. Louis, Denver, 550 Howard Street, San Francisco.

Marconi Wireless Telegraph Co. of Canada, Ltd.
Sole Canadian Distributors

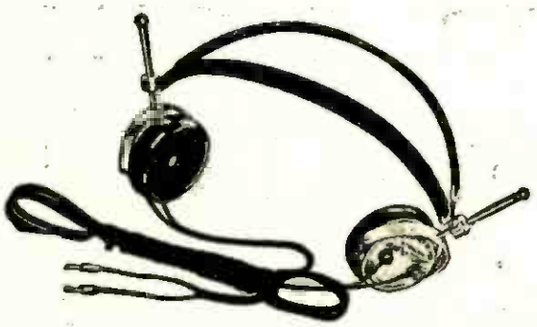
New Atlas speaker with the exclusive and strikingly beautiful bronze-brown ripple-finish.





Atlas unit, complete with attachment couplings, to fit all standard phonographs.

AMPL-TONE PHONES



2200 Ohms $5.00

Loud—Clear—Equalized Tone

Only best materials used and finest workmanship employed. Quality and quantity now combined.

NOTICE

We further wish to notify our trade that we are now located in our new and spacious quarters at Derby, Conn.

All our orders will be shipped from our new location where we are in a position to render immediate deliveries of quantity orders to our customers. We wish to thank our many friends and customers for their past valued orders and trust that our new location will be of benefit to you.

Dealers—Write us for further information.

UNION FABRIC COMPANY
Successors to
C. M. FRENCH MFG. CO.
Derby, Conn.

Performance

The first and only six tube radio receiver that brings in any desired station by a single turn of a single dial to a single pre-determined dial setting. Tone purity and clarity unmatched by any other receiver.

Thermiodyne appeals particularly to the non-technical man or woman who wants perfect performance with easy operation. May be used with any type antenna, or under favorable conditions, with none; with dry or storage batteries and with any make tubes.

14 Points of Thermiodyne Supremacy

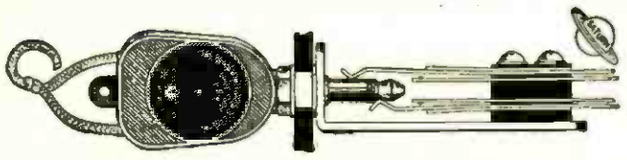
1—Single Control.
2—No outdoor antenna necessary.
3—No directional loop.
4—Wavelength or Kilocycle pickup of stations, instead of meaningless degrees or numbers.
5—Cannot Squeal or Howl.
6—Cannot Radiate.
7—Cannot Distort.
8—Newspapers give time and wavelength.
9—Thermiodyne picks them at the exact setting every time.
10—No logging of stations, nothing to remember.
11—Stations of different wavelengths cannot interfere with each other.
12—A six tube receiver, three stages of Thermionic Frequency, Detector, two stages Audio Frequency.
13—Distance, Volume, Clear as a bell, without fuss or excuses.
14—A 180 degree turn of the Single Control is like an instantaneous tour of dozens of cities.

Beautifully built, in exquisite genuine mahogany cabinet with space for all batteries for dry cell operation. **$140**

Insist that your dealer demonstrate Thermiodyne

Made and Fully Guaranteed by

SHEPARD-POTTER CO., Inc.
33 So. River St. **Plattsburgh, N. Y.**



The *New* SATURN

Improved Automatic Radio Plug

THE famous SATURN Plug radically improved to meet the latest requirements. Neat, polished case of genuine *Bakelite*—no exposed metal to produce capacity effects or short circuits. Remember the big SATURN feature—no tools to connect—just insert phone cord terminals into plug. Held in a vise-like grip—electrically perfect: instantly released by a touch on the small release lug. A *real* guarantee backs every SATURN Plug. Although so much improved, the price stays the same. Greater value than ever at the reduced price 75c.

SATURN Perfect Jacks

Easy soldering terminals with crowfoot offset, tinned with non-corrosive solder flux compound.

Rounded corner brass brackets, nickel plated.

German silver blades with sterling silver contact points.

The SATURN Battery Switch

Velvet-smooth action—the result of perfectly balanced blade construction. A slight pull makes connection; an easy push breaks it. Fits any panel. Built according to the SATURN standard of materials and workmanship.

List price, 75c.

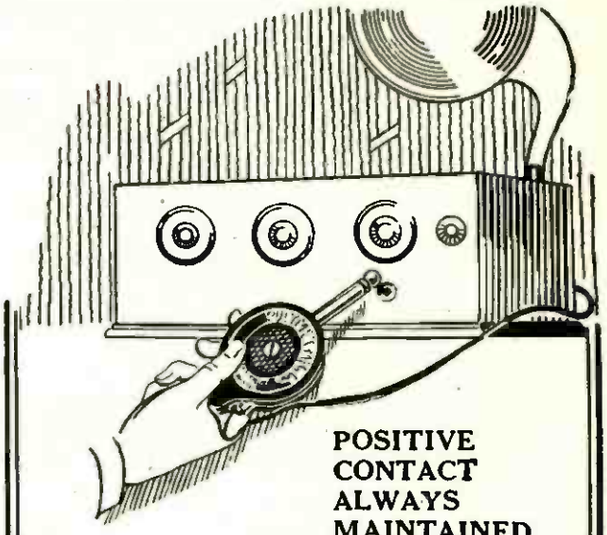
SATURN *Products for Better Connections*

How to Buy SATURN Radio Products

In case your dealer has not yet received his stock of SATURN Products, you may order direct, being sure to mention his name. Satisfaction guaranteed or your money returned.

Write for Our New Circular

The SATURN Mfg. & Sales Co., Inc.
Dept. P.
48 Beekman St.
New York, N. Y.



POSITIVE CONTACT ALWAYS MAINTAINED

Poly Plug

The tension slot, a big feature of POLY-PLUG, permits the phone cords to be pulled and jarred without the slightest disturbance to the contact.

Eliminates every inconvenience so annoying in the operation of the unsatisfactory screw type plug.

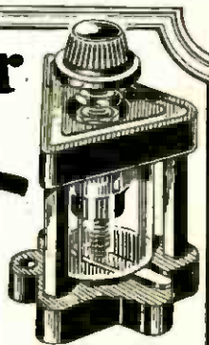
No necessity to take POLY PLUG apart—not a single screw to tighten.

At your dealers or sent postpaid on receipt of purchase price.

75c
"worth it"

POLYMET MFG. CORP.
70-74 Lafayette Street
New York City

Best for Reflex



and Crystal Sets

FRESHMAN

Double Adjustable Crystal Detector

No more searching for the sensitive spot. —Merely turn the knob as you would a dial.

For base or panel mounting, complete with Freshman Super - Crystal **$1.50**

At your dealer's, otherwise send purchase price and you will be supplied postpaid.

CHAS. FRESHMAN CO., Inc.
106-7th Avenue, New York

$26.00

Build it with the

ULTRADYNE KIT

Now, the famous Ultradyne Receiver has been so simplified that anyone can successfully build it with the Ultradyne Kit.

