Popular Radio

Edited by KENDALL BANNING

25¢

NOVEMBER
1924

How to Build a Low-Loss Tuner for Short Wave Reception

"Are those Tubes Genuine?"

The question is heard at every radio counter: "Is it a genuine Radiotron?" Almost every dependable manufacturer uses genuine Radiotrons in his sets. Everyone who builds his own knows enough about radio to know that nothing else but the genuine will do. And the man who replaces used-up tubes in his set knows that to get the same performance, he must have the same tubes—genuine Radiotrons only. So everybody asks "Is it genuine?" And asks to see the marks that prove it—the name "Radiotron" and the "RCA" mark.

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.

Radio Corporation of America

Sales Offices

233 Broadway, New York 10 So. La Salle St., Chicago, Ill. 433 California St., San Francisco, Cal.

This symbol of quality is your protection

Radiotrons

REG. U. S. PAT. OFF.

Table-Talker

Keep in Touch with National Events

The final desperate spurt as the Presidential campaign draws to a close! The returns as they pile up on election night. Great speeches and vital messages—the inaugural address, the later congressional messages—hard, slow reading, but easy to listen to—with a *Table-Talker.*

And, too, there's everything from football to recipes, from grand opera to market reports, from prize fights to bedtime tales. All brought to your home—shared with your family and your friends by the *real* reproduction of the *Table-Talker.*

PRICE

$10

Brandes

The name to know in Radio

Superior $6 Matched Tone Headset $7 in Canada

Table-Talker $10. 50¢ extra west of the Rockies In Canada $12.50

Navy Type $8 Matched Tone Headset $9 in Canada

POPULAR RADIO

EDITED *by* KENDALL BANNING

CONTENTS *for* NOVEMBER, 1924

(Cover design by Frank B. Masters)

VOLUME VI NUMBER 5

DEPARTMENTS

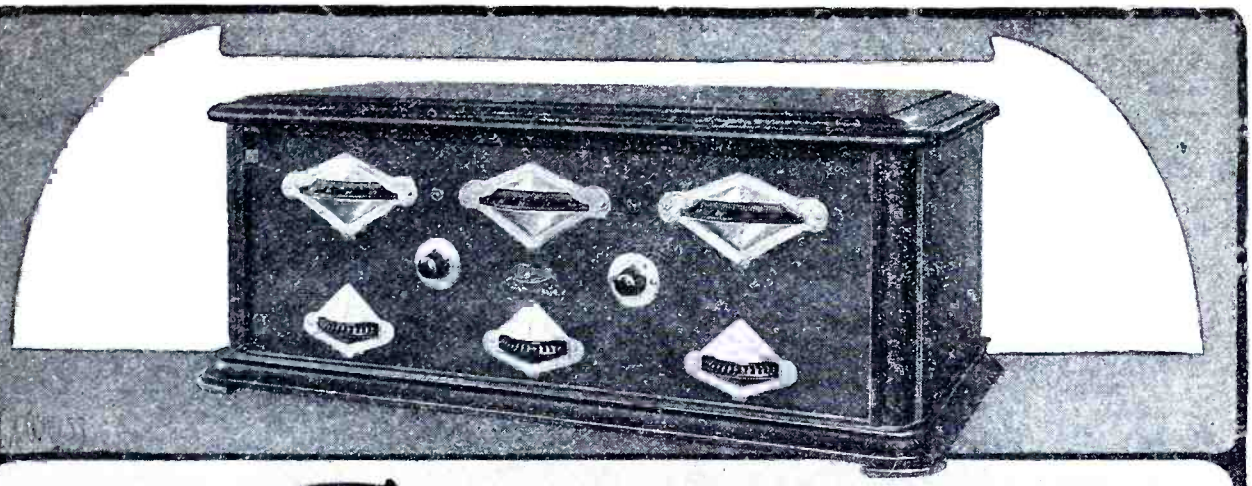
VOLUME VI NOVEMBER, 1924 NUMBER 5

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

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



GREBE SYNCHROPHASE

TRADE MARK

"If a house is crammed with treasures of gold and jade, it will be impossible to guard them all."
—Lao Tzu

Of worth far greater than things of gold and jade is your Grebe Synchrophase. Highly will you treasure it; zealously will you guard it.

Doctor Thu

THE high degree of selectivity and over-all efficiency attained in the design of the Grebe Synchrophase is rivalled only by its rare craftsmanship and thorough ease of dependable operation.

Write for literature

A. H. GREBE & COMPANY, INC.
Van Wyck Blvd., Richmond Hill, N.Y.
Western Branch: 443 So. San Pedro St., Los Angeles, Cal.

GREBE RADIO
TRADE MARK
REG. U.S. PAT. OFF.

All Grebe apparatus is covered by patents granted and pending.

PAGES WITH THE EDITOR

IN the next number of POPULAR RADIO will be published the first, detailed, "how-to-build" description of the very latest word in superheterodyne receivers—the remarkable "foolproof" superheterodyne that operates on new principles. It has been developed in the experimental laboratory of the Signal Corps in Washington.

* * *

THE article has been written by Capt. Paul S. Edwards, in co-operation with Mr. J. H. Pressley, the technical expert of the Signal Corps. Both of these scientists and inventors are responsible for the development of this new receiver. And both of them were associated during the war with Edwin H. Armstrong, also a Signal Corps officer, who developed the famous Armstrong circuit.

* * *

AND in the January number will be published Laurence M. Cockaday's article descriptive of his new superheterodyne reflex—a receiver on which he has been working for many months, and concerning which a more detailed announcement will be made next month.

* * *

THE steady growth of POPULAR RADIO has been largely attributed to articles of just this kind—articles that constitute real contributions to the literature of radio because they treat of radio apparatus that themselves constitute real contributions to the art and science of radio. And much of this apparatus (like the four-circuit tuner, for example) has been developed in the POPULAR RADIO LABORATORY.

* * *

"WE do not expect to settle all great questions at once," once wrote a country editor, "but the long-standing controversy concerning the efficacy of prayer will be finally disposed of for all time ere our next issue: we are asking the Lord to 'send us 10,000 subscribers next week."

* * *

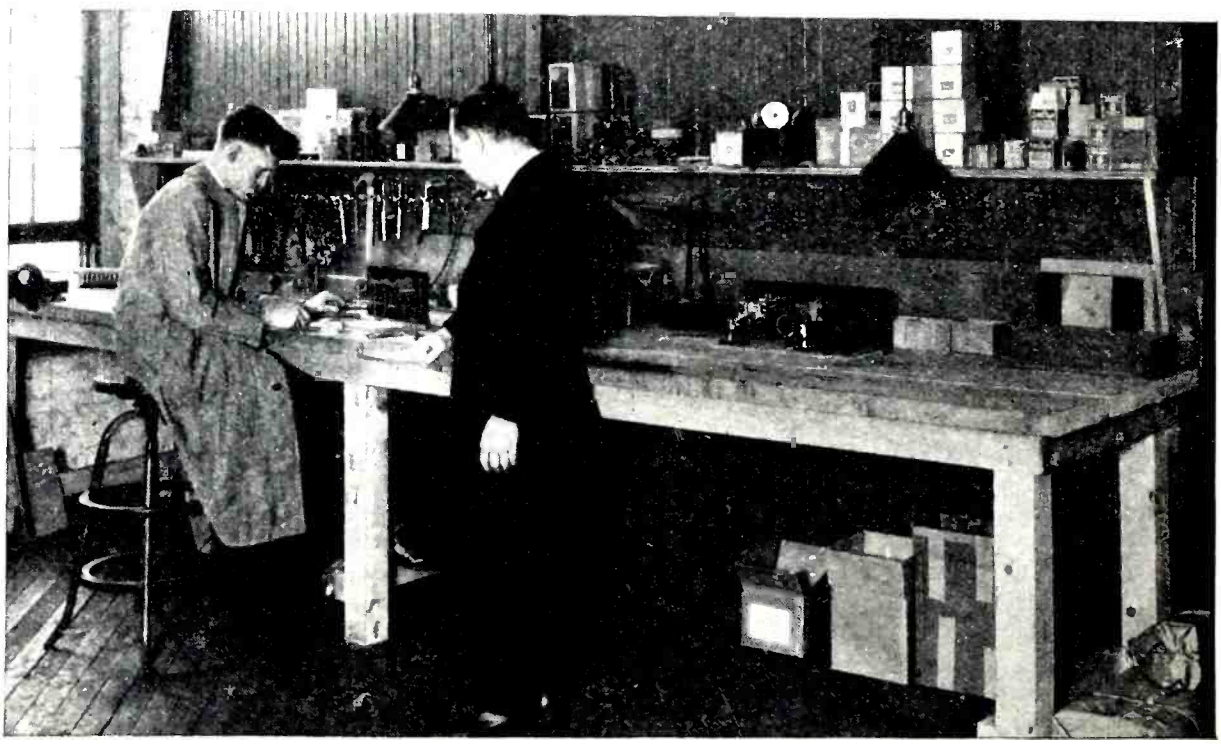
ARTICLES like the Cockaday and Edwards articles are something in the nature of POPULAR RADIO'S prayers. And the Editor will be something more than surprised if each of these valuable articles does not add considerably more than 10,000 readers to the magazine!

* * *

IN the face of the recent activities of the various censorship bodies and reformers who seek to muzzle our press, gag our drama, edit our films and in other ways to enforce by prosecution and by persecution their own particular brand of morality upon others, the article on page 433, "Will We Have a Radio Censorship?" by James H. Collins, the well-known author, comes with timely significance.

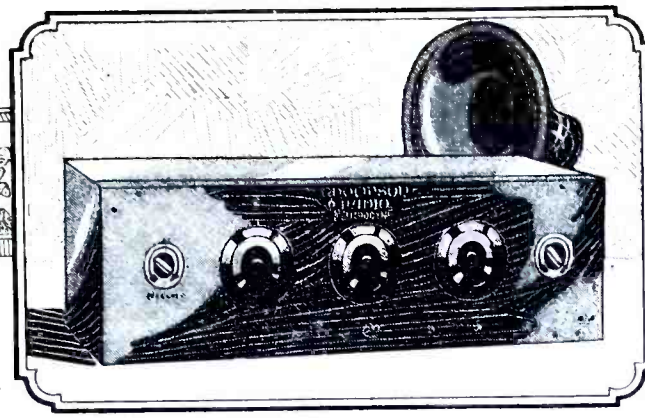
* * *

(*Continued on page 6*)



WHERE THE *POPULAR RADIO* EXPERIMENTAL SETS ARE CONSTRUCTED

Constructional details for receiving sets are worked out on this bench in the POPULAR RADIO LABORATORY. *Here experimental sets are built in order to try out the functioning and adaptability to home construction of the various radio parts that are used in the descriptive articles.*



"EXPERIENCE IS THE VITAL FACTOR IN EXCELLENCE"

THOMPSON RADIO

Thompson radio products are as fully developed and as standardized in radio as is the telephone in wire communication. Thompson owners do not worry about how their set and speaker will compare with "next year's model." Perfection remains Perfection.

Thompson simplicity of operation as well as Thompson range and power makes it possible to receive the desired radio program just exactly as it is given before the microphone. Those who wish *real* radio entertainment at low cost will be decidedly interested in the Thompson Neutrodyne Radio Receiving Set—*NOW* $125—and the Thompson Speaker—*NOW* $28.

The fully developed Thompson Radio Products at such reasonable prices are possible only to an organization that has been making radio products *exclusively* for many years.

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

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.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

(*Continued from page 4*)

A "CENSORSHIP DRIVE" which has been launched by these self-appointed guardians of our welfare has been met successfully by the publishing as well as by the theatrical and motion picture interests. A periodic show of activity on the part of these censors is expected and perhaps inevitable; they are hired by privately contributed funds for this purpose and they must earn their wage.

* * *

RADIO is opening up too large a field to be long ignored by the professional reformer. Just as he has attempted to dictate what we should and should not read and see and know, so he will attempt to dictate what we should and should not hear—and to enforce his opinions by legislation if he can.

* * *

DOUBTLESS, this subject of radio censorship will come up for discussion at the Third National Radio Conference in Washington and, when it does, it may be safely assured that the conferees will concur with the Secretary of Commerce, who has already announced himself as opposed to any form of official radio censorship.

* * *

AND in the long run the Editor believes that public opinion can alone successfully determine what should or should not be broadcast.

* * *

IN the article on the four-circuit tuner with resistance-coupled amplifier which appeared in POPULAR RADIO for October, the cost of the parts necessary to make the receiver was given as $55.00. This figure was a typographical error—the cost of the parts is $65.00.

* * *

"IT is always a mistake," a well-known and successful dramatist once told the Editor, "to write *down* to your audience. Write *up* to it. It is seldom safe to assume that your audience has less intelligence than you have, and it is never safe to let it know it!"

* * *

THE problem of the Editor, however, is a bit different. And it is different in this one and important particular; the readers of POPULAR RADIO include both the experienced technical experts as well as the inexperienced beginner. And each issue of the magazine must contain reading matter of interest and practical helpfulness to both groups.

* * *

IT was with this purpose in mind that the Editor introduced into POPULAR RADIO, for the special benefit of the novice, the "picture diagram" that even the most inexperienced beginner can comprehend.

* * *

OF course, these "picture diagrams" are scorned by the more experienced amateur who has learned how to read the radio symbols as easily as he reads type.

* * *

"YOU did well in adhering to the symbolic type of diagram," writes Herman P. Roth of Olivet, Michigan. "This type of diagram is ten times easier to read and interpret than the so-called 'picture diagrams.' I recently discontinued my subscription to a magazine which adopted the picture diagrams. That magazine also adopted the policy of presenting most of its material in picture form, obviously on the supposition that the average reader is unable to get the full benefit from a good magazine article, technical or otherwise."

* * *

OF course, the Editor believes that the "average reader" of POPULAR RADIO is quite a bit more intelligent and more exacting than the reader of any other radio periodical; that is one reason why POPULAR RADIO has adopted the standard symbols in its radio diagrams.

* * *

BUT in each issue, POPULAR RADIO publishes an article for beginners only—(like the article "How to Build an Efficient Crystal Receiver" on page 467 of this number, for example)—and for their guidance the picture diagram is employed.

* * *

SO, when the experienced reader comes to that article, he may skip over it hastily—and find on page 486 an article, "How to Build a Low-loss Tuner for Short-wave Reception," that is closer to his calibre.

* * *

EVERY mail brings increasing evidence of the enormous—and growing—popularity of the four-circuit tuner, perhaps better known as the "Cockaday Circuit."

* * *

THIS remarkably valuable contribution to the radio art was developed by Laurence M. Cockaday in the POPULAR RADIO LABORATORY, and the first announcement of it was made in POPULAR RADIO for May, 1923. Since that date it has been estimated that over 1,000,000 Cockaday sets have been built—from plans published in this magazine.