This Kit includes all the special parts required to build the Ultradyne, designed by R. E. Lacault, the inventor,—1 Type "A" Ultraformer, 3 Type "B" Ultraformers, 1 tuning coil, 1 oscillator coil, 4 matched fixed condensers.

The Ultradyne incorporates the new "Modulation System"—a decided departure from the detector arrangement of radio reception used in all other Super-Heterodynes. This "Modulation System" is the latest development of R. E. Lacault, A.M.I.R.E., Consulting Engineer of this company and formerly Radio Research Engineer with the French Radio Research Laboratories.

Even Super-Heterodyne Engineers marvel at Ultradyne performance—its unusual selectivity and great range on the loud speaker.

There is no greater receiver! Now you can build it yourself!

Write for descriptive folder

PHENIX RADIO CORPORATION

7-9 BEEKMAN ST. **NEW YORK CITY**

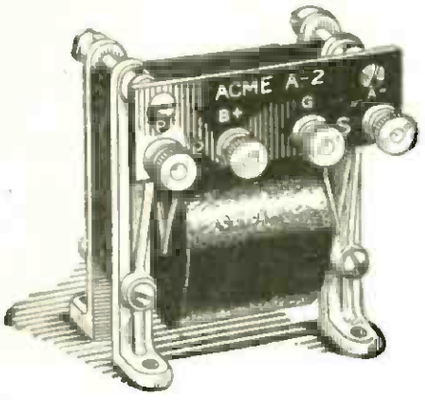
R E L

To protect the public, all genuine Ultraformers bear Mr. Lacault's personal monogram seal (R.E.L.) and are guaranteed so long as this seal remains unbroken

Send for 32-page illustrated book, giving latest authentic instructions on drilling, wiring, assembling and tuning 6 and 8 tube Ultradyne receivers.

50c

ULTRADYNE
The Improved
SUPER-HETERODYNE



After distance, what do you want?

Amplification without distortion,

OF COURSE, you want to hear the distant stations but you want these loud and clear so a whole room full of people can understand.

And when you listen to a fine musical program from your local station it certainly is fascinating to get all the notes, all the words, and to be able to close your eyes and just be content.

If you use Acme Transformers in the set you build and insist on their use in the set you buy, you are giving your loudspeaker a chance to reproduce the singer's voice, the violin's notes, the orchestra or lecture, loud and clear, without distortion.

Send 10 cents today for 36-page book "Amplification without distortion," containing many practical wiring diagrams and many hints for getting the best out of your set.

ACME APPARATUS COMPANY
Transformer and Radio Engineers and Manufacturers
Dept. 93 Cambridge, Mass.

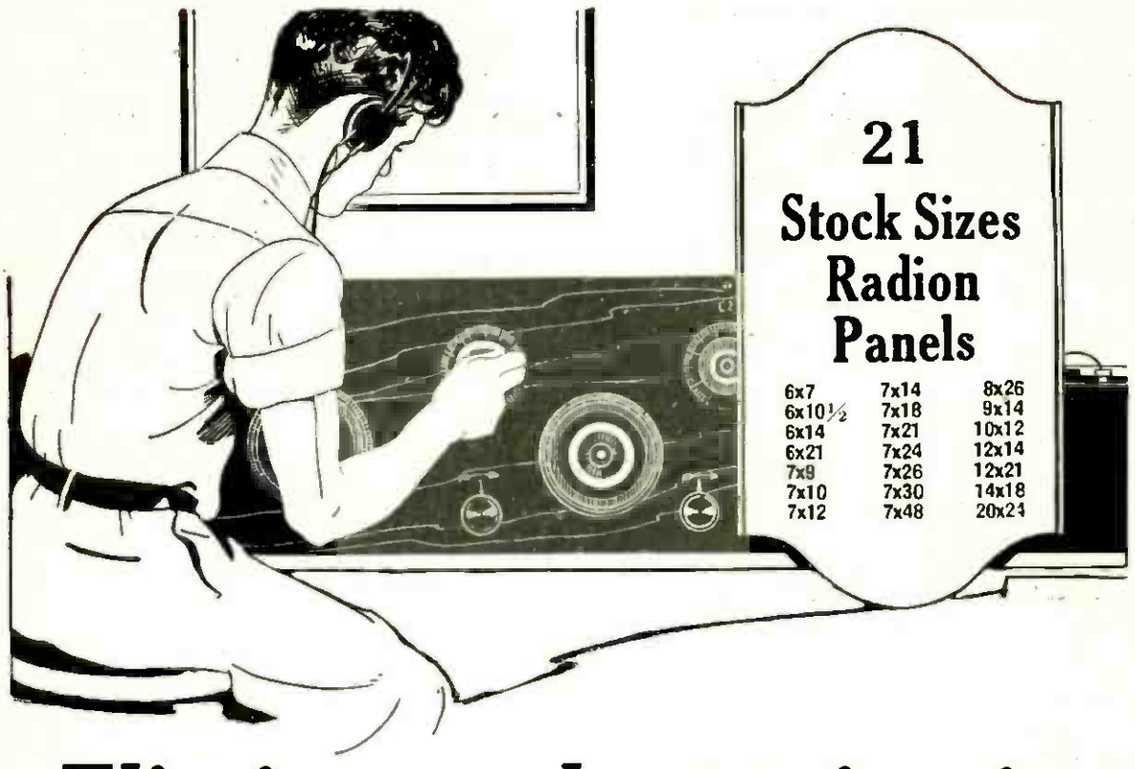
ACME
~ for amplification

ACME APPARATUS COMPANY,
Dept. 93, Cambridge, Mass.
Gentlemen: Enclosed find 10 cents for copy of "Amplification without Distortion."

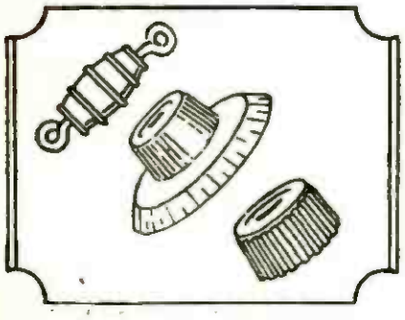
Name .....

Street .....

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



Eliminate short circuits and distortion



Any panel material which will absorb moisture is apt to cause short circuits and distortion. Radion Panels are impervious to moisture. They eliminate most of the leaks of radio frequency currents where other materials fail.

Your dealer carries a stock of Mahoganite or black Radion Panels, Dials and Knobs. Experienced amateurs and professionals, too, demand genuine RADION. Try it and you will notice the difference.

Look for this stamp on every genuine RADION Panel. Beware of substitutes and imitations.

RADION

The Supreme Insulation

PANELS

AMERICAN HARD RUBBER CO., 11 Mercer St., N. Y.

"I have been fortunate enough to dispose of all the loud speakers I had on hand before I received the Thorola, for I would never have been able to do so, had I demonstrated the Thorola."

Scores of signed opinions like this come in from smart radio dealers. They know the public pulse. Nothing in radio, they tell you, has caused the profound stir of Thorola. Besides, thousands of dollars *in advance* came in to reserve Thorolas the moment this loud speaker was announced by the makers of the celebrated Thorophone.

Thorola, perhaps more than any other single factor, now lifts radio to an undisputed place in musical art. Thorola fidelity of reproduction dumfounds the critics. Thorola advance over previous highest standards elates the most sophisticated fans.

Costliest sets are exactly the opportunity Thorola seeks, to demonstrate beyond question what vast improvement now is made possible. Whatever circuit or power you use, Thorola will show you new radio enjoyment.

You will bring in weak signals clear and strong, so good is Thorola volume, even tuned down to the limit. You will have so much volume ordinarily that clarity need never be sacrificed.

You will discover volume, tone quality, sharpness of speech, delicate shading, response to control, made possible only by Thorola betterments—the acoustically perfect horn of Thorite compound—the Permanent Adjustment for precise synchronization with your set—the Controlled Mica Diaphragm—the Amplifying Lever and other advancements.

But you must convince *yourself* of all this superiority. Thorola must improve your set in your own judgment or the Thorodealer refunds your money without question. Thorola thrives under this guarantee. See your Thorodealer.

REICHMANN COMPANY, 1729-35 West 74th Street, CHICAGO

THOROLA

GAROD

ANNOUNCES THEIR NEW POWERFUL NEUTRODYNE MODELS THE GEORGIAN AND THE V

The public wants Power

The Garod Georgian

Rich brown burled walnut, with door-panel borders of inlaid ebony and holly —5 tube model—built-in loud speaker—battery compartments and accessory drawer. Will grace the finest drawing room—provide the best in radio reception. Size 35½" long—16⅝" deep—42½" high.

$400.00

The Garod V

Genuine mahogany highly finished cabinet—graceful 15° sloped genuine mahogany panel—carved feet—five inch dials—double reading Weston volt-meter — 5 tube model. Size 34⅛" long—13¾" deep—11⅜" high.

$195.00

The Garod RAF

The receiver that made GAROD famous. Added mechanical improvements — 4 tube model — with which you are familiar. Size 19½" long—7⅜" deep—10" high.

$135.00

Power—to produce great volume.

Power—to bring in distant stations.

Power—to work through local stations.

Power—to moderate or intensify volume.

Power—to render the original quality of tone transmitted.

Power—to select programs.

Power—to get the best out of the program.

∿ ∿ ∿

These models have power plus—and then more power. They are full voiced—with tonal quality of exquisite timbre. They can be controlled to meet the capacity of the small living room, or manipulated to take full advantage of the acoustic possibilities of the large hall.

In every respect, they are worthy of bearing the name GAROD.

We are now ready to enter orders, and grant jobbers of standing, exclusive non-conflicting territories, where open.

NEUTRODYNE

SEE OUR EXHIBITS AT

First Radio World's Fair
Madison Square Garden, New York
September 22 to 28, 1924

Third Annual Chicago Radio Show
Coliseum, Chicago, Ill.
November 18 to 23, 1924

The GAROD *Corp.*
120 Pacific Street, Newark, N.J.

Astonishing Performance for the Price

Four Tube Set

$75.00

Five Tube Set

$120.00

Goldcrest Cleartone Radio sets in four and five tube sizes will give you more volume, more distance and more selectivity than anything offered at anywhere near the price. You will find that on the average you must pay 40 per cent more to get sets that equal them.

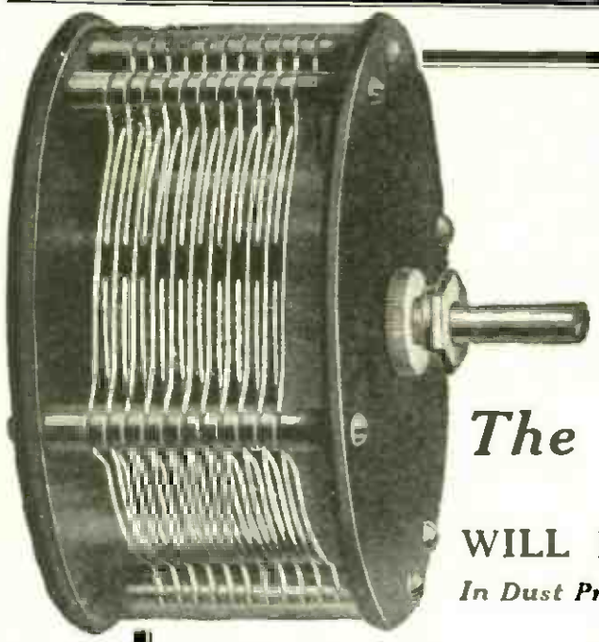
Examine the materials and you will find them the best—good condensers, moulded sockets, Formica base panels—and neat, accurate and clean cut wiring.

The high grade mahogany cabinets and brass panels give them the finest possible appearance.

JOBBERS and DEALERS: Test the Cleartone and your own judgment will tell you it offers a wonderful selling opportunity.

Model 60	$60.00	Clear-O-Dyne Model 71	$90.00
Model 61	75.00	Clear-O-Dyne Model 72	135.00
Model 62	120.00	Clear-O-Dyne Model 80	120.00
Clear-O-Dyne Model 70	75.00	Clear-O-Dyne Model 81	190.00

The Cleartone Radio Company, :: :: Cincinnati, Ohio.



Complete with separate vernier attachment which may or may not be used, as desired.

LIST PRICES

18 Plate .0003	$4.50
22 Plate .0005	5.50
44 Plate .001	6.50

LIBERAL DISCOUNTS TO JOBBERS AND DEALERS

A Laboratory Instrument at a Commercial Price

NIAGARA MIGNON

The King of Condensers

with the red and blue edged plates

WILL MAKE THE BEST SET BETTER

In Dust Proof Enclosure that eliminates short circuiting

Perfectly Balanced Equal Element

Anti-Body Capacity ***Single Hole Mounting***

Tapered Watch Pivot Bearings

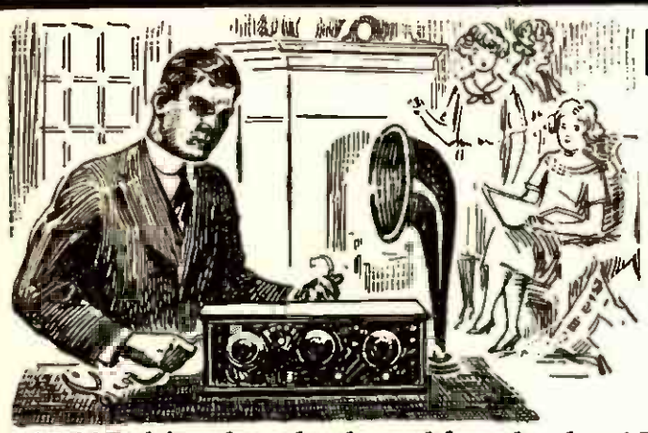
Only One-Half Depth of Ordinary Condenser

Vernier Variable

Can be bought wherever good radio equipment is sold, or will be sent prepaid upon receipt of price.