* * *

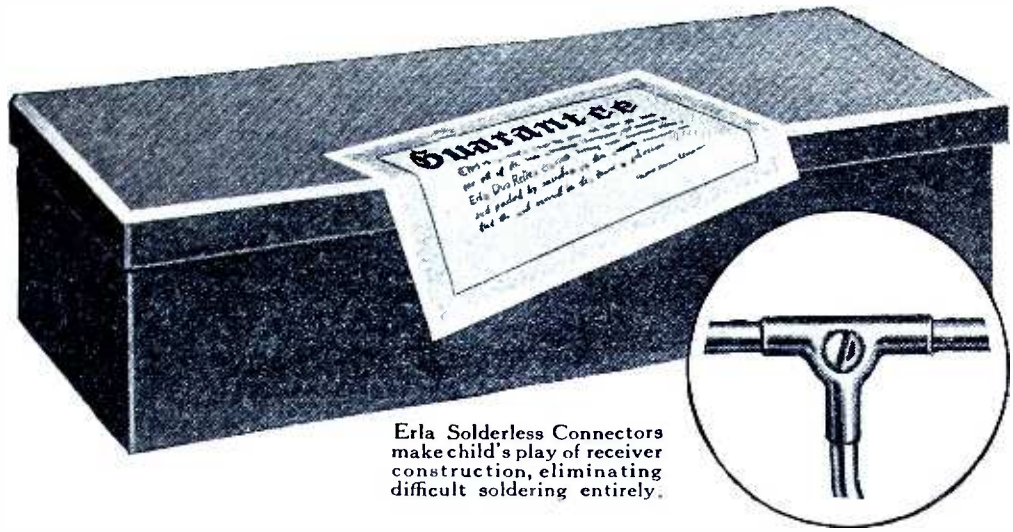
OUT of the mail bag the Editor picks the following letter—not at random, but as a specimen of the representative reports that enthusiastic radio fans send in:

* * *

"I HAVE a Cockaday Improved Four-Circuit Tuner," writes Robert Graham of Seattle, "built from your prints. If there is a set in Seattle that will touch it I have failed so far to see it. No other set here can touch it—this after a series of exhaustive tests in every condition and location. Seattle is considered to be a bad location for reception, yet I can consistently bring in Chicago and other more distant stations on the loudspeaker *in the daytime*."

Kendall Banning

Editor, POPULAR RADIO



Erla Solderless Connectors make child's play of receiver construction, eliminating difficult soldering entirely.

Build Most Efficient Circuits By Methods Most Advanced

With lowest dielectric and resistance losses ever known, Erla Miniloss Condensers, with new compensating plate form, lead in efficiency. 5 to 41 plates, $3.50 to $5.50.

Smoothness, excess capacity, freedom from noises distinguish Erla Precision Rheostats and Potentiometers. Rheostat, $1.10—Potentiometer, $1.25 and $1.40

In frosted silver or gold, with Bakelite knob proportioned for utmost delicacy of touch, Erla Dials improve any receiver. 2", 3", 4" dia. ¼" shaft. Prices 50c to $1.25.

A thousand and one circuits and theories have been dangled before the amateur radio builder. Erla engineers, from the beginning, dedicated themselves to creating those particular circuits which the radio public could select as the last word—circuits with the inherent superiority to *remain* in the forefront of radio advancement.

From this fixed purpose came Erla Duo-Reflex Circuits, rated the most powerful in radio, tube for tube. Now research and development have intensified every original Erla advantage in the latest Erla circuits, ranging from one to five tubes, in loop and antenna models. Beyond present Erla perfection it is not possible to go in range, volume, tonal purity, selectivity or ease of control.

These very finest circuits are now also easiest to build! Available in factory-sealed cartons, under warranty, are the complete Erla Knockdown Receivers, ready for correct assembly, in truly professional manner, by anyone, with pliers and screwdriver only.

Erla precision apparatus, vital to matchless Erla results, is furnished complete, right down to Erla solderless connectors, which banish soldering. The panel is drilled and lettered, while the baseboard is stenciled, correctly locating every unit and connection.

You yourself, therefore, can construct the most advanced radio circuits, by the most efficient and most economical method, confident that your receiver, sponsored by Erla, is unsurpassed. Ask your dealer, or, if writing direct to us, give dealer's name.

ELECTRICAL RESEARCH LABORATORIES
Department R, 2500 Cottage Grove Avenue, CHICAGO

ERLA

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

The Service Behind OZARKA Makes This Distance Possible

Pittsburgh, Pa.
Ozarka, Inc.
Chicago, Ill.
Gentlemen:—I want you to know that I think I have received the greatest distance possible on my Ozarka—KGU, Honolulu, Hawaiian Islands.
A great many friends who have radio instruments of all kinds and bought at all kinds of prices, but no one in this city to my knowledge ever received from such a great distance. To say that I am pleased with my instrument is putting it mild. Yours very truly,
H. J. R.

Alden Bridge, La.
Ozarka Incorporated,
Chicago, Ill.
Gentlemen:—A few nights ago I heard the beautiful Hawaiian Orchestra, direct from Honolulu, territory Hawaiian. When you consider the distance that this is from Alden Bridge, I certainly think it ought to be a record. This music came in beautiful and clear, in fact, it could not have been any better.
Yours very truly,
W. H. B.

Nashville, Tenn.
May 14, 1924
Ozarka Inc.
Chicago, Ill.
Gentlemen:—I consider my best night when I successfully connected in with the following stations: CKAC - Montreal, KGU - Honolulu, WBAP - Fort Worth, WGN - Chicago, WBZ - Springfield, WOAI - San Antonio, KDKA - Pittsburgh, WCAL - Northfield, Minn., WFAA - Dallas, WGY - Schenectady. On a recent night Station KYW - Chicago gave a special program lasting all night.
Yours truly,
O. C.

Why Ozarka Receives from Honolulu

OCCASIONALLY some owner of a radio instrument receives from London, England. But did you ever hear of any one receiving Honolulu, Hawaiian Islands? We will gladly give you the names of the writers of the letters reproduced here, as well as send copies of many letters showing how other Ozarka owners have had results from London, England, Cardiff, Wales and Glasgow, Scotland.

These cases are exceptional, of course, but they must prove to every thinking person that the Ozarka is the greatest distance receiving instrument known today.

In the ownership of an Ozarka Instrument, you are assured of not only the last word in radio, but you will receive expert service, which is far more important than the instrument itself. This is a point you should keep well in mind when you buy radio. Be absolutely sure that the person or firm from whom you purchase is thoroughly capable of keeping that particular instrument in perfect condition. The situation in Radio is exactly the same as that of the automobile. Both are mechanical—both have little things go wrong at times, and both are quickly and easily fixed by the man who knows how.

The Ozarka Radio instrument is sold only by trained factory representatives who know every part, every wire of this instrument. Before he can wear the Ozarka gold button he must satisfy our engineers that he is thoroughly capable of delivering trained service.

4 Tube Ozarka Radio $39.50 and Up

The Ozarka representative will gladly set up this Ozarka instrument in your own home on trial. He will not make any claims but will let you operate it and prove to yourself that it absolutely has no equal for volume, tone, distance and ease of operation. This will not obligate you in any way.

And as for price, you will, no doubt, be agreeably surprised because Ozarka Four Tube Instruments, for loud speaker operation, are sold as low as $39.50.

Let us send you more information about Ozarka, including hundreds of letters giving the most marvelous results ever received on a radio instrument. Drop us a card for our free illustrated book No. 200. Please give name of your county.

More Men Wanted To Sell Ozarka

RADIO offers today an exceptional opportunity for the right kind of a man to build up a permanent, substantial and profitable business of his own. Ozarka factory representatives are today building up very satisfactory incomes for themselves.

In territory which is not now covered there is still an opportunity for a mechanically inclined man who is willing to place himself under our training. We can show such a man how it is possible, to build up a business in his own town, possibly in spare time to start with, but sooner or later will justify giving it all of his time.

We are looking for men who realize that there must be some way of improving their condition. We prefer men who know absolutely nothing about radio, because we can then train them according to our own method.

The man we are looking for has a good reputation, is well and favorably known in his community, may not be a salesman but can talk convincingly on something he knows perfectly and firmly believes in.

The Ozarka Plan will give such a man his first real opportunity to establish himself in a business of his own. Investment of money is small but necessary.

All we must make sure of is that you are determined and willing to put forth the effort. If you will do this just 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.

This Button identifies Ozarka Representative in your city—your assurance of complete radio satisfaction

OZARKA, Inc., 806 Washington Blvd., CHICAGO

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Underwood & Underwood

"POPULAR RADIO *plays an important part in the development of radio," writes Senator Marconi*

"THE United States of America has the honor of being the first country in which broadcasting became a regular feature of daily life, the widespread interest aroused being largely fostered and extended by the excellent periodicals which have devoted themselves to the interests of wireless. It therefore, gives me very great pleasure to offer my cordial congratulations to POPULAR RADIO and to wish it well for the future."

G. Marconi

Underwood & Underwood

How Radio Is Electing Our President

When the present-day campaigner "takes the stump" he reaches an audience estimated as high as 25,000,000 people—nearly a quarter of our population. This was the approximate number of listeners who heard Frank W. Mondell notify President Coolidge of his re-nomination—and heard the President accept. *(See page 446.)*

Popular Radio

VOLUME VI NOVEMBER, 1924 NUMBER 5

WILL WE HAVE A RADIO CENSORSHIP?

The voice of the grim Puritan has already attempted to dictate what we shall and shall not be permitted to see on the screen or on the stage, and what we shall and shall not be permitted to read in our books and periodicals. Will he seek to dictate what we shall hear?

By JAMES H. COLLINS

"YOU turned him off!"

"I didn't—he wasn't there!"

"I've told you a million times not to touch the dials after anyone stops speaking or playing—you turn them off and then can't turn them in again."

"I tell you he wasn't there! You couldn't miss anything on WEAF in this part of town. Why, we're right under its antenna!"

"That was the only thing in tonight's program I really wanted to hear," scolded the disappointed wife, "and you had to go and monkey with the radio and lose it!"

"I tell you he wasn't there!" insisted the husband.

Thus they battled that Sunday night, some months ago, when James K. Hackett, the eminent Shakespearean actor, was on the program to give readings from Shakespeare at WEAF in New York City.

The announcer had spoken of Mr. Hackett's triumph as "Macbeth" in London and Paris, and then introduced the veteran actor-manager. Instead of beginning his readings, however, Mr. Hackett spoke of certain newspaper critics in New York City who had pronounced "Macbeth" a dull melodrama and declared it out of date.

"Such an opinion is not new," he said, "for it has been voiced before, and invariably at a period when the English stage was at a very low artistic ebb."

The actor seldom has an opportunity to answer his critics. With an unseen audience of perhaps a million people, Mr. Hackett took this opportunity to defend, not himself, but Shakespeare. Most of his allotted time

was consumed by this talk, fervent but in no way biased. Finally the listeners who wanted to hear him read Shakespeare chirped up when the speaker said:

"I am told that I have been announced to give readings from Shakespeare, therefore, if you will kindly wait a few moments I shall read portions of scenes from the fifth act of "Macbeth." Just five seconds please."

It was at this point that the wife sat up to listen, and the husband touched the vernier just a shade to give the actor better reception. Five seconds passed—ten seconds—thirty seconds—a minute—two minutes— Not a sound came from the loudspeaker. The husband plugged in with headphones, but still there was silence—or nothing but the echo of a distant jazz band. He turned the dials, at first cautiously, then anxiously hoping to catch at least part of the Shakespearian readings. Still only silence. Then the controversy began, and was interrupted by the voice of WEAF'S announcer, saying that Mr. Hackett, whose readings from "Macbeth" had just been heard, was playing at such-and-such a New York theatre.

There the matter might have rested, with Friend Husband vaguely suspecting that he had tuned out WEAF, but wondering how it had been done. On Tuesday morning, however, there was a newspaper explanation. Mr. Hackett had delivered passages from "Macbeth" into the microphone, and both he and the announcer had been under the impression that they had been broadcast. But the microphone was dead. Somebody closed a switch carelessly, failed to make contact, and there was no voice energy in the antenna.

"Is there a radio censorship?" people began asking. "Do the great corporations that control broadcasting decide what shall or shall not be said? A switch slipped! Isn't that just a tactful way of explaining an intentional interruption?"

The fact that Mr. Hackett devoted most of his time to criticism of the critics, instead of Shakespearean readings, as announced, gave a certain plausibility to the censorship idea.

About a month before, a fifteen-minute talk on prohibition, delivered by the scientist, Hudson Maxim, at WOR, in Newark, had been interrupted in a similar way.

"Censorship!" growled suspicious listeners and newspaper critics, and Mr. Maxim was more inclined to take that view than accept the explanation of mechanical trouble.

This question of radio censorship is a real issue, with two very definite sides—a problem for which a satisfactory solution must ultimately be found. On one hand, the great radio public, jealous of free speech from the standpoint of the listeners, as well as the speaker, and on the other hand, a growing demand for censorship similar to that which has affected moving pictures, and now threatens books and periodicals.

Not long ago the Methodist Ministers' Association of Philadelphia voiced a demand for radio censorship, with a half hour of compulsory religious devotion included in each day's radio program.

And not so long ago, either, it was

A Censorship Ruling in One Broadcasting Station—

> "A man may talk about what he stands for, what his party stands for, etc., but he may not revile or attack his political opponent or any other party.
>
> "If a speaker violates this rule he will suddenly find that the current has been switched off and he is talking into a 'dead' microphone."

¶ *"Outside censorship of radio programs will undoubtedly be advocated by professional reformers—and it behooves the radio audience to fight it by safeguarding the Constitutional right of free speech."*

proposed that some way be found under the federal law that prohibits the transmission of prize-fight films from one state to another, to prohibit the broadcasting of ringside reports of prize fights.

There are two sides to this censorship controversy. Let's look at both sides without partisanship and see, if a line must be drawn, where it is to be drawn, and who had better draw it.

In the Hackett and Maxim cases, I honestly believe mechanical trouble was to blame, not censorship. Considering the complexity of broadcasting apparatus, it's a wonder that programs go along with so few hitches. Telephone service, while excellent, is only ninety-five percent perfect. People get wrong numbers, or answer the telephone to hear the operator say, "Excuse it, please." Broadcasting apparatus is much more complex than telephone apparatus, so "Excuse it, please," may be a legitimate apology.

Besides, the big eastern stations *do* exercise a supervision over much of the spoken material radiated from their antenna, and make no bones about saying so.

It amounts to censorship—but the broadcasting companies call it policy.