NIAGARA SALES CORP., 3 Waverly Place, New York, N. Y.

Be A Master OF THE Air



Pleasant Home Study

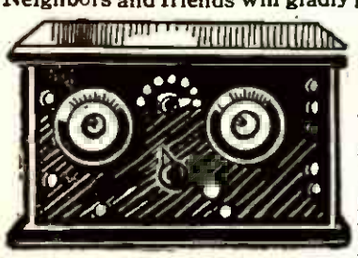
During the next few months you can, by devoting a few hours each week in pleasant home study, qualify yourself to get into the biggest paying field of all time. My practical, understandable course of instruction enables you to be a Master of the Air. Every problem in radio becomes an open book to you. *Be a Master of the Air and you will be a master of your future.*

$3,000 to $10,000 A Year as a Radio Expert

15,000 ships, hundreds and hundreds of Radio stations, with new ones springing up every day, are all keenly competing for the services of the radio-trained man. So enormous is the call for the radio expert that the man who knows his business in this field is in a position to *command* the size of his salary. On land or sea, in Government or private service, there are boundless fine paying opportunities for the man who understands radio problems and how to solve them.

RADIO *where* Knowledge is Power —And Power is Cash

I show you how to construct, install, operate, repair and sell radio equipment. Instead of being a spectator in this big game with big stakes, you become an active player. I qualify you to handle every branch of radio. There is nothing theoretical or practical that is not presented to you in complete, concise form. You are standing face to face with the greatest money-making chance ever presented to you. Will you turn your back on it or will you decide now, once for all, that you will get your share of the millions being divided among radio-trained men? Right in your own neighborhood you can make easy profits. Neighbors and friends will gladly give orders for sets and pay for advice on radio problems.



FREE 1000 Mile Radio Outfit

This set, when completed, has a range of over a thousand miles. I give it free with my course. I give you practical training by having you work on this set. The knowledge you gain is not mere book knowledge but is usable, practical experience. When you have finished my course, you can sell this set at a price that will more than pay the cost of the course.

A. G. MOHAUPT, B. A., M. S.
Head of the Radio Association of America. Graduate Electrical Engineer, University of Wisconsin. Former Radio Instructor for U. S. Government. Author of "Practice and Theory of Modern Radio."

I give my personal attention to every student taking my course. Your individual problems and questions are answered by myself. I work with you at every stage of the course, guiding you, directing you to your goal to be a Radio Engineer in the big pay class. My course prepares you to successfully pass Gov't examination for Operator's License.

QUICK PRACTICAL TRAINING

Everything in my course is clearly and simply stated so that you can easily understand every point I bring out. No previous experience or education is required. I give you fundamental and practical training in every angle of radio. There is no time to lose. Now is the best time to pass the other fellow by. Mail coupon today and get full information on my course, also details of the thousand mile set that I give free.

A. G. MOHAUPT, Radio Engineer
RADIO ASSOCIATION OF AMERICA
4513 Ravenswood Ave., Dept. 510, Chicago, Ill.

MAIL COUPON

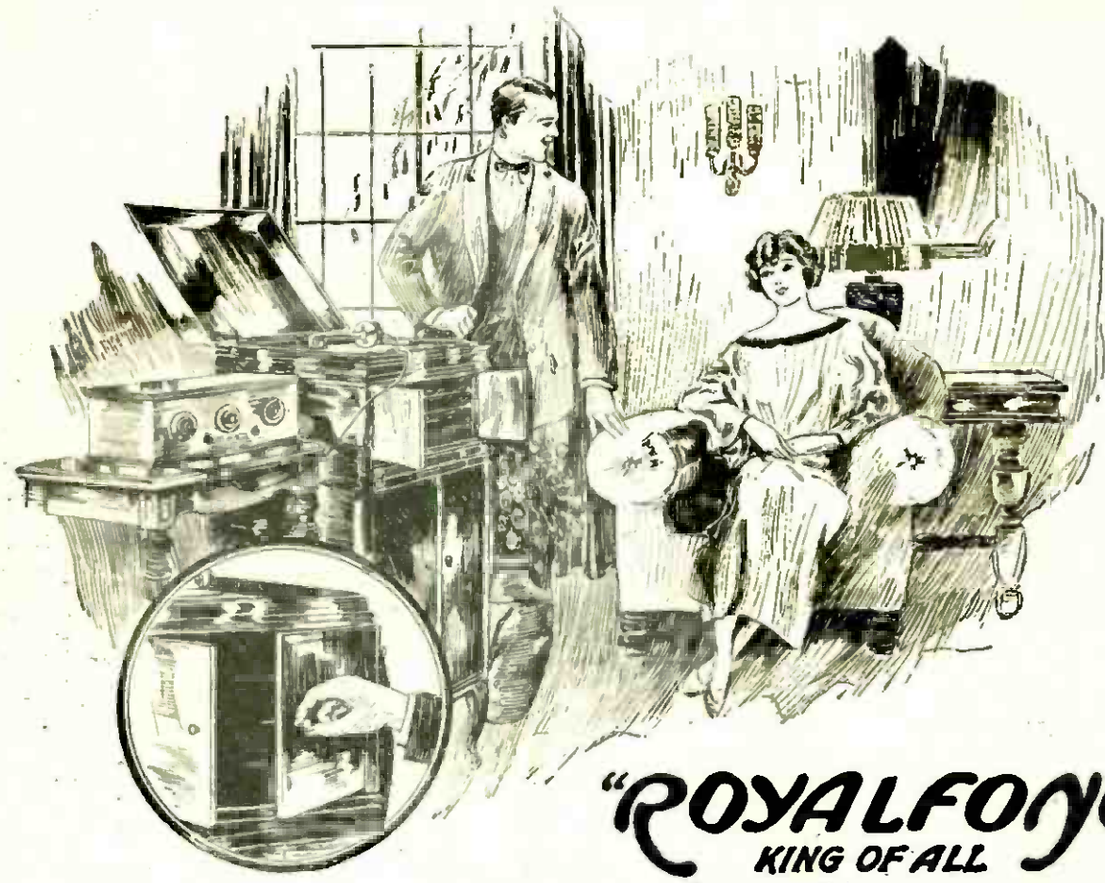
A. G. MOHAUPT, Radio Engineer,
Radio Association of America,
4513 Ravenswood Ave., Dept. 510, Chicago

Please send me details of your Home Study Course—also your Free "Radio Facts" and information on how I can get a FREE 1,000 mile Radio Set.

Name .....

Address .....