To begin with, the law of the land has established censorship in certain matters. It is a crime, for example, to explain methods of birth control. It is a crime to utter treason.

True, the right of free speech makes it possible to talk on such subjects, and the speaker is answerable only when he or she oversteps the law. The big broadcasting studios, however, are not

SHOULD RELIGIOUS PROPAGANDA BE CENSORED—OR SUBSIDIZED?

About fifteen percent of the broadcasting stations in the United States are owned and operated by religious bodies, many of which use them for exploiting their particular brands of doctrines. Here, for example, is Wilbur Glenn Voliva, of the "Latter Day Saints," whose station WCBD is used for preaching that the world is flat and other strange tenets. Should such stations be restricted in their use of the ether?

experiment stations in which speakers may find out whether they have overstepped the law or not, and anything under suspicion is barred.

Then, there is the censorship of the libel law. Compared with those of some other countries, our libel laws are lenient. In England, when people are killed or hurt in a disaster, many hours, and even several days, may pass before the list of victims is published by the newspapers, where in this country it would head the first account. The stiff British libel law is responsible—should a newspaper print John Smith's name among those of the victims, and it later be discovered that Smith had escaped unharmed, Smith's relatives could sue the newspapers for damages, and probably collect, having "suffered anguish" as a consequence. In this country, generally speaking, the person who brings suit for libel virtually goes on trial himself. Yet libel suits are brought here, and damages collected. Brown might be doing a real public service in telling what he thought of Smith, yet be accountable for libel. The broadcasting studio is not an experiment station for Brown, either, and speakers must not only avoid any approach to the libelous, but in more than one studio they are required to sign a contract assuming all liability of that kind.

Again, when a publisher prints an author's book or an editor accepts his article for a magazine or newspaper, what the author has to say is backed by the character of the publisher or the periodical. On that account, publishers and editors are careful about the company they keep—and it is exactly the same with the broadcasting station.

The extremist advocate of free speech points to Hyde Park, in London, where the most radical opinions may be uttered freely. "Even anarchy, treason and blasphemy are tolerated," says the opponent of censorship, "because the Britisher knows that dangerous opinions become harmless when they find a safety valve.

"Quite so," admit the directors of the big broadcasting stations. "But you don't take your family to Hyde Park and let them hear such rant. The Hyde Park crank cannot enter your home and voice his opinions. The broadcasting station isn't a safety valve for anybody. It has probably the most extensive audience in the world, not simply in numbers, but in range of ages. Children

Courtesy of Station WGY

PROGRAM MANAGERS ARE THEIR OWN CENSORS OF FEATURES SUBMITTED FOR BROADCASTING

This policy is maintained merely as a matter of precaution, however, in order to avoid the surreptitious broadcasting of press agent matter, libel and unsuitable material generally.

too young to read listen in on the radio every day, and young people whose minds are being formed. The manager of a broadcasting station is virtually the head of a great family, and must guard its members against evil influences that are barred from the home when they try to enter through other channels."

Viewing his responsibility in that way, the station director has the unwelcome task of deciding what is fit to go out into the ether, and what shall be suppressed.

Censorship generally comes down to personal opinion in the end. It may be the personal opinion of an individual, or of a committee, or an official bureau. There may be certain broad rules to give it impartiality, but the personal element creeps in sooner or later, and the censor's view conflicts with average public opinion. Nobody has yet invented a foot rule to measure opinions, and it isn't likely that anybody ever will.

Despite his powers, the broadcasting director has thus far been tolerant. In only one case recently, in the east, anyway, has a radio speaker been deliberately cut off the air for expressing views that a director considered improper. Madame Olga Petrova, the actress, speaking some months ago at WOR, in Newark, on the economic freedom of women and the social and biological changes likely to result from that freedom, was cut off on the grounds that her statements were "too strong for the public." Madame Petrova declares that her address was similar to one delivered at Columbia University, but it was interrupted, and with no blame on mechanical trouble—apparently a real case of station censorship.

The station director seldom finds it necessary to interrupt a speaker in actual delivery, because his power of censorship is exercised beforehand. It is customary at the big eastern stations to ask speakers for a written script of their talks and to require that they read this script into the microphone instead of speaking *extempore*. Censorship is

exercised not only in striking out statements that seem to be offensive, but technical talks are also submitted to experts—that is, the script of a speaker giving advice about investments might be submitted to responsible persons in the investment banking business, who would pass upon the soundness of the speaker's counsel and his personal standing in the investment field.

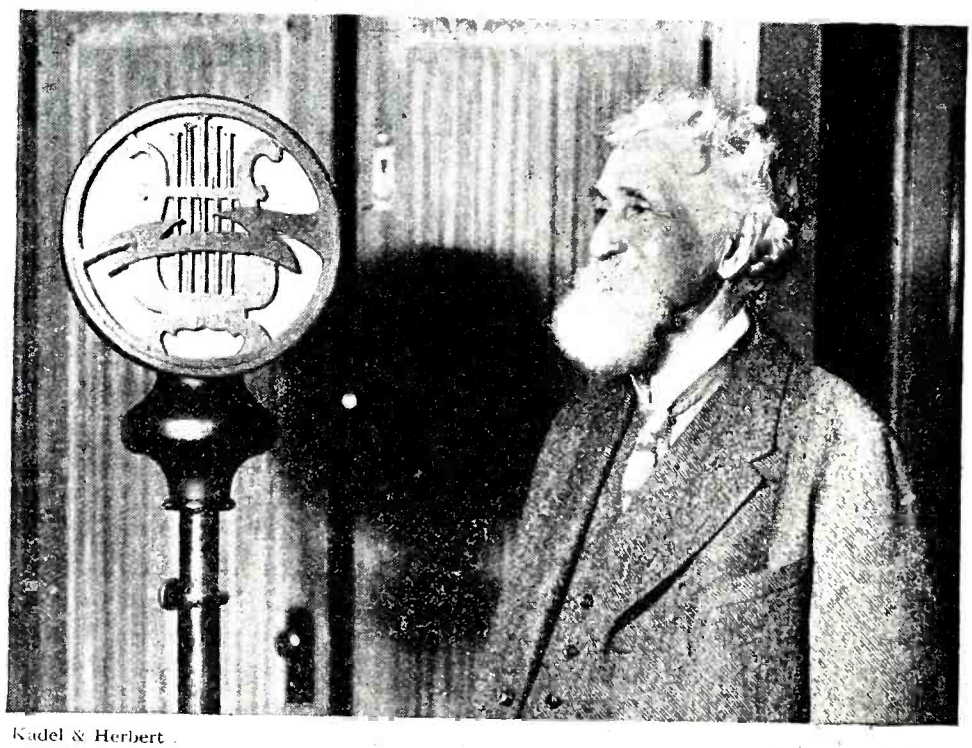
However, this supervision makes more for accuracy and responsibility than for the censoring of improper material. The station director is trying to get quality in his program rather than to keep questionable views off the air.

There is another side to station censorship indicating that, if radio is to have a censor, the station director doesn't hanker for the job. In fact, he is already dodging it by seeking program events that censor themselves.

A year or two ago the radio program was made up almost entirely of studio numbers. Today, the trend is toward outside numbers—concerts delivered in auditoriums, banquets held in hotels, sporting events reported from field and ringside, important addresses of public officials, and the like. In broadcasting these events the director automatically steps out from under. He is no longer a publisher, passing upon the fitness of what others say, but simply a reporter, letting his audience hear what is said and fastening responsibility on those who say it.

And he finds the radio audience with him overwhelmingly.

The station director would have been horrified, a year ago, at the suggestion that he invite either a prominent Fundamentalist or Modernist to express his beliefs in this great religious controversy of the moment, speaking from the studio. At that time, letters would probably have poured in, charging him with partisanship. But when WJZ installed a microphone outside to broadcast a great Modernist-Fundamentalist debate in New York City, it proved one of the most popular features in that



Kadel & Herbert

CAN "EXCUSE IT, PLEASE," BE USED AS A TOOL BY THE RADIO CENSORS?

When Hudson Maxim gave a vitriolic talk on prohibition at a broadcast station he was suddenly cut off. "Censorship!" charged the newspapers. "Mechanical trouble," answered the station manager.

Courtesy of Station WEAF

EACH STATION PASSES ITS OWN JUDGMENT ON WHAT IS "ACCEPTABLE"

The program committees in each station determine what shall and what shall not be broadcast—but their decisions are based on tabulations that show what broadcast listeners want and do not want. Will the voice of this radio censor dictate what the audience should and should not hear?

station's program. Instead of blame, there was praise for WJZ's enterprise in letting the vast radio audience hear both sides of the controversy stated by authoritative leaders. Radio debates of other controversial questions, like Prohibition, have also brought warm commendation from listeners. The "nut" letter writer, wet and dry, is always right on hand in next morning's mail, with strong approval of the speaker on the side he favors and untempered denunciation of his opponent; but, generally, correspondents thank the station for giving both sides a fair hearing, and there is a feeling that debates bring such questions out into the open, and take from them the suspicion of propaganda. And as in a public hall, so on the air, the skillful debate has all the interest of a good horse race or prize fight.

¶ *If radio censorship comes, what form will it take?*

Probably the same form as Prohibition, censorship of moving pictures, the war on cigarettes and tobacco — the usual "anti" tactics. That is, advocates of censorship will find it easier to secure the passage of local and state laws than a federal law, and there are pretty certain to be communities where prejudice can be aroused and pressure brought upon state legislators or city fathers.

Few people know—even New Yorkers—that smoking is prohibited in the New York subways and on elevated lines because an anti-tobacco organization quietly secured a regulation when the first subway was planned, an illustration of how zealous, tireless work for a cause brings results, particularly when nobody is active on the other side. The triumph of the Eighteenth Amendment grew out of such small beginnings.

Whether he is a city official, a state committee, or a federal bureau, the radio censor will have a somewhat peculiar job. Putting the local "Thou shalt not" upon a book or moving picture is simple in comparison, because these are tangible things—they can be held in the hand, read or run off on the screen, and duly censored. But where are the state lines in radio? Where would the international line be if we had federal censorship, and Havana, Montreal or Mexico City wanted to bootleg unlawful material into the United States? Yes, London, Vienna, Moscow and Calcutta—for world-wide broadcasting and reception will undoubtedly be commonplace by 1930. It will be easy enough for the censor to sit in the local broadcasting studio and pass upon the program—but will there be a radio censor at every public dinner, political convention and broadcast event of every kind?

Radio has been burdened with a censorship problem that isn't really its own, because it broke in upon a perplexed world. As the world gains in sweetness and light, the problem may disappear.

Going back to the dear old "Mikado" for an example:

Suppose radio had been developed thirty years ago. The idea of hurting Japan's national feelings with a comic opera would have been preposterous in those humdrum days of the late Victorian era, when the nations were at peace and Woman, with a capital "W," was in the home, and people voted the straight party ticket, and nobody had found grievances for the working man, the farmer, the negro, or the Jew.

But radio burst into a world full of nationalism, revolution, race feeling, class feeling, sex antagonism, religious strife, party rancor, artistic radicalism, propaganda and selfishness generally. Why, there is hardly anything left in the world that hasn't been turned into a problem about which no two persons can agree, and each problem has its aggressive organizations, fighting on the principle of the old-time politician who believed that the only good opponent was a dead one—not politically dead, but really dead. Prohibition, woman's rights, immigration, taxation, Bolshevism, League of Nations, Unionism, farm blocs, Americanization, nationality, race, creed, party—

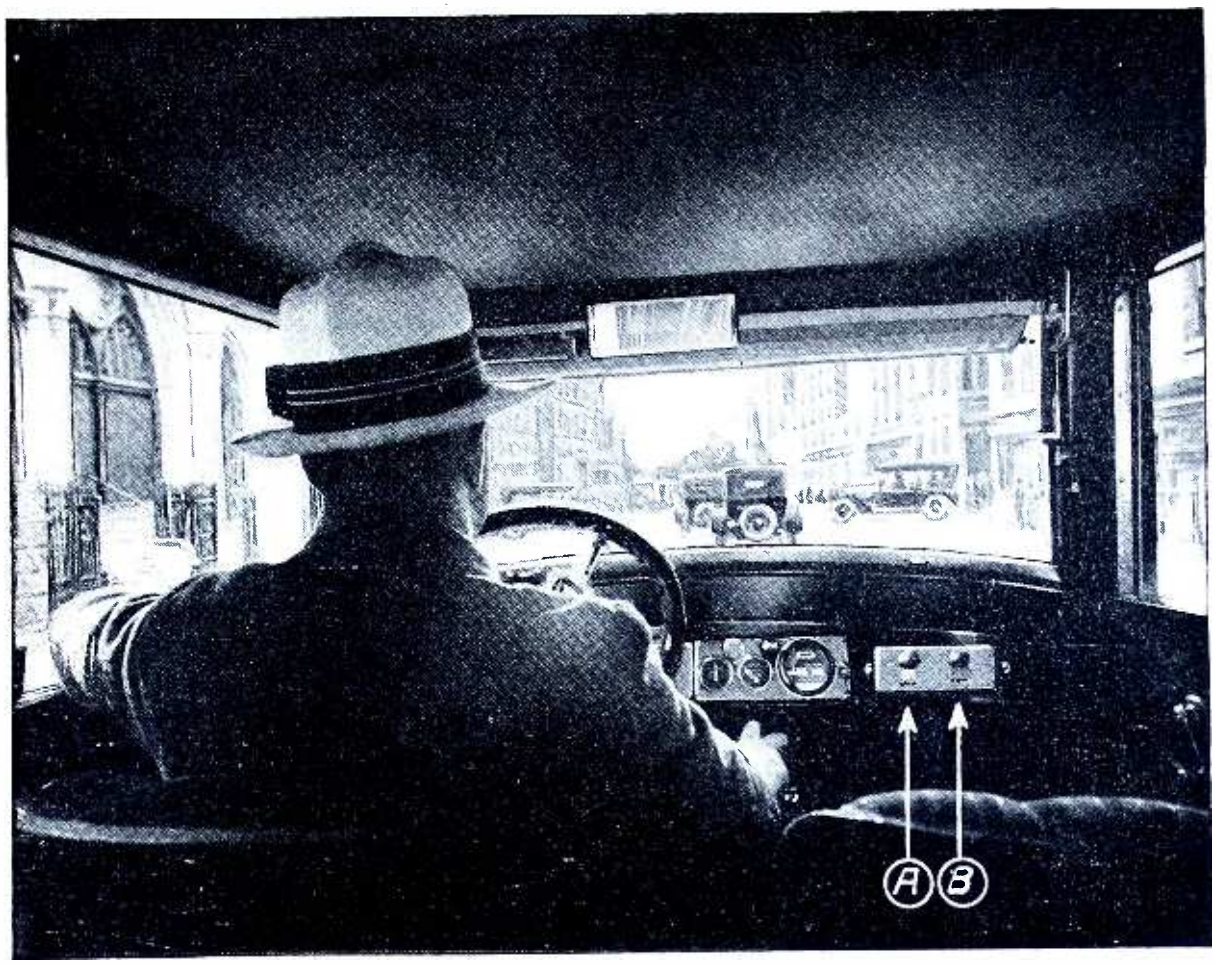
What a mess!

Some of the demands for censorship have been brought upon publishers, moving picture producers, and theatrical managers, by their references to sex and crime.

That radio has inherited this problem is shown by the fact that even those who propose censorship make no charges of the kind brought against the producer and publisher in other fields. Radio has absolutely no sex appeal. Nor has it any possibility for the encouragement of crime.

Censorship has already been officially applied to radio in the allotment of wavelengths and the supervision of the federal government to prevent interference. That, however, was censorship of the best kind, the adoption of rules by those interested in the industry. The next step in censorship will probably be the elimination of squealing sets. And it can likewise be brought about through teamwork in the industry.

But outside censorship will be advocated as well, and it behooves the radio audience and the radio industry to fight it, by safeguarding the Constitutional right of free speech—and by voluntary inside censorship that will abolish grounds for the other side.



THE "STOP" AND "GO" SIGNALS IN YOUR OWN CAR

The proposed radio control of city traffic would require only a few feet of antenna wire concealed in the body of the car and a neat panel with sockets for a yellow light, A, and a green light, B, which could be set into the dash beside the speedometer.

The "Radio Traffic Cop"

¶ *The fifth of a series of articles that speculate upon the probable applications of radio to our everyday life—all based upon* PRESENT-DAY POSSIBILITIES

By LAURENCE M. COCKADAY

THE cities of the United States are being slowly choked to death. The thing that is choking them is the automobile.

I do not mean that the gases from the cars that fill our streets are interfering with the breath of the inhabitants, although that is a danger which Professor Henderson of Yale and other experts regard as really serious. What I mean is that the multitude of pleasure cars, taxicabs, delivery trucks and other automotive vehicles is so clogging the main arteries of wheeled traffic that the business life of our cities has already been noticeably impaired.

One of the great city problems of the day—possibly the greatest city problem of the day—is the problem of the adequate control of automobile traffic.

New York and London have already found it necessary to study this problem in an intensive way. Other cities throughout the United States are up against the same situation. Some of them—notably Los Angeles—are already in the grip of still worse tangles than either New York or London.

What we are to do about this traffic problem is a question that is agitating the civil engineers, the city planners and the automotive experts.

May not the radio engineer be able to contribute something worth while to the discussion?

I believe that he can. I have a distinct idea, in fact, that the radio engineer already possesses a key which may prove able to unlock the whole tangle.

It is a scheme for what might be called an automatic traffic cop.

The present system for the control of traffic depends, essentially, on this ubiquitous official. He is not really a policeman, for few responsible people would intentionally snarl up the traffic on a street or wilfully disobey a recognized rule of the road.

The traffic officer is really nothing but a signalman. He corresponds to the antiquated system of dispatching traffic on the railways, the system that placed a signalman at each switch and crossing so that the engineer and conductor of a train would know which track to take or how long to wait for another train.

The railways got over this long ago. Train traffic is now handled by automatic signal systems of great complexity and efficiency. It is time that the same change went into effect on highways, indeed an approach to an automatic system has already gone into effect on the longer streets in New York and in parts of certain other cities.

In New York, for example, Fifth Avenue, Park Avenue, Broadway and Sixth Avenue are equipped, for portions of their length, with traffic towers that carry red, green and yellow lights. When the yellow light burns, north and south traffic may move; when the green light burns, east and west traffic may move. The red light stops all traffic, preparatory to a change to the other direction.

Each tower is manned by a traffic policeman. He can see the other towers. One tower is selected as the master tower and all the other towers change lights when and as it does. The policeman on the crossings can see the lights on the towers and they direct the traffic accordingly. Drivers are supposed, also, to watch the signal lights and to stop or move as they direct.

This system is the invention of Dr. John S. Harriss, Honorary Deputy Police Commissioner of New York City, and a student for many years of the problems of city traffic. It has been a pronounced success, is popular with automobilist and pedestrian alike, and constitutes, undoubtedly, the last word in the present handling of automobile traffic in cities.

But it has several remaining faults. For one thing, the automobilist who approaches one of the long streets, say Fifth Avenue, from a cross street cannot see the signal lights until he actually runs

How the Radio Traffic Cop Works—

1. Each automobile has a dash panel with sockets for two lights:
2. The north and south radio signal flashes the yellow light:
3. The east and west signal flashes the green light:
4. There is no interference with existing radio systems.

Brown Bros

THE "RADIO COP" WILL MAKE TRAFFIC CONTROL TOWERS UNNECESSARY

The colored signal lights that now direct the motorists in our larger centers may be replaced by radio apparatus that will operate automatically by means of a master time clock—and save enormous sums of money to the cities.

out on the crossing, away from the obstruction of the buildings. If traffic is heavy and a policeman is on duty at the corner, this is no great matter. Under other circumstances it means that a driver approaching from a side street may run out onto the Avenue when he should not, or, if he is especially careful, he may make a stop when it was not necessary. And this last, mind you, is a really serious matter when speed of moving traffic is a necessity, as it indubitably is in all cities as congested as New York.

It would be much better, therefore, if there were a special traffic light at each corner, visible to side-street drivers as they came up toward the Avenue, as well as when they actually reached it. But there are objections to this on other grounds and it cannot be considered a final solution.

Another objection to the traffic tower system, equally with any other system yet devised, is the number of policemen that it requires. Where traffic is congested at all, or where the signal towers are difficult to see, a man must be on duty on the corner at all times. I have seen a five-minute absence of the directing officer produce a traffic snarl that it took four mounted patrolmen thirty minutes to straighten out.

A good traffic cop is ornamental as well as useful. We like to see him on our streets. But he is also costly. From the standpoint of the taxpayer we would like to see some way to make him less frequent; to divert his unquestioned abilities to some more productive job.

Can this be done? I am sure that it can. And, as in so many other matters of modern life, it is radio that points the way.

Suppose we string along the streets of a city an ordinary insulated wire. Sup-

pose then that we send out over this wire a radio signal of a certain frequency for north and south traffic; a certain other frequency for east and west traffic. Suppose, to take the example of the New York tower system, that the street radio cable carries a signal of 100,000 cycles for a green light (east and west traffic) and a signal of 120,000 cycles for a yellow light (north and south traffic).

If, then, your automobile was equipped with a receiver capable of distinguishing these signals you would always know, *no matter where your car was in the city*, just how the traffic was moving on the main traffic arteries. When you drove up toward Fifth Avenue on a side street, a moment's listening at your receiver would tell you, while you were still half a block away, whether the Avenue was open for you to cross or whether it was not.

But our radio resources are still more considerable than this. You do not need to *listen* to the traffic signal. It is a simple matter to equip a car with relays operating on the battery of the car and which would light a green or yellow light on the dash, in exact correspondence with the signal lights of the city street. You could have a small replica of the traffic towers on your dash in front of you.

Suppose a system like this were installed throughout New York. All the traffic of the city could be regulated from a single set of cables. On a given signal every automobile in the whole city would show a small green light on its dash. Those that were moving north and south would stop. Those that had been waiting to move east and west would start.

Not one traffic policeman would be necessary in the whole town except one to work the system and as many as might be necessary to arrest violators, just as for any other law.

On the other hand, if it is desired, for any reason, to have the traffic in different parts of the city regulated by separate sets of signals, that, too, can be easily arranged. The radio signal sent out from the cable system need not be a strong one. It can be given a range sufficient to reach only those automobiles that are within a limited number of feet from the cable. Dissimilar signals from different parts of the city will not then interfere with one another.

There are no important technical difficulties about such a system. Any radio engineer could design the necessary transmitters for the cables, the receivers for the cars, the lights and relays for the dash. The signal in the cable could have either a low frequency, just above the audio range, or a very high one, well above the ordinary radio range. There need be, therefore, no disturbance whatsoever with present radio activities.

The only element of expense to the city would be the installation of the signal cables. Even for this, it is possible that the present wires of the Fire Department or Police Department telegraphs would serve, and without interference with their present duties.

I honestly believe that a system like this could be tried out in New York in connection with the present traffic towers, or in any other city in connection with any mechanical or electrical signal system, at an expense so small as to be trifling. And, if traffic were speeded up by so little as five percent, the saving to the city's business men would pay many times any possible cost of the radio installation. This says nothing of the additional savings if a few of the traffic policemen could be diverted to other duties.

As to the cost of the relays and receivers on the automobiles, most drivers would be willing to pay the few necessary dollars for the mere convenience of having on the dash a replica of the city traffic lights. I know that I would.

If this plan ever goes into effect an aviator looking down on a city at night would see a remarkable sight. Thousands of automobiles would be moving

north and south. Suddenly a multitude of tiny green lights would flash up inside all the cars. Instantly every north or south moving car would stop. Simultaneously the east and west movement of traffic would begin.

To the aviator it would seem as though some mighty magician held all those thousands of moving machines in his thrall, to stop or start as he wished. The aviator would be right.

That magician would be radio.

The Radio Grouch

THE idea of combining radio and movies has its drawbacks. We know some actresses who should be screen and not heard.

* * *

CURIOUSLY enough, many a fan has had his enthusiasm dampened by a dry lecture.

* * *

A CRYING need of the industry is broadcaster oil for squeaky sopranos.

* * *

YOU can hock your watch and yet have the best time in the world—direct from Washington.

* * *

YOU can find out how the ball game, the horse race and the prize fight came out and yet enjoy respectable society.

* * *

YOU can listen to opposing views upon prohibition, the League of Nations, the K.K.K., Muscle Shoals, autosuggestion and censorship and come out of it knowing that you were right all along.

* * *

SOMEBODY recently complained that the movies had made us an eye-minded people. Before he had got this complaint out of his system we had turned ear-minded. A good old phrase has gone by the board. Henceforth we must say, "He is very much in the public ear."

* * *

YOU can now hear an after dinner speech and yet get something to eat. On laundry alone you can soon save the cost of an outfit. A public dinner ruins an evening shirt, but you can listen to a radio speech without even wearing a collar.

—HOWARD BRUBAKER

Photo by A. T. & T.

THE RADIO EYES OF THE PRESIDENTIAL CAMPAIGN

Sitting apart from the participants, this new type of reporter, that has been evolved by radio, observes and interprets to the broadcast listeners what is going on at the political gathering and then lets them listen-in on the proceedings for themselves.

How Radio Is Electing a President

What modern science is doing to enable candidates for office to sit in their homes and talk to 25,000,000 people at one time

By R. W. KING

DURING the recent campaigns, and on certain other occasions just preceding them, what might be called a "transcontinental broadcasting system" has frequently been brought into service. Indeed, so frequently has it been used that the fact itself, although it is certainly remarkable and as worthy of the Twentieth Century as anything that might be mentioned, no longer excites amazement.

The story of the development of this system of broadcasting is an interesting tale of engineering achievement; a tale dealing with the latest advances in wire telephony as well as in radio broadcasting, and in the manning of a vast network with such skill that its uttermost extremities—thousands of miles apart—perform their proper functions upon schedule time to within almost a fraction of a second.

Back of each such achievement is a corps of engineers and at the bottom of the many details of their arrangements is a fundamental plan. This plan gives the essential electrical details concerning all of the broadcasting stations to be tied together, as well as the telephone circuits by which the tying is accom-

plished. For the ready instruction of the engineers who are charged with the responsibility of operating a transcontinental broadcasting system, the most essential information is placed upon a diagram similar to that shown on pages 450 and 451.

This figure gives the layout which was used on the occasion of the Democratic National Convention meeting in New York. It shows in diagrammatic array the eighteen broadcasting stations which were employed and the several thousand miles of telephone lines which joined them together. Though possibly a little confusing at first sight, the diagram well symbolizes the elaborate preparations that were required. Furthermore, it carries a reference to practically every piece of special apparatus that was employed, the microphones, the equalizers for correcting distortion, the special amplifiers, as well as the regular repeaters, the volume indicators, the testing oscillator, and so on.

Near the right-hand upper corner of the diagram is shown the layout for the convention hall. On the platform were two microphones which transmitted the speeches. Another microphone marked

Underwood & Underwood

ON THE "RADIO STUMP"

For the first time in history, a presidential candidate's campaign speech can now be heard broadcast throughout the land. The microphone shown here on the speaker's desk enabled John W. Davis, the Democratic nominee, to transmit his speech of acceptance from Clarksburg, West Virginia, throughout practically the entire country.

"band" and placed in the band stand transmitted the music, while two others marked "announcers' booth" brought the necessary explanations.

When broadcasting such an important event as a national convention, it is not enough for the listener to get his picture from a single microphone placed on the chairman's desk. The music is also essential, and, if the listener can in addition hear the cheering of the galleries and the rapping of the chairman's gavel, it requires but a word of explanation by the announcer to complete the picture and enable the listener to enter into the spirit of the occasion.

Other details of the convention hall layout which may be noticed are the "mixers," the loudspeaker horns with the special amplifiers, and the testing oscillator marked "OSC."

The "mixer" is a device for silently but quickly shifting from one microphone to another while the program is in progress. It is the practice to pick up with only one microphone at a time and by means of the mixer a shift can be made from the announcer to the band or to the platform as occasion requires, without any annoying clicks reaching the radio listeners. By means of the testing oscillator a steady tone of any desired frequency can be sent out over the entire system which greatly facilitates the work of lining up the many co-ordinated branches of the system.

Going out from New York as a center, let us follow the circuit to Boston.

Located at 24 Walker Street, New York City, we note an amplifier whose amplification is indicated as 16-T.U. and currents leave it at a level indicated as +9.6 T. U. The T.U., meaning transmission unit, is a quantity devised by

Photo by A. T. & T.

HOW THE WIRE LINES THAT RELAY THE PROGRAM ARE TESTED

The test room is an established part of every wire transmission plant. Telegraph lines are tested by the instruments on the bench in the foreground and the telephone lines are checked up on the panels.

Photo by A. T. & T.