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

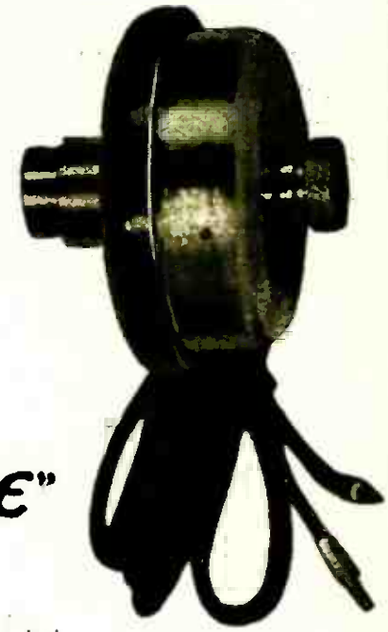


"ROYALFONE"
KING OF ALL

LOUD-SPEAKER UNIT

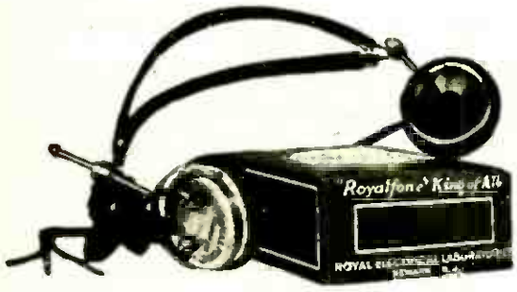
Adjustable for Tone Volume As Easily As a Phonograph

PERFECT reproduction at any tone volume—A NEW advantage in loud-speaker units. Simply turn the adjusting screw until the desired volume is attained—just as you open or close the door of your phonograph to control the volume. Balanced diaphragm overcomes every possible tendency toward distortion. The culmination of years of experience in the manufacture of reproducing apparatus. Makes any standard phonograph a high class radio reproducer. Also adaptable for regular loud-speaker horns.



Heavy Nickelplated Nozzle and Ample Connecting Cord

$5.00



"ROYALFONE"
KING OF ALL

HEADSET

The most comfortable headset you ever had on your head. Adjustable headband and other comfort features. Incorporates every vital improvement and feature of radiophone construction evolved to date.

List $4.50.

You can buy the *Royalfone Loud-Speaker Unit* and the *Royalfone* Headset direct by mentioning your dealer's name

Manufacturers and Jobbers of phonographs and loud speakers—write for interesting offer

ROYAL ELECTRICAL LABORATORIES

NEWARK NEW JERSEY

Simplified Blueprints

for the NEW Cockaday 4-Circuit Tuner

EACH set consists of three prints; (A) Panel Pattern; (B) Instrument Layout; (C) Wiring Diagram.

Panel Pattern.

This blueprint is the exact size of the actual set. So accurate that you need merely lay it on your panel and drill as indicated. You can readily appreciate the convenience of this Blueprint. No scaling to do, no danger of ruining the panel through faulty calculation.

Instrument Layout.

Again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet. Even the cabinet structure is clearly shown.

Wiring Diagram.

The unusual feature of this Blueprint is that it is a **full size picture diagram** of the finished set. Each instrument or other part appears exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

Blueprints Ready.

At the present time three sets of Blueprints are available and have been priced at the very low figure of $1.10 per set, postpaid. Each set consists of three Blueprints and we cannot break a set to supply single prints.

NEW Cockaday 4-Circuit Tuner with Resistance Coupled Amplifier. This five tube set, described in this issue of POPULAR RADIO, promises to be the sensation of the year. It is remarkably easy to build; cost does not exceed that of the ordinary three tube set; has only two tuning controls and one vacuum tube control; is absolutely distortionless and is unsurpassed in loud speaker volume and distance range. If you are going to build one of these new sets or are planning to rebuild your old three tube Cockaday Set you should secure a set of Simplified Blueprints to insure absolutely accurate results.

Set of three Simplified Blueprints . . . $1.10

We also have in stock Simplified Blueprints covering the following:

Non-Regenerative (Simplified Neutrodyne) **Tuned-Radio-Frequency Receiver,** described in the April, 1924, issue of POPULAR RADIO. Cost of parts about $70.00.

Audio-Frequency Amplifier, absolutely distortionless, described in the May, 1924, issue of POPULAR RADIO. Cost of parts about $45.00.

Any of the above sets of Blueprints will be mailed postpaid on receipt of $1.10.

POPULAR RADIO, INC.

627 West 43rd Street **Dept. 104** **New York City**

POPULAR RADIO, Inc., Dept. 104
627 West 43rd St., New York City Date.....

Enclosed is my remittance of $....., for which kindly send me Blueprint Set (s) consisting of Panel Pattern, Instrument Layout and Wiring Diagram as checked below:

- ☐ **NEW Cockaday 4-Circuit Tuner with Resistance-Coupled Amplifier.**
- ☐ **Non-Regenerative Tuned-Radio-Frequency Receiver.**
- ☐ **Audio-Frequency Amplifier.**

Name.....

Address.....

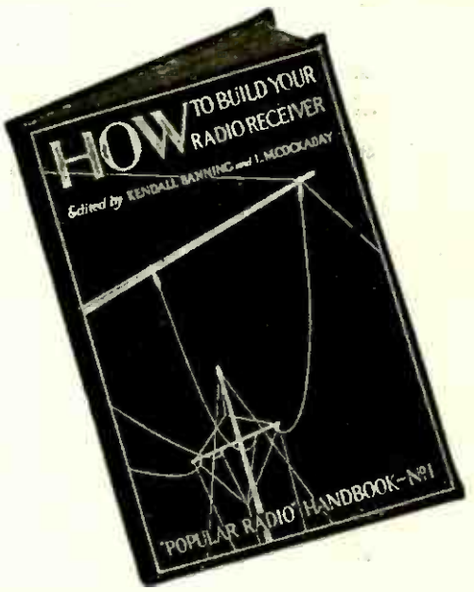
City..... State.....

Any one set of three Blueprints for $1.10; any two sets for $2.20; all three sets for $3.30

NOTE:

Dealers write for terms

FREE
WITH
POPULAR RADIO



A final opportunity is afforded to secure this valuable 100 page volume in substantial cloth binding at no expense.

Build Your Own

Why is interest in radio so universal? Because everyone can enjoy it. There is a type of receiving set within financial reach of every man, woman and child. Strange terms and complicated looking diagrams have given radio an air of mystery that it neither deserves nor in fact possesses. It was the purpose of the editors, Kendall Banning and L. M. Cockaday, to produce a book that would demonstrate the simplicity of radio in a practical way. Of the thousands who have written so enthusiastically about the sets they have constructed from the directions contained in this book, fully two-thirds had no previous experience or training.

You can do the same! By building your own you will save at least one-half of the amount that you would spend for a finished set. And there is no more fascinating pastime than the actual construction of a radio set.

Free Advisory Service

POPULAR RADIO is full of helpful suggestions as well as instructive and entertaining articles on radio and allied scientific phenomena. This information is supplemented by an advisory service that is free to all subscribers. Any problem you encounter that is not answered in the book or magazine will be answered by personal letter if you will submit it to the Technical Service Bureau. For this purpose a big, modern laboratory with a trained staff of investigators under Mr. Cockaday's personal direction are always at your service.

A Valuable Combination

For the next thirty days we will give you a copy of "How to Build Your Radio Receiver," FREE and enroll you for all privileges of the Technical Service Bureau at no further expense, on receipt of your remittance of $4.00 in payment for a 16 months' subscription for POPULAR RADIO. (As an alternative offer, if you wish the combination with POPULAR RADIO for 7 months only—send but $2.00). In any event, you run absolutely no risk as we will refund in full if you are not more than satisfied with your purchase.