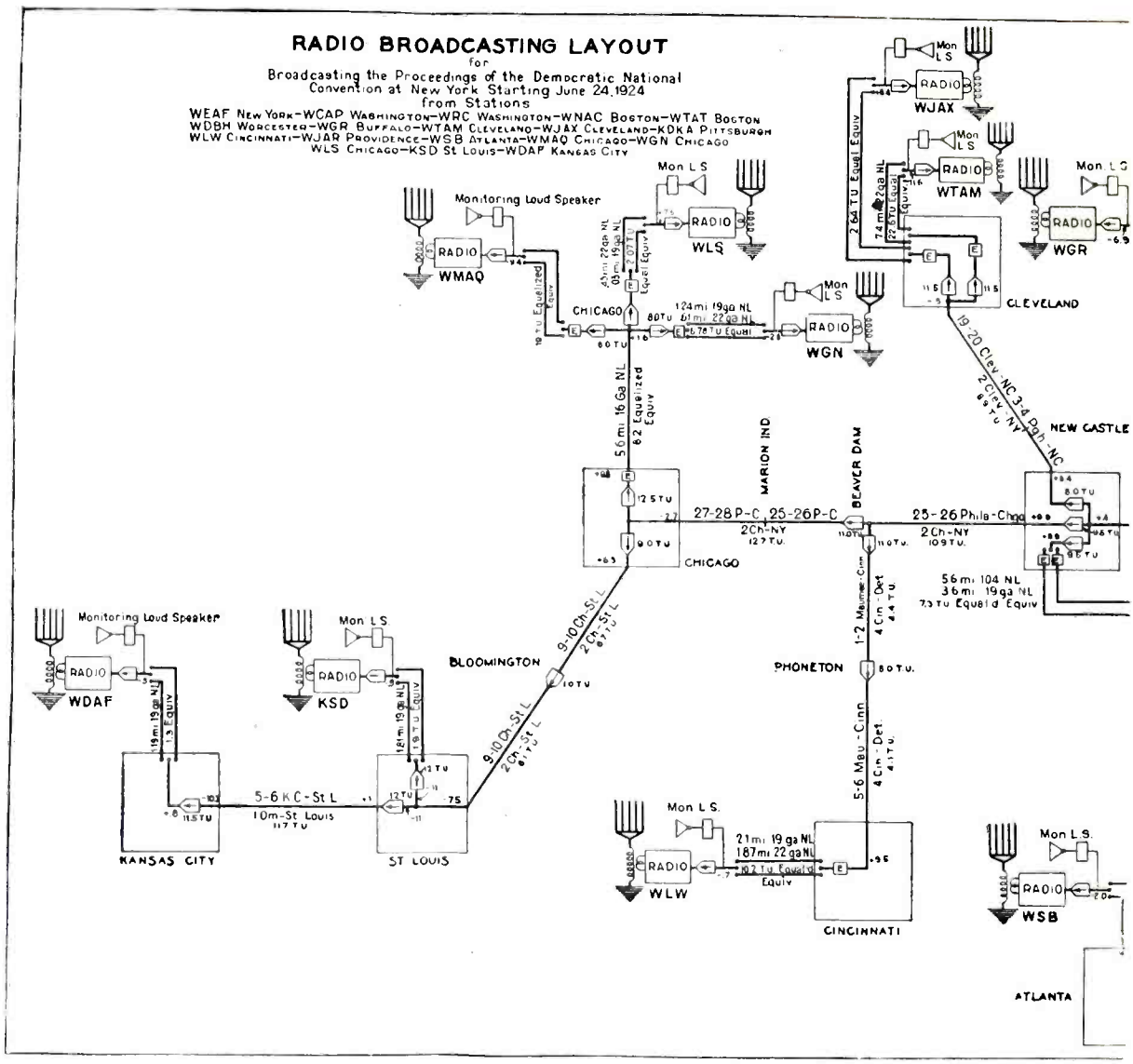
THE MONITOR OF THE LONG DISTANCE LINES

The five men seated at the table are telegraph operators who are in touch with all parts of the broadcasting network. The man standing is in charge of the amplifiers which feed the long distance lines.

the telephone engineer to measure and indicate the volume of transmitted speech at any point in a circuit. The telephone line used to carry the program to Boston is the number 1 Boston-Pittsburgh circuit and is located on pins 7 and 8 of what is known in the telephone plant as the "Central" pole line. This circuit introduces a loss of 9.7 units so that the program arrives in Boston at a level of —0.1. It next encounters an equalizer and then an amplifier which raises the level by 7.5 units, finally reaching the radio station through either one of two short cable circuits at a level of —0.1 T.U.

The circuit which for illustration we have just traced is one of the simplest, but similar information is given by the diagram for each of the many branches of the network, one of which runs as far west as Kansas City. It will be understood that the proper gain imparted by each of the many amplifiers is calculated in advance, as the loss instituted by each branch of the network is accurately known. This insures that the program, as it reaches each of the radio stations, will be of the proper loudness and also free from extraneous disturbances such as interference from power lines and other sources of noise.

One might draw the conclusion offhand that the preparation and operation of an extensive broadcasting network such as is shown, might be compared to the problem of train dispatching on an extended scale. But these two undertakings differ in one very fundamental respect and make the problem of transporting speech one of marked complexity. In train dispatching it is only neces-

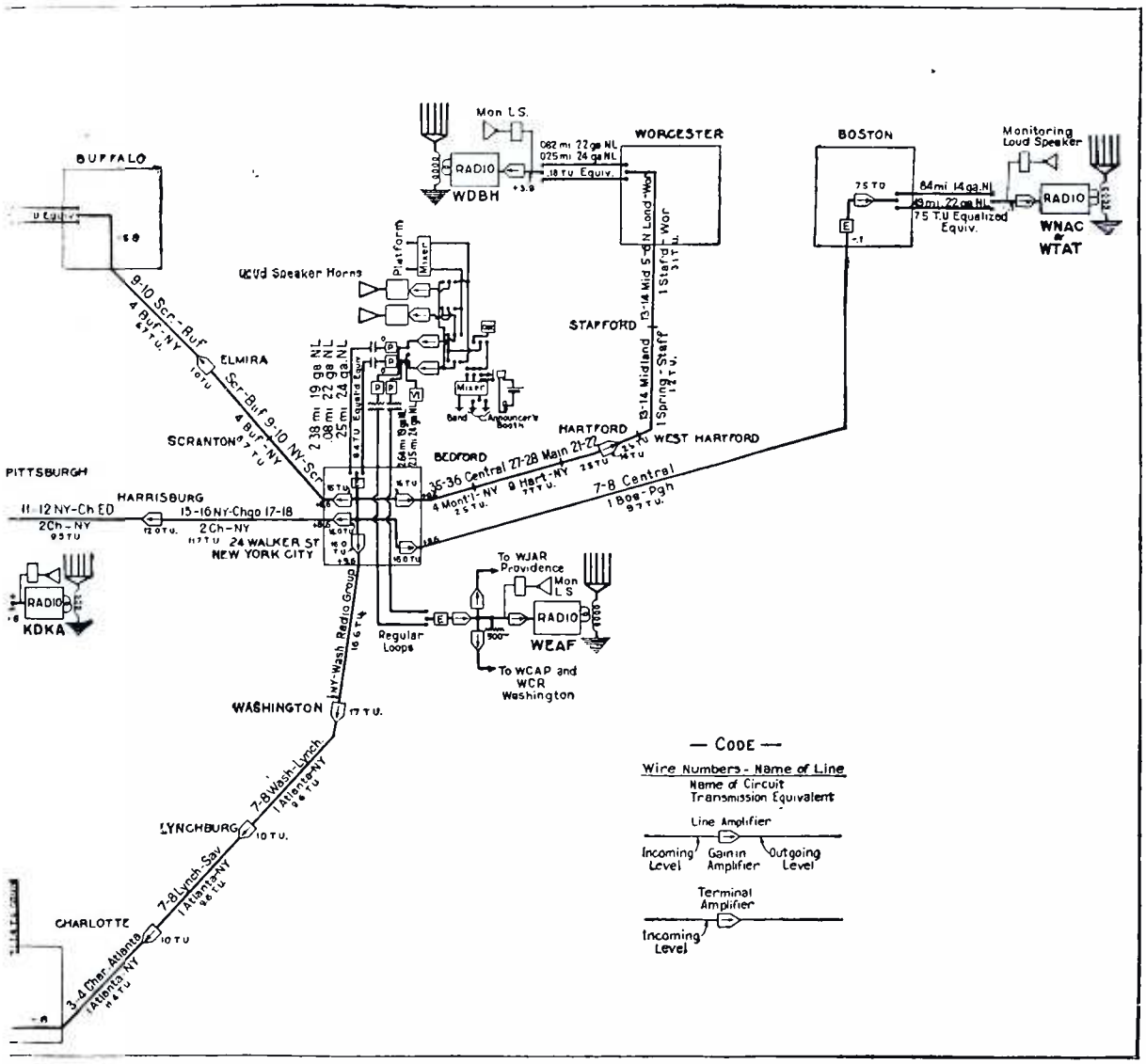


HOW WIRES ARE USED FOR BROADCASTING A POLITICAL GATHERING FROM SEVERAL STATIONS AT ONCE

Unlike a railroad, where trains may still be run, even if miles of track are out of commission, each branch of the wire network that carries the broadcasting must function perfectly, otherwise the stations that are supplied by that branch will be cut off completely. A serious breakdown in the center of the distributing system would stop all communication.

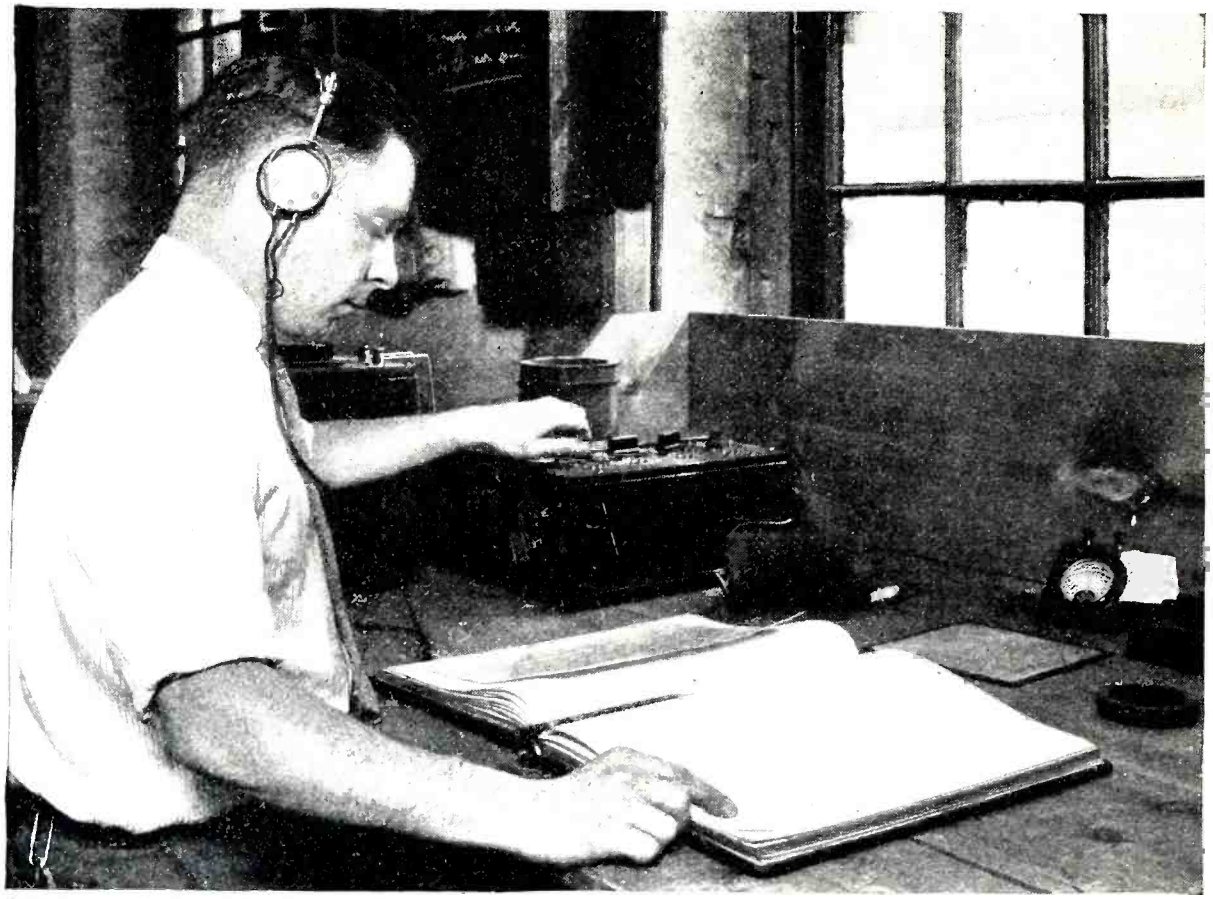
sary to keep in mind a short section of track, perhaps a few miles long, ahead of the train. But, in dispatching a broadcasting program, however, the entire track from the center to the farthest extremity of every branch must be operating at each instant. The speed of the program currents is practically the speed of light, so that while an express train is advancing a foot or so along its track, the current has had ample time to traverse the entire network. While a train can be sent forward, even though a distant point on the railroad is disorganized, the dispatching of telephone currents requires that every inch of the circuit, even though thousands of miles long, be in perfect operation.

Besides the lines actually carrying the material to be broadcast, others are available for use in case of emergency. Furthermore, telegraph channels are maintained at all times between the engineers in the control room of the convention hall and those at the radio sta-



tions. These are used for lining up the circuits, issuing instructions for the adjustment of the apparatus along the line and for frequent reports as to how the material is being received.

The initial announcement at the opening of a program and the reports that come back to the main control room immediately afterward comprise perhaps the most thrilling moments. Just preceding the advent of the central announcer on the air, each station must make its local announcement. This must be accurately timed so as to be finished and yet not so long finished that an awkward gap occurs before the central official announcer takes up the story. By telegraph—there is a special telegraph operator at each of the broadcasting stations—these stations are told when to begin their local announcements. Within a second or so of one another come back the reports that they have finished. Each station then throws over from its local microphone to its long distance telephone line. Next a momentary test—scarcely a second in duration—and the official announcer is on the air. Then, within another few seconds the telegraph instruments in the central control room begin to click, and the tension, which has been becoming more and more evident for some minutes past, subsides, as Boston, Atlanta, Washington, Chicago, Kansas City and the other cities in turn send in the welcome news that their program is coming over fine.



From a photograph made for POPULAR RADIO

HOW THE CAPACITY OF A MULTI-LAYER COIL IS MEASURED

The distributed capacity of a multi-layer coil will not be more than the capacity of a single layer which may be considered as one plate of a cylindrical condenser.

Why Damping Causes Interference

Article No. 10

Does your receiver tune broadly? High damping qualities in the tuning coils may be the reason. In this article the author explains what damping is and how it can be avoided

By SIR OLIVER LODGE, F.R.S., D.S.C., LL.D.

ANY open oscillating circuit transmits its energy to the ether, and so radiates it into space. If a circuit consisted of two capacity areas separated by a long wire or rod, it would be an exceedingly powerful radiator, and would radiate practically all its energy in two or three swings or alternations.