In "How to Build Your Radio Receiver" you will find complete constructional diagrams, specifications, photographs and instructions for building the following sets. Each has been selected as representative of its circuit because in laboratory tests it proved the best for distance, selectivity, tone volume, simplicity of construction, ease in tuning, reliability and all-around satisfaction.

A $5 CRYSTAL SET

The simplest up-to-date set for local broadcast reception. Approximate range, 15 miles, though distances up to 400 miles are not extraordinary. Gives clear signals on headset without distortion. No operating cost whatever.

THE HAYNES SINGLE TUBE RECEIVER

An efficient set that may be made by a novice at an approximate cost of only $15 for parts. Simple to tune, selective, good audibility. Long distance range up to 1,000 miles on earphones. Six-volt storage battery and 22½-volt "B" battery required, or may be adapted for dry cells and dry cell tubes.

A TWO-STAGE AUDIO-FREQUENCY AMPLIFIER

This instrument may be added to any set, crystal or tube, to strengthen the received signals, so that they will operate a loudspeaker. It is easy to construct, efficient and inexpensive, costing only $15 for parts. Operates on the same "A" battery that is used on the vacuum-tube detector unit.

THE COCKADAY 4-CIRCUIT TUNER

A 3-tube set, famous for its high selectivity and beautiful tone. So neat and compact that it may be kept in a bureau drawer. Cost of parts about $40. Receiving range approximately 1,500 miles on a loudspeaker. Operates on a 6-volt storage battery and two 45-volt "B" batteries, or may be adapted to dry cells and dry cell tubes.

A 5-TUBE TUNED RADIO-FREQUENCY RECEIVER

Two stages of tuned radio-frequency amplification, detector, and two stages of audio-frequency amplification are here employed so that the possibility of "oscillation and re-radiation" is eliminated. The set can be operated on a loop antenna and may be built at a cost of only $90 for parts. Six-volt storage battery and two 45-volt "B" batteries required. Range about 1,000 miles on loop or indoor antenna, and 2,500 to 3,000 miles on an outdoor antenna.

THE "IMPROVED" COCKADAY 4-CIRCUIT TUNER

Probably the most important contribution yet made to the equipment of the radio fan. A compact 5-tube set with a receiving range of over 3,000 miles. Cost of parts about $95. Wave length range from 150 to 675 meters. Automatic tuning and power amplification. Maximum volume of sound, excellent reproduction and no interference. Requires a 6-volt "A" battery, three 45-volt "B" batteries, one 22½-volt "B" battery and a 9-volt "C" battery.

THE REGENERATIVE SUPER-HETERODYNE RECEIVER

More sensitive, more selective and more simple to tune than any other 6-tube receiver yet developed. A three-section, 6-tube set employing the Haynes Single Tube Receiver as tuner. May be further extended to a four-section, 8-tube set by the addition of the two-stage audio-frequency amplifier. The cost of parts approximates $100. Range of 3,000 to 4,000 miles on a loudspeaker. Has been called the "Rolls-Royce" of radio receivers.

POPULAR RADIO, Dept. 105.
627 West 43rd Street,
New York City.
Enclosed remittance of $4.00 is payment in full for a 16 months' subscription for POPULAR RADIO and copy of "How to Build Your Radio Receiver" FREE.

Name .....

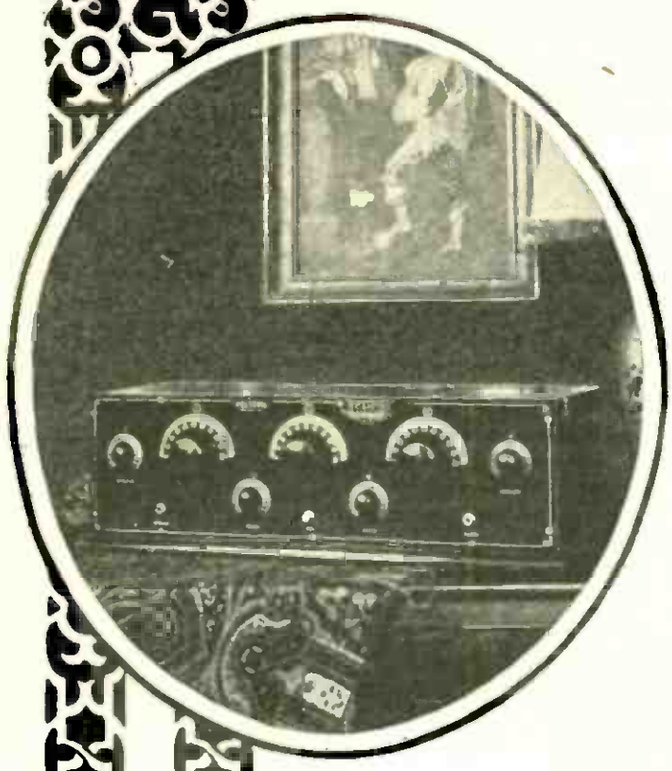
Address .....

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

☐ Check here and remit $2.00 if you prefer POPULAR RADIO for 7 months only in combination with "How to Build Your Radio Receiver."

POPULAR RADIO
627 West 43d Street :: New York City

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



RADIO ENJOYMENT

The A-C DAYTON POLYDYNE XL-5 is offered to those buyers of fine receiving sets who will demand, above everything else, positive CLEARNESS OF RECEPTION, insuring true radio enjoyment.

Of course, we have included every other requirement to be expected in a high grade receiving set.

With an XL-5 you can select your favorite program, be it orchestral or vocal music, a speech, or a dance orchestra and honestly enjoy listening to it. Radio reception with perfect clarity of modulation, minus disconcerting interference and distortion will be yours with this remarkable receiver.

We have also recognized the fact that a fine set must possess beauty in design and finish to harmonize with well appointed interiors.

The XL-5 comes to you with a triple guarantee of satisfaction and at a price that is more than reasonable. Do you know the A-C DAYTON dealer in your community?

Ask him for a demonstration, or write direct to us and we will see that he calls on you.

KNOCKED DOWN SET

The A-C Dayton XL-5 can be purchased in knocked down form, including all parts, with complete directions, for $72.50---($76.50 west of the Rockies).

Write for circular.

The A-C Electrical Mfg. Co.

DAYTON, OHIO

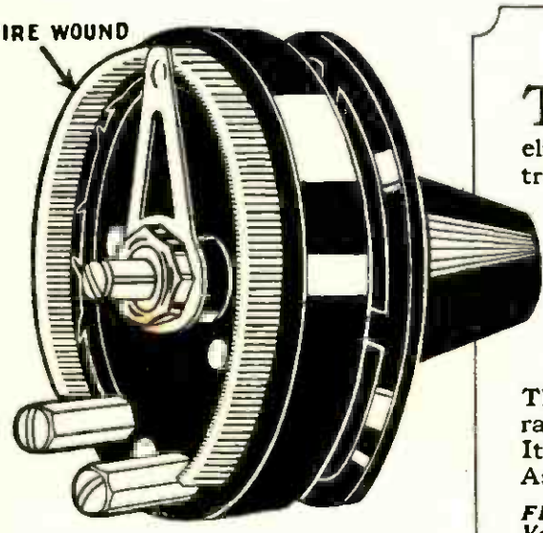
Makers of fine electrical equipment for twenty years

Reputable radio jobbers and dealers will be interested in our sales plan. Write for complete information.