However, a circuit of this type would be unsuitable for tuning or for any precisely resonant effects. To prolong the oscillations we must introduce electrical inertia in the form of inductance. The electrical oscillations will then alternate back and forth for a much longer time. It will conserve its energy to some extent; in other words, the damping coefficient will be diminished, so that if left to itself it would continue swinging twenty or thirty, or even more, times;

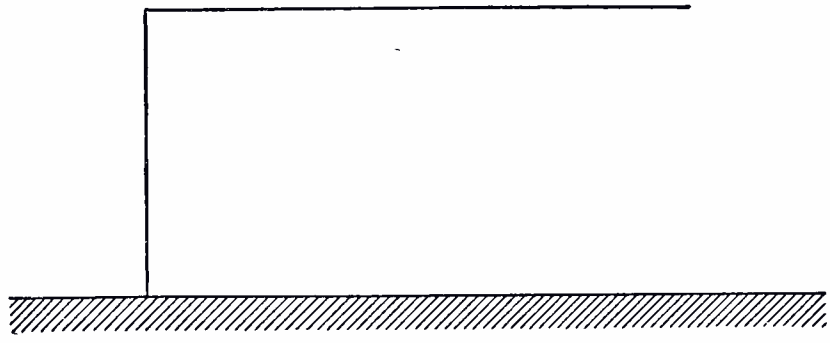
or if connected to a continuous-wave generator it will be kept in vibration with but little applied power when tuned to the right frequency.

When a current runs through a wire, it inevitably wastes some energy in the form of heat, especially if the wire is of small diameter. Any straight conductors should therefore be fairly large so as not to damp the vibrations out too much. But inductance which must be added to prolong the oscillations, and control the frequency of oscillation, has to be added in the form of a coil. For best operation, the resistance of this coil should be a minimum, and its inductance a maximum. It is obvious that if too great a length of wire is used, the resistance will be unnecessarily high, and the resistance and damping effect more than is needed. The question is whether thin wire will do for the coil, or whether it must be as large in cross-section as the lead-in wires.

Let us now consider the resistance and inductance of a coil wound in a given channel, or on a specified size of tubing or other frame. The damping depends on the ratio of R to L (i.e., Resistance ÷ Inductance); and so long as this ratio is constant, the damping will be the same. It does not depend on R alone, nor on L alone, but on the ratio of the two. Suppose we fill the channel with a thick wire, its resistance will be small, but its inductance will be small also. Whereas, if we wind it with wire of small diameter, we shall have a large number of turns; so that the resistance will be high, but the inductance will also be high, and we must, therefore, consider whether the ratio remains the same. We shall find that it does, and that whether the coil is wound with a single thick wire, or whether it is wound with thousands of turns of fine wire, the ratio is not altered. For the resistance will depend on the square of the number of turns, since the length of wire will increase with n, and the cross section of the wire will diminish with n. Therefore, the resistance will depend on n^2. But the inductance also depends on n^2. Hence the ratio of R to L remains constant whatever wire is used.

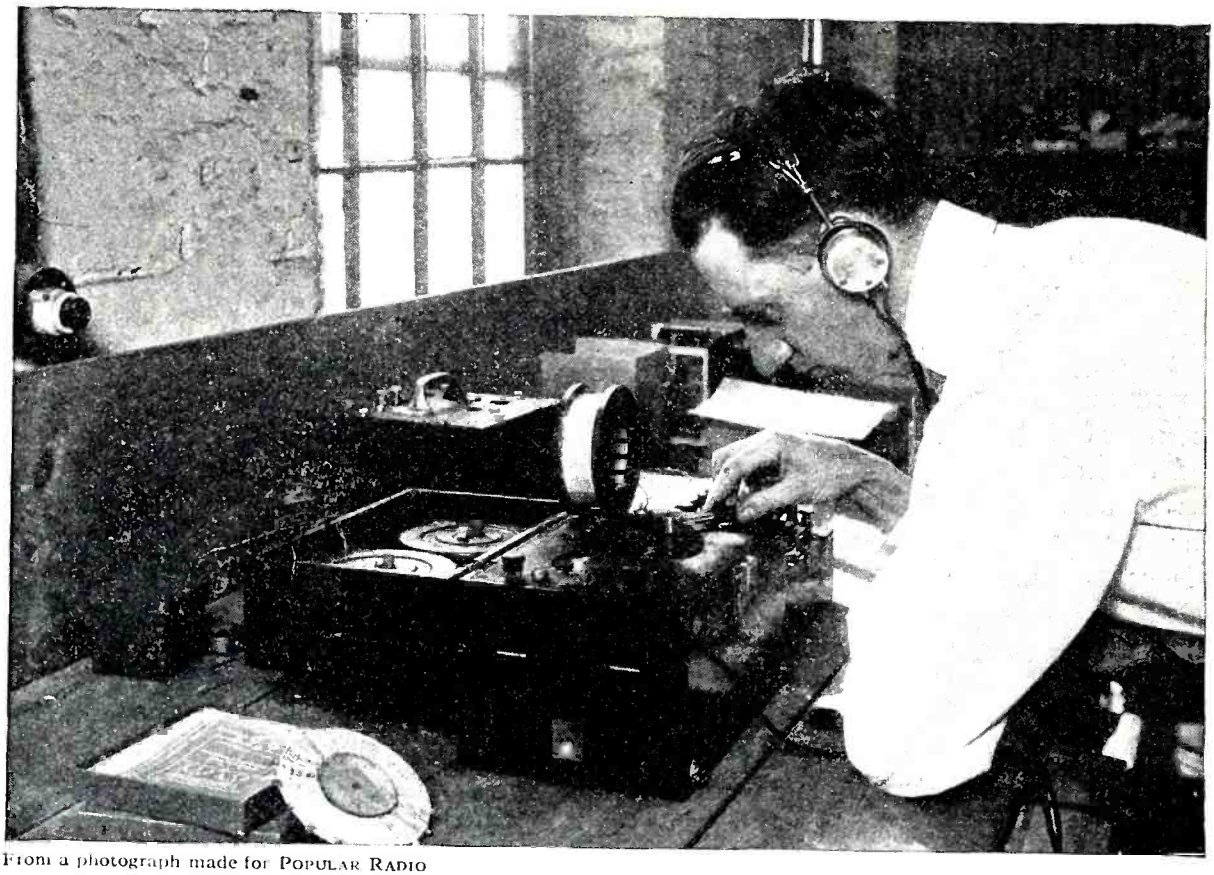
With extremely thin wires the space is largely occupied with insulation, and there is a tendency for the ratio of R to L to increase somewhat on this account as the thickness of the wire is diminished. But the increase is little, and for practical purposes is unimportant. Consequently, although the lead-in wires should be fairly substantial, or at least not too constricted in diameter, the wire on the coil may be reasonably thin. And any further details about the winding should be dealt with from the point of view of capacity as the resistance may be left to take care of itself.

The way to keep the capacity in the coil small is to wind it in a single layer, such as a number of turns wound on a cylinder. In that case we have only the capacity of each turn upon those on



THIS CIRCUIT WOULD RADIATE ITS ENERGY QUICKLY

If a circuit consists of two capacity areas such as the antenna and ground arranged as shown, it would radiate practically all its energy in two or three swings or alternations. Such a circuit could not be tuned properly.



From a photograph made for POPULAR RADIO

THE DAMPING QUALITIES OF A COIL CAN BE MEASURED

In order to determine the damping qualities of any coil it is only necessary to measure its resistance and inductance. Calculation of the damping effect of a coil will indicate how sharply it will tune in a radio circuit.

each side of it, unless the tube on which it is wound is of some conducting material, in which case the wire will form one coat of a cylindrical condenser, and the capacity will be far from insignificant. It is important, therefore, to use good insulating material for the cylinder on which wire is wound.

Another plan, though more troublesome, is to wind the wire as a thin disc, in a large number of superposed layers of small breadth. By adopting this method of winding, and without using end pieces or metal frames of any kind, we reduce the capacity to a minimum. And we can, if we like, separate the turns, making a sort of basket winding, or else a spiral with interspaces, such as is often used for a loop antenna. Such methods of winding, however, are far from giving the maximum inductance possible with a given length of wire; so that the resistance may begin to be excessive, since that depends on the total length of wire used.

If the wire is wound more compactly, say as compactly as possible, by filling a square section channel with layers of wire, one on top of the other, the inductance can be made a maximum by choosing a channel of the right dimensions, in proportion to the diameter of the coil; and the length of wire used will be a minimum, which is advantageous if the capacity effect is not troublesome.

To calculate the capacity effect of a coil of many cylindrical layers, we can treat each layer as if it were one coat of a cylindrical condenser; and we shall find that we do not have to add these capacities together. The effective capacity of the whole coil will not be more than the capacity of a single layer, because the whole difference of potential between the terminals will not be applied to any one layer,

but only a fraction of it. The whole difference of potential exists between the terminals of the coil, that is, between the inner and the outer layers. If there are six layers, only 1/6 of the difference of potential is applied to each, and to reckon the effective capacity we shall have, therefore, both to multiply and to divide by 6. Hence it is that the number of layers does not matter. All we want to know is the capacity of any one layer.

Take the axial dimensions of the coil, or what may be called its breadth; call that b. And take the radius of the coil, which we may call r. The layer forms a cylinder whose area is the circumference multiplied by the breadth; that is,

$$2 \pi r b.$$

It only remains to reckon the distance which separates one layer from the next, and this will be equal to the thickness of the covered wire minus the thickness of the uncovered wire. For an approximate estimate we can neglect the thickness of the uncovered wire, assuming that it is thin, and take the distance as the diameter of the wire, that is, twice the thickness of the covering.

Treating it in this way, we know that the capacity of a plate condenser is

$$\frac{A}{4 \pi Z}$$

where A is the area of either coating, and z the distance between the coatings. So in the above case this quantity will be

$$\frac{2 \pi r b}{4 \pi T}$$

if T is the thickness of the insulation. We will consider the order of magnitude of this capacity for a given example.

Let the breadth of the coil be 2 inches, and the mean radius of all the windings on it be 3 inches, and let the diameter of the covered wire with which it is wound be rather more than ½ millimeter, or say 1/40 of an inch. The capacity of each layer, with regard to the layers above and below, will then be

$$\frac{r b}{T} = 240 \text{ inches}$$

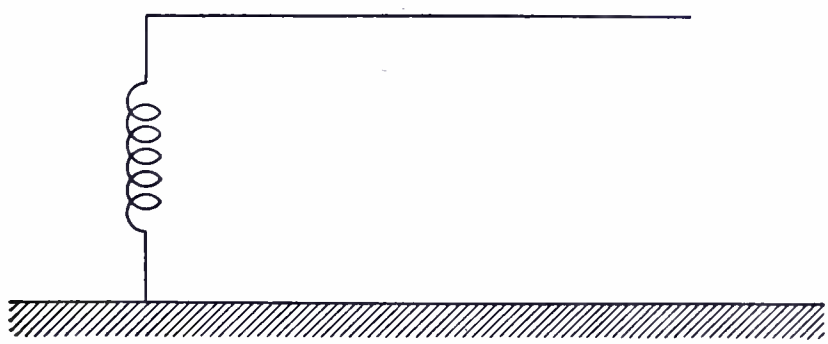
that is, 20 feet, which is comparable to the capacity of a single-wire antenna 400 feet high!

The coils I advocate are wound with much thinner wire than that. And if the diameter of the covered wire is .006 of a centimeter, even though the breadth of the channel is only 1 centimeter, yet with the mean radius 3 centimeters, the effective capacity will be

$$\frac{3}{.006}$$

that is, 500 centimeters, or 5 meters, which is still very large—bigger than most amateur antennas.

To have that capacity, a single-wire antenna would have to be about 100 meters long, and even a quadruple horizontal antenna with its four wires spaced a yard apart would have to be 40 meters in length.



THIS CIRCUIT WOULD TUNE SHARPLY

The inductance added to the circuit between the antenna and ground serves as a balance wheel to the electrical oscillations and keeps them swinging much longer than would be the case with the antenna shown on page 453.

But we do not want the capacity of the coil to have any relation to the capacity of the antenna. The coil should be kept in its due insignificance so far as regards capacity. What we want in the coil is inductance. Distributed capacity along the coil only introduces confusion, spoils the sharpness of the tuning, and makes precision impossible. It introduces the same kind of confusion as a submarine cable introduces into telephonic speech. The Leyden jar effect of a cable—that is, of a wire conductor separated by an insulator from an outside coating—prevents high-speed transmission and tends to smooth out the signals and make them indefinite.

This effect in cables can be remedied by the introduction of coils at intervals, showing that coils are not in themselves deleterious. But they should always have as much inductance as possible in proportion to their resistance, so as not to introduce unnecessary damping.