Priced at $115.00, less tubes and accessories, the XL-5 is a wonderful value. (West of the Rockies---$120.00.)

A-C DAYTON XL-5

ROYALTY
VARIABLE GRID LEAK



Revolutionary!

THE ROYALTY Variable GRIDLEAK has revolutionized gridleak construction. It has eliminated at one stroke every source of gridleak trouble. It is a **wirewound** gridleak!

The lever arm **cannot** scrape away the resistance element, as it does in ordinary gridleaks, because of this wire winding. The ROYALTY variable GRIDLEAK is noiseless; it retains its resistance value indefinitely. It is absolutely non-inductive.

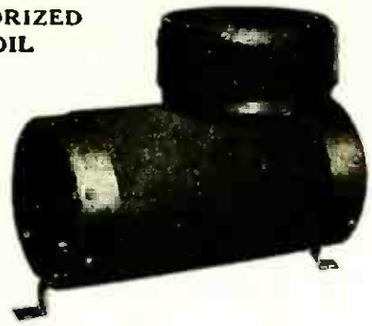
The ROYALTY Variable GRIDLEAK has a range of from 100,000 ohms to 7,000,000 ohms. It meets every gridleak requirement and more. Ask your dealer!

FREE—Write for hook-up booklets of ROYALTY Variable GRIDLEAKS and RESISTANCE UNITS.

WIRELESS PRODUCTS CORPORATION
136 Prince Street, New York City

THE ONLY AUTHORIZED COCKADAY COIL

$5.50



Used in

COCKADAY'S
4-Circuit Tuner

The features of the 4-Circuit Tuner are features of the Authorized Cockaday Coil. Selectivity, greater volume, sharp tuning and maximum sensitivity are integral qualities of both.

The Authorized Cockaday Coil is made in strict accordance with specifications of Laurence M. Cockaday, inventor of the famous Cockaday Four Circuit Tuner. Wound on hard rubber tubing, ⅛ inch wall, with No. 18 D. S. C. copper wire which insures the best results. Guaranteed.

At your dealers, otherwise send purchase price and you will be supplied postpaid.

PRECISION COIL CO., Inc.
209-B Centre Street New York City

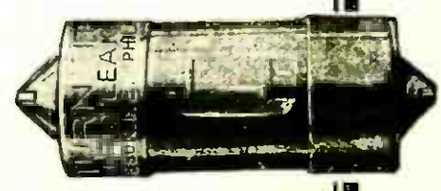
TURN-IT
ADJUSTABLE GRID LEAK

Changes the Range of Resistance to Suit the Strength of Reception

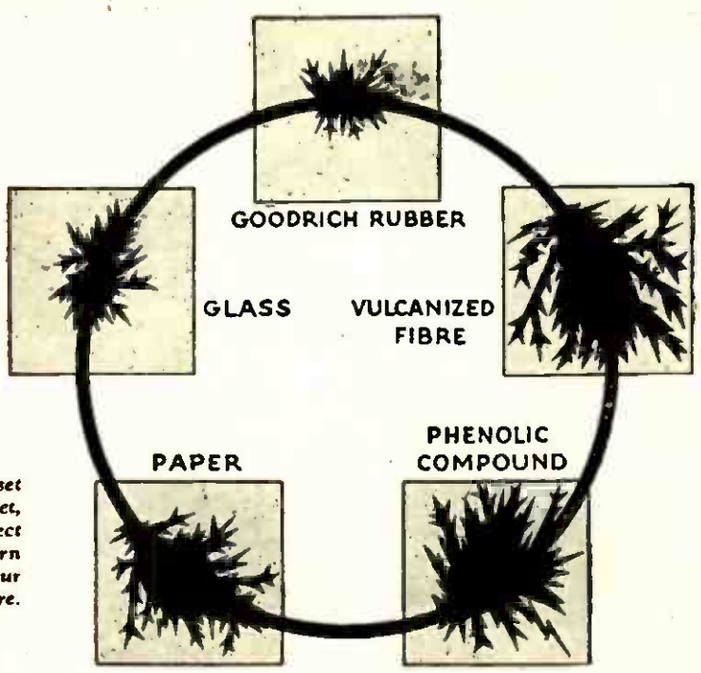
Constructed along entirely new lines which avoid all use of graphite or carbon and the microphonic noises generally attending the use of these materials. Turn-It greatly increases the volume, secures greater distance and reduces noises in your set.

A Turn-It gives constant and undiminished satisfaction. There is nothing to wear out.

Absolutely guaranteed.



TURN-IT GRID-LEAK IS ONLY $1
At Your Dealers or Direct from us
TURN-IT RADIO SALES, Inc.
30 Church St., N. Y.



Before you build your set write for our new booklet, "Rubber for More Perfect Radio Reception." Learn how rubber can improve your set and add to your pleasure.

Science says use Hard Rubber Panels *to avoid* Dielectric Losses

DIELECTRIC losses reduce range and selectivity. Use hard rubber radio panels in building your set and minimize these losses. Hard rubber—the chart shows—has the lowest dielectric losses.

And more, it is easily worked with ordinary tools—more moisture-proof—and less expensive.

Goodrich Radio Panels give you all basic hard rubber advantages—and more!

- Won't warp from the heat of tubes because their softening point is 25° Fahr. higher than that of usual hard rubber.
- Permanently retain their rich, glossy finish because of a much lower free sulphur content.
- Conserve all electrical properties because of lower moisture-absorption.

So ask for Goodrich! Two attractive colors—black and mahogany. All standard sizes—individually packed.

THE B. F. GOODRICH RUBBER COMPANY
Akron, Ohio ESTABLISHED 1870

Goodrich HARD RUBBER *Radio Panel*

Quality plus Service since 1915

C-12 — Similar to C-11 with standard base

C-11—1.1 Volt .25 amp. Dry Battery Det. and Amp. Special Base

C-299—3 Volts .06 amp. Dry Battery Det. and Amp.

C-300—6 Volts Gas Content Detector

Cunningham RADIO TUBES

For Clear Reception

To perfection in design are added the productive resources and scientific skill of the great General Electric Laboratories. The result—a series of Radio Tubes that give peak satisfaction in detection, amplification, and rugged long life.

Amazing accuracy governs every step in Cunningham manufacture. Testing is carried to extremes in order to give to every purchaser a tube as nearly perfect as is humanly possible. Knowledge of Cunningham methods and policies is the answer to the why and wherefore of Cunningham preference.