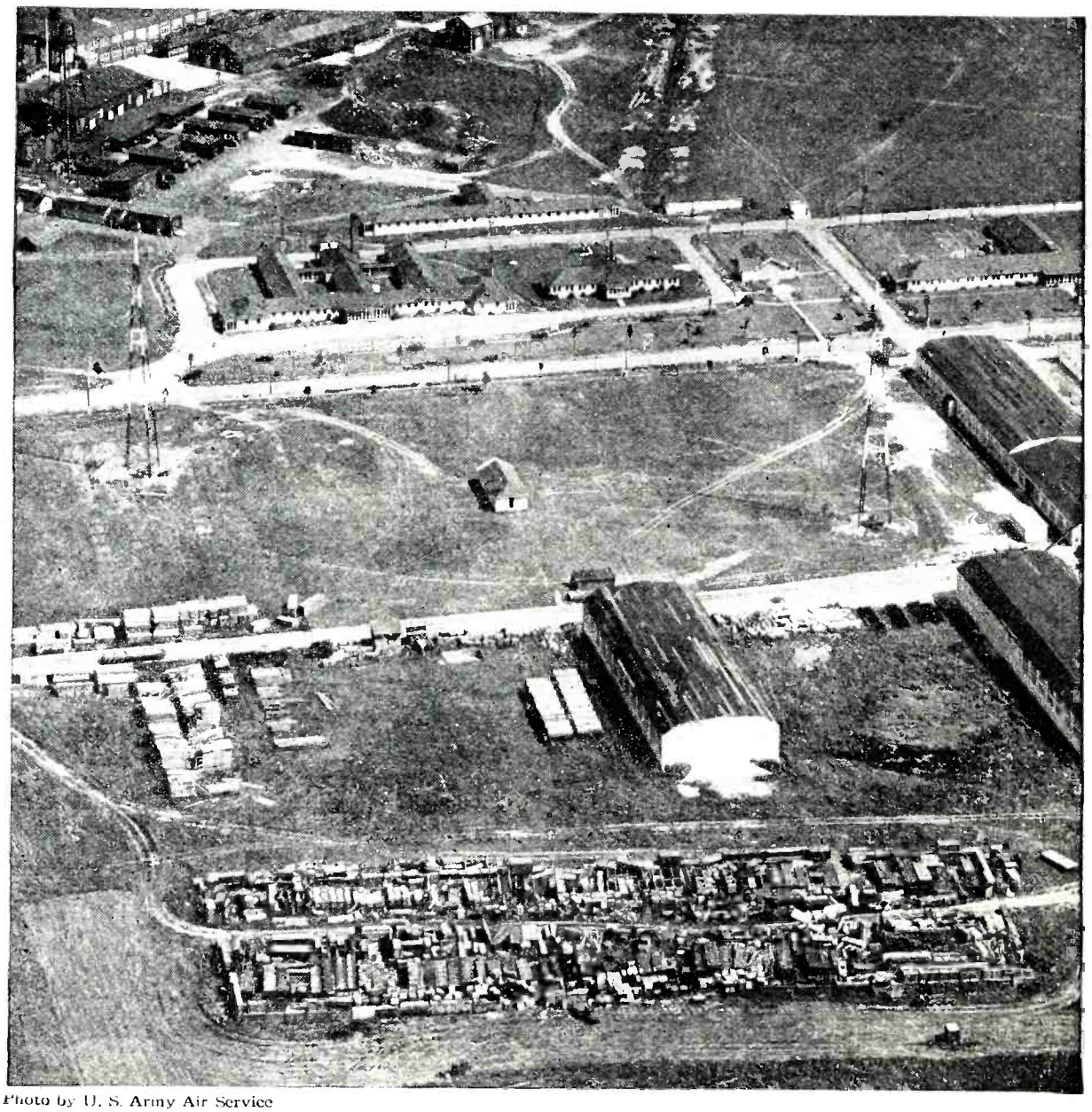
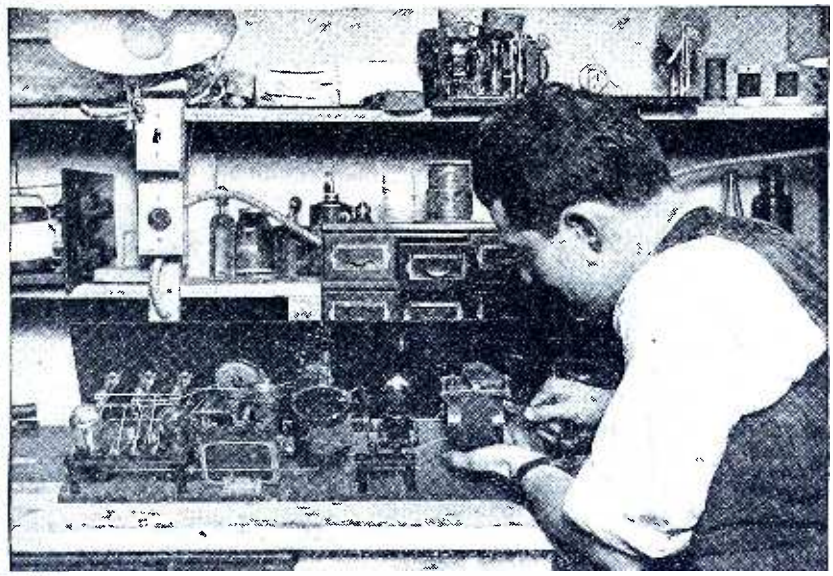


Photo by U. S. Army Air Service

AVIATORS DEPEND ON THIS STATION FOR WEATHER REPORTS

A radio broadcasting station has been established at Wilbur Wright Field in Fairfield, Ohio, by the Government. Storm warnings and lectures on aviation make up the programs instead of the usual jazz and vocal selections sent out by other stations.



Care in wiring and a well-thought-out arrangement of the instruments in the receiver he built make it possible for Harold Herberts of New York to receive the Pacific Coast stations regularly.

Practical Helps for Radio Fans

By Y. Z. MUTS

How to Place Condenser: Placing a condenser in series with your aerial or ground, will materially reduce the wavelength of your receiving set. If you cannot reach the higher waves on your set, this may be the cause. Place the condenser so that one side is connected to the aerial and the other to the ground; this is a parallel connection and will increase the wavelength range of the set.

Don't Change Wiring While the Tubes Are Lit: Do not be guilty of trying to change the wiring in a receiver installed in a cabinet while the tubes are lit and the "B" battery is connected. Disastrous results are often caused in this manner, but particularly the burning of tubes, through the crossing of the "A" with the "B" battery. Take caution and heed this warning; it will save you money.

Where to Look for Interference: Often large metallic frames and rafters effect the loop antenna and the functioning of your receiver. Should the set be removed to another room in the opposite direction, surprising results may be obtained. It is well to bear in mind that no radio set, whether receiving or transmitting, will work efficiently if large grounded metallic elements are in the immediate vicinity.

On Grid-leaks: The ordinary fan goes into a store to purchase a grid-leak. It is such a small looking article that he often does not realize its importance. It is poor policy to buy the cheap ones. A cheap leak will change its value several times during the night and may even be responsible for noises in the receiver. It is good policy to buy the best.

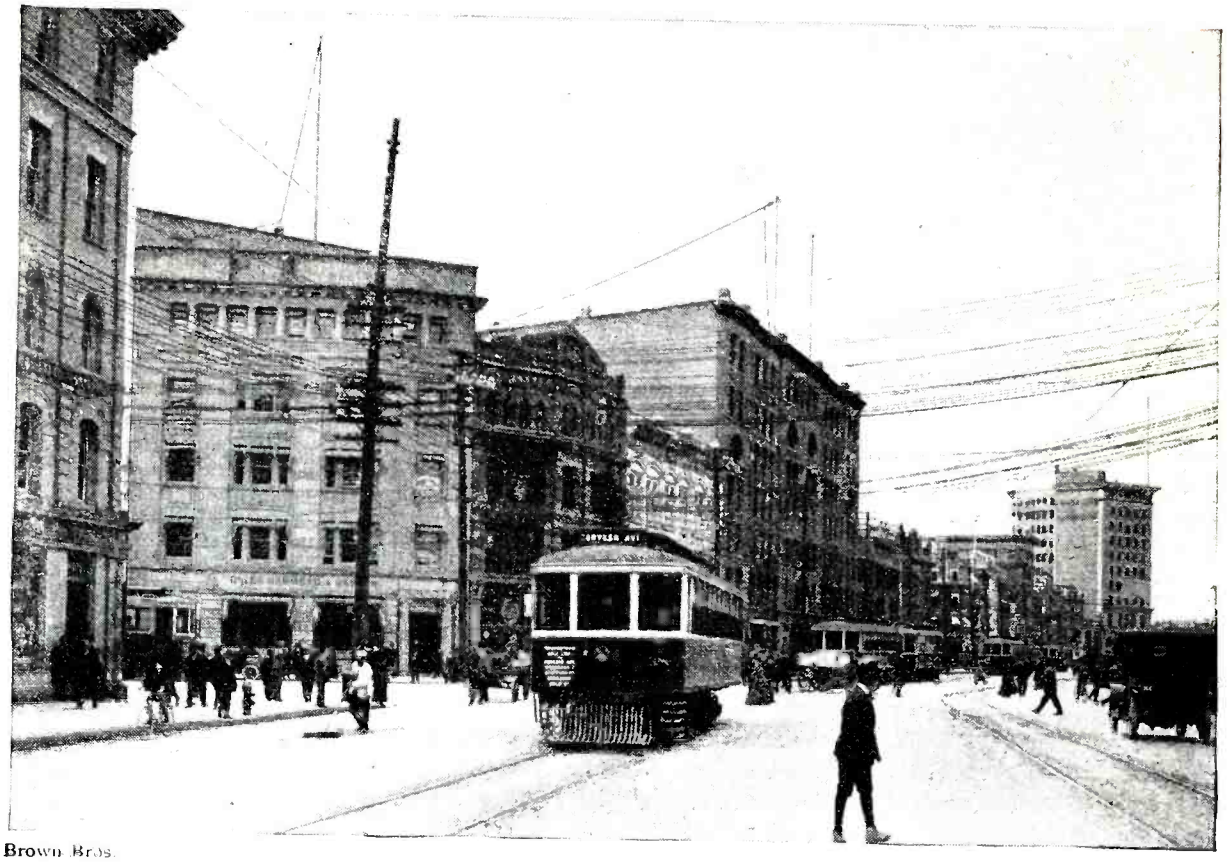
Tighten Aerial: An aerial that is permitted to swing may produce jerky and uncertain reception. The tighter the wire is stretched, the better it is for the receiving of signals. Place your aerial in such a manner that it can be made tight and that nothing will loosen it.

Mounting Transformers: Never mount transformers too close together. Close mounting causes squealing and howling in the headphones or the loudspeaker.

Regenerative Set: In regenerative sets, begin tuning for the station with regeneration at zero. When the station is heard, increase regeneration until the signal is at its loudest pitch.

How to Make Dials Turn Smoothly: Have you ever noticed that on some sets the dials turn with a velvety feeling and on others you have tried they turn hard and touch the panel at certain points, which causes an unpleasant scraping sound? All dials can be made to have that velvety feel even if the shafts of the instruments do not pass through the panel at a perfect right angle. Cut out a circular piece of felt, similar to and slightly smaller than the circumference of the dial, with a hole in the center to accommodate the shaft. The felt piece is placed between the panel and the dial and acts as a bumper at the point where the dial usually touches the panel.

Use Large "A" Battery Wires: When the "A" battery is some distance away from the receiving set, it is best to have the wires rather heavy to reduce resistance. No. 12 rubber-covered will be satisfactory for this purpose.



Brown Bros.

ONE CAUSE OF POOR RECEPTION

Besides the various noises that may be produced in receiving sets by defects in the large number of electrical wires in the neighborhood, the overhead trolley system generates grinding and crackling noises that seriously interfere with reception.

HOW TO LOCATE

Interference from Power Lines

A common cause of annoyance to broadcast listeners—and how to locate and overcome it

By W. VAN NOSTRAND, JR.

ONE of the most serious problems confronting those interested in radio broadcast reception at the present time is the interference experienced from power lines.

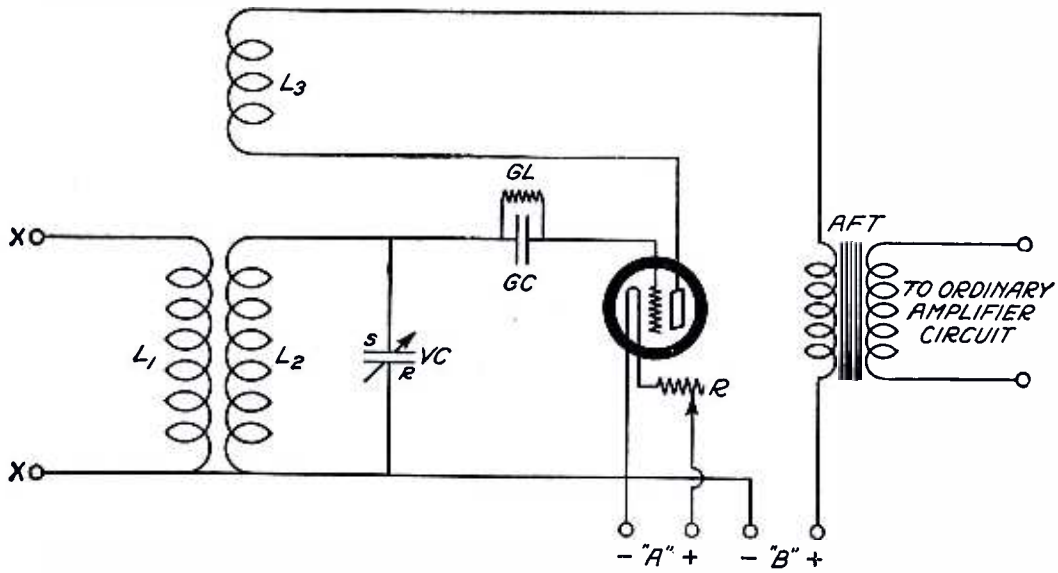
Interference of this nature may be set up in power lines by various defects, such as grounded transformers, leaky insulators, arcing from one circuit to another or to the ground, faulty generators and innumerable other causes. In most cases, while leakages of this nature strongly affect the super-sensitive receivers in use at the present time, the losses from such leakages are not noticeable at the power house or sub-station, and the average operating company is without the proper means of locating such disturbances—although it is usually found that they are anxious to locate and remove the faulty circuit when it is possible to do so.

Inasmuch as interference of this nature is so noticeable in radio reception, it is natural that a radio receiver should be used in locating the source of the disturbance.

Such a receiver must be portable and it must employ a loop antenna or receptor. The most essential factor is the directional property of this loop antenna. If the loop antenna is directional in its effect the source of interference may be located by direct tracing or by triangulation; that is, by taking a bearing with the loop receiver from two or more different points in the zone of interference and drawing lines on a map of the city, one from each point where a bearing is taken, in the direction in which the loop antenna points, and the source of the interference will be found at the point of intersection of these lines.

A common type of power-line interference is that produced by an arc in a circuit due to leakage from one circuit to another, from a circuit to the ground, or to a poor connection. This arc tends to set up currents which feed back through other power lines, with the result that the interference is noticeable over a wide area, although the maximum interference will be noted in the immediate vicinity of that part of the circuit which is arcing. With an ordinary receiver that employs a loop antenna, it is often difficult to locate the source of interference by triangulation, due to the fact that the interference is prevalent over such a wide area and affects the receiving circuit direct or through the battery and telephone leads, thus tending to destroy the directional property of the loop antenna. It is, therefore, essential that a receiver be employed which will not be affected by disturbances except through the medium of the loop antenna. A receiver of this type has recently been used in an investigation of power-line interference in a Georgia city.