PRICE THE SAME ON ALL FIVE TYPES
C-301A C-299 C-300 C-11 C-12

PATENT NOTICE

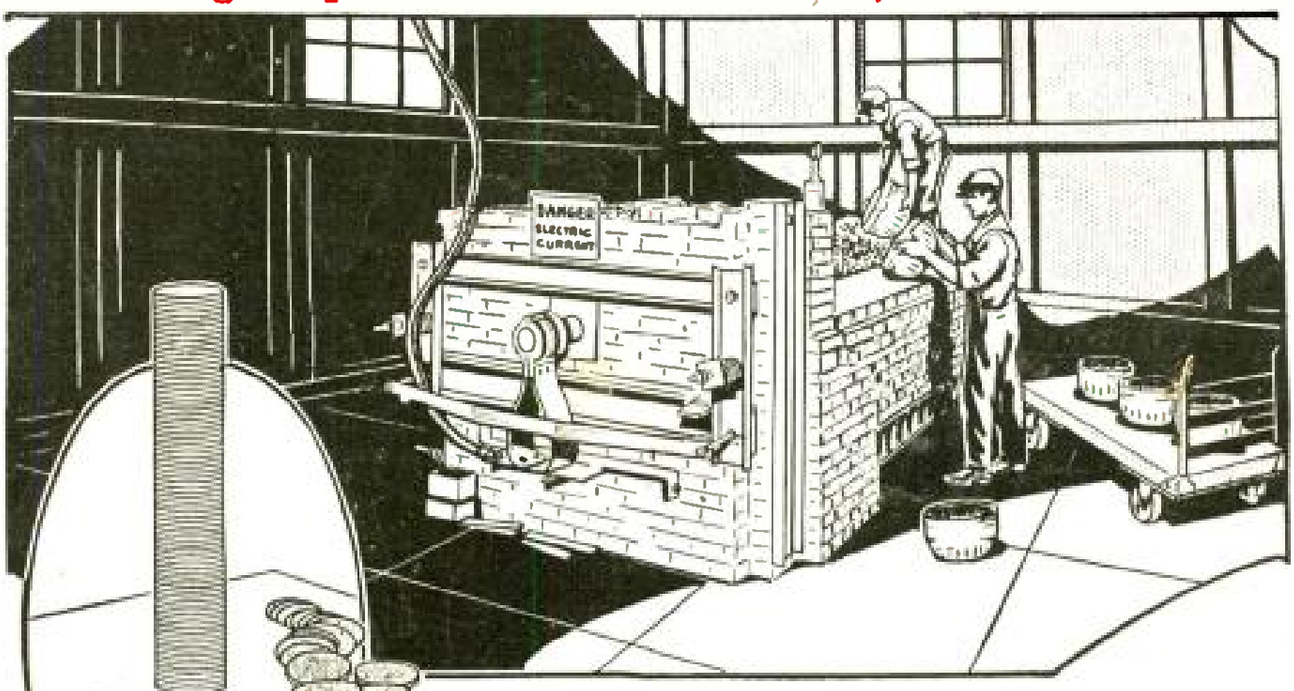
Cunningham Tubes are covered by patents dated 2-18-08, 2-18-12, 12-30-13, 10-23-17, 10-23-17, and others issued and pending. Licensed only for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

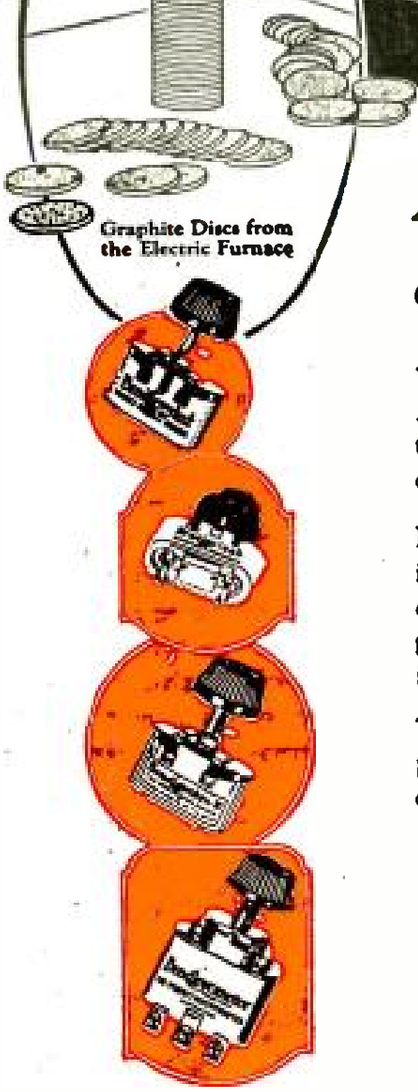
C-301A—6 Volts 1/4 amp. Amplifier

E. T. Cunningham Inc.

Branch CHICAGO — HOME OFFICE 182 Second Street, San Francisco — *Branch* NEW YORK

Producing Graphite Discs in Allen-Bradley Electric Furnaces





Graphite Discs from the Electric Furnace

Allen-Bradley Radio Products are the best insurance against trouble

FINE, stepless control is not the only distinctive feature of Allen-Bradley graphite disc radio devices. It is true that with no other type of rheostat can you enjoy the noiseless, stepless, selective control of the Bradleystat. No adjustable grid leak can equal the Bradleyleak.

But there also is the inherent reliability of the graphite discs, produced in the terrific heat of the electric furnace, and encased in porcelain containers that cannot warp. Atmospheric changes mean nothing to graphite discs. Corrosion cannot destroy them. Continuous use cannot impair their perfect operation.

The slight extra cost of Allen-Bradley radio products is an insignificant premium on insurance against interrupted radio reception. Think this over! The quality endures after the price is forgotten.

Allen-Bradley Co.
Electric Controlling Apparatus

287 Greenfield Ave. — Milwaukee, Wis.

Manufacturers of Graphite Disc Rheostats for more than 20 years

ALLEN-BRADLEY CO.
297 Greenfield Av.
Milwaukee, Wis.

Please send me descriptive leaflets on Allen-Bradley radio products.

Name.....

Address.....

Radiotron
WD-11

The Tube *means* Music or Noise

All Radiotrons now reduced to $4.00

It isn't a genuine WD-11 unless it's a Radiotron.

It isn't a genuine WD-12 unless it's a Radiotron.

It isn't a genuine UV-199 unless it's a Radiotron.

It isn't a genuine UV-200 unless it's a Radiotron.

It isn't a genuine UV-201-a unless it's a Radiotron.

Buying anything but the best in vacuum tubes is like trying to run a car on gas that is half water. In radio, everything, in the end, depends upon the Radiotrons. You can put perfectly good Radiotrons in a poorly made set—that's true. But the point is that the very finest receiver made can be no better than its tubes. This is no new or startling announcement. Everyone knows it. And that's why, at the radio counter, you see each man pick up a Radiotron and look at the base for the word "Radiotron", and at the glass for the "RCA" mark. For best reception—real music—nothing short of the best in tubes will do.

Radio Corporation of America

Sales Offices, Suite No. 410

233 Broadway, New York — 10 So. La Salle St., Chicago, Ill.

433 California St., San Francisco, Cal.

RCA

This symbol of quality is your protection

Radiotron

REG. U. S. PAT. OFF.