The wiring diagram of the receiver is shown in Figure 1. The primary and tickler coils are wound in the same manner as the coils in a "low-loss" tuner, of No. 18 cotton-covered wire, 3¼ inches in diameter, the primary having 5 turns and the tickler 12 turns. The secondary is wound on a 4-inch cardboard tube in the ordinary way, of No. 18 cotton-covered wire, having 23 turns. A .0005



THE WIRING DIAGRAM OF THE INTERFERENCE LOCATOR

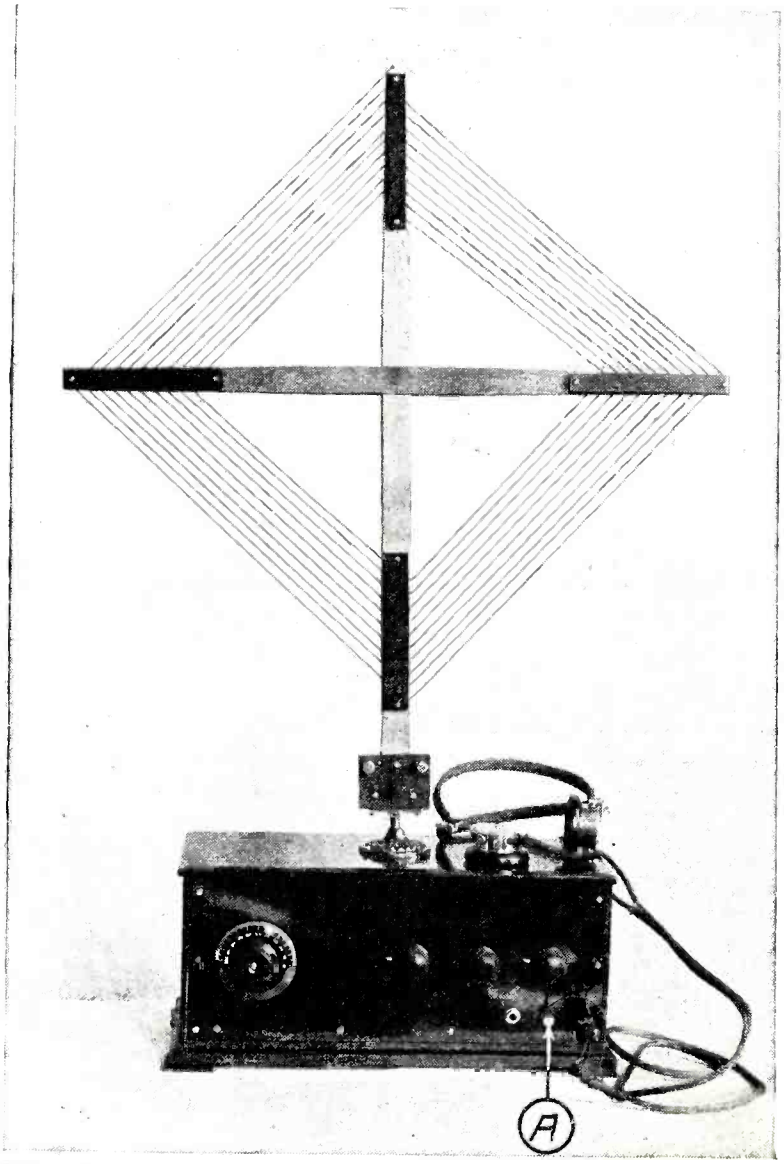
FIGURE 1: *The terminals marked X connect to the loop. The circuit is the ordinary three-coil tickler hook-up. Any other good circuit can be used provided it is arranged to tune the wavelengths below the broadcasting, so that the interference can be received without the music or lectures.*

mfd. variable condenser is shunted across the secondary.

The construction of the loop antenna is shown in Figure 2.

The thorough shielding of the receiver should be noted from Figure 3. The inside of the receiver cabinet is lined on all sides with tin and all battery and telephone leads are covered with copper braid connected to the shielding inside of the cabinet. The shielding around the telephone leads is connected to a binding post between the telephone jacks, the binding post being connected to the shielding inside of the receiver cabinet.

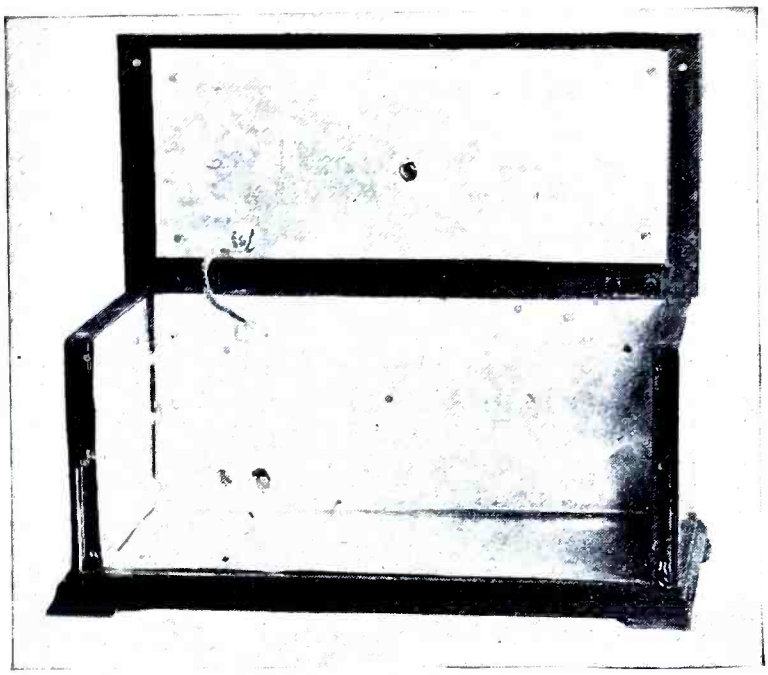
The first test was made with an ordinary loop receiver, with which the interference was traced to a street lighting circuit, which, when cut off, eliminated the interference. This circuit, however, is twenty miles long and the power company had no means available for locating the exact point in the circuit from which the interference came and the loop receiver being used was not sufficiently directional to locate it. A power-line expert was then sent to this city but was unable to locate the



From a photograph made for POPULAR RADIO

A SET THAT LOCATES POWER-LINE INTERFERENCE

FIGURE 2: *The binding post A, between the two jacks, is grounded on the shielding inside the cabinet so that an extra wire connected to the copper braid that is wound around the phone cords may be grounded to the inside shield.*



From a photograph made for POPULAR RADIO

COMPLETE SHIELDING MAKES THE LOOP SHARPLY DIRECTIONAL

FIGURE 3: *Shielding may be of doubtful value in many types of receiving sets, but it is essential in locating interference. The cabinet shown above is completely lined with sheet metal. The top section is electrically connected to the rest of the shield by the piece of copper braid, as shown.*

exact source of the trouble, although exhaustive tests were made of lights, insulators, generators and other equipment under suspicion. These tests, however, developed some interesting facts and after comparing notes on these two tests it was decided to construct the receiver referred to above.

Another test was then made using this thoroughly shielded receiver. The interference was found to be greater in one section of the city and the point of maximum intensity was found by listening on various broadcast receivers in the vicinity. Maximum interference was noted at the residence of a broadcast listener two blocks from the point where the defect in the lines was ultimately found. At this point, using a receiver employing three stages of radio-frequency amplification, detector and two stages of audio-frequency amplification, connected to a loudspeaker, the disturbance could be heard for nearly two city blocks, completely drowning out all broadcasting stations.

The shielded receiver was mounted in an automobile and the maximum signal strength was noted when the loop receptor was pointed directly down the street. As a 13,000-volt transformer was located in the center of the street about five blocks away, the automobile was moved in that direction, but upon arriving at the transformer it was noted that the signal strength had decreased and the loop receptor pointed back up the street. Several trips were made up and down the street between two of these transformers until the car was finally stopped about two blocks below the residence of the broadcast listener, directly in front of a suspended street light, where it was found that the signal strength was at its maximum.

A pole was secured and when this light was tapped the interference varied from nearly minimum to maximum as the light swung from its support; this variation was noted on both the portable loop receiver and also on the receiver located in the residence of the broadcast

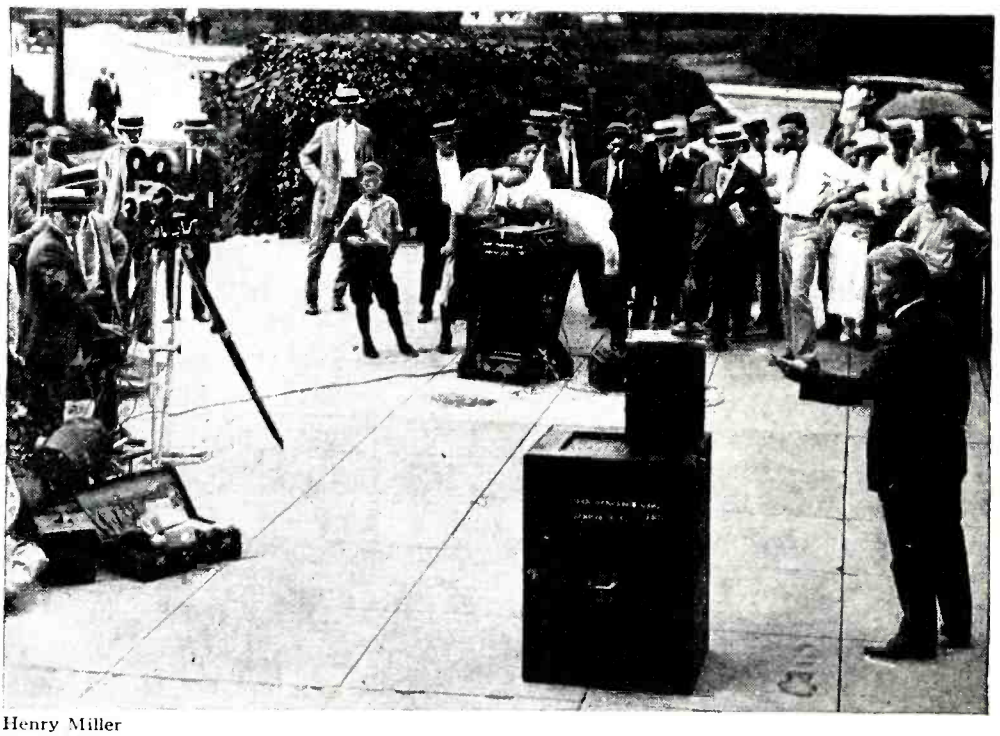
listener two blocks away. The car was moved about one block, first to the right and then to the left of the light, and new bearings taken; and in each instance the loop pointed directly toward this light.

A lineman was secured who shorted the light, which was a high-voltage series lighting circuit. But this did not remove the interference. The outlet to this light was then shorted on the pole and the circuit leading to the light entirely cut out, but this also failed to eliminate the trouble, although tapping the light caused the strength of the interference to vary as first found. The lineman shook the various wires attached to the pole below the 13,000 volt line; it was found that the interference stopped when the steel guy wire, supporting the street light, was raised. This guy was found to be lying across a 2,300-volt primary circuit, causing an arc. The light, swinging in the wind at times, apparently accounted for the intermittent nature of the interference.

The tests were started at 8.00 P.M. and the trouble was located about midnight; a lineman was secured and the trouble remedied about 3.30 A.M. About eight hours were required for the test. It will be found in such cases that patience is as much a necessity as the proper type of equipment.

The circuit employed in a receiver used for this purpose was not found to be important, so long as sufficient amplification is employed, two stages being preferred, and the wavelength range is low enough to avoid interference from local transmitting stations.

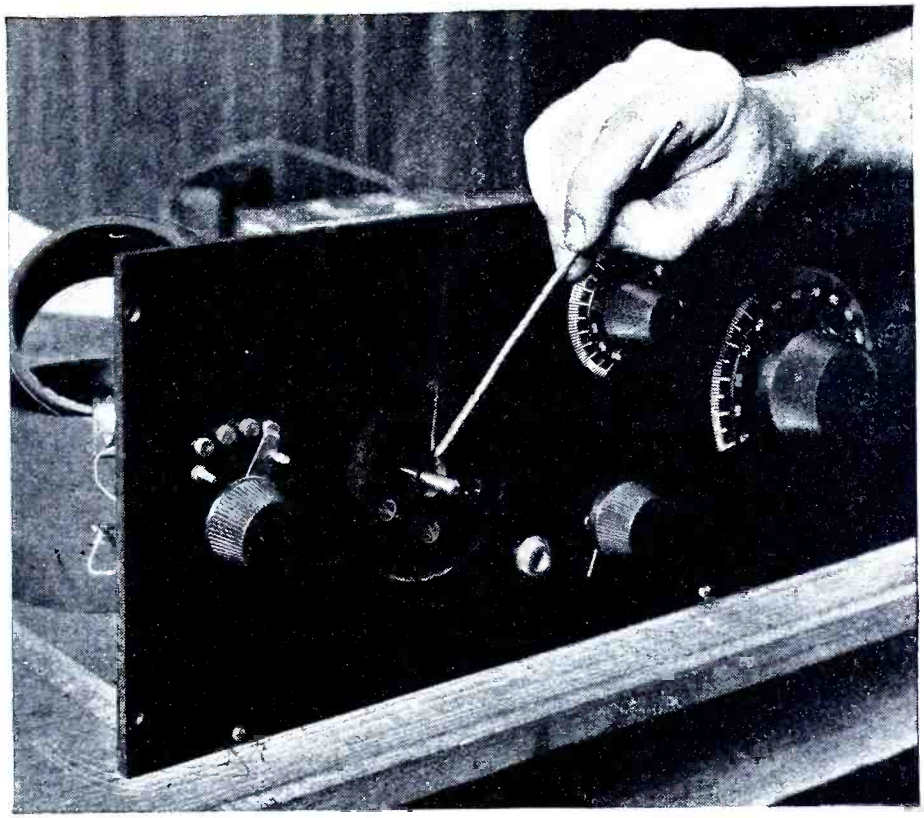
The shielding, however, is extremely important. Isolating the receiver in this manner, but not connecting any part of it to the shielding, tends to increase the directional properties of the loop receptor, which is a vital factor in locating any type of interference.



Henry Miller

HOW RADIO ENABLES THE PRESENT-DAY POLITICIAN TO MAKE "CARBON COPIES" OF HIMSELF

Between the motion picture and the talking machine the modern campaigner can be seen and heard simultaneously in innumerable places. This picture shows Robert La Follette rehearsing a speech before the De Forest phonofilm, for use during his presidential campaign.



From a photograph made for POPULAR RADIO

MAKE LARGE HOLES FOR THE SHAFTS OF INSTRUMENTS

In properly designed condensers, rheostats and other instruments that are made to mount on the panel with the shaft projecting through it, it is not necessary that the hole in the panel should serve as a bearing for the shaft. Note the clearance around the shaft; it cannot bind on the edges of the hole and turn hard.

Useful Radio Kinks

"The other day," writes Mr. Rosebury, "I was watching a newly-bitten radio fan making his first set. I particularly noticed how he laid off the holes for a switch arm and contact points, and connected the leads from the variocoupler to the contact points. As an intimate friend, I was privileged to criticize and to show him some easy ways of doing the hard jobs and some easy methods of obtaining accuracy. And that incident gave me the idea of writing this article."

By FRED ROSEBURY

NOT every fan has access to practical information in a hurry. In fact, many rely solely on instructions that are given by a busy radio dealer. In many cases the information thus obtained is not explicit and it is sometimes inaccurate.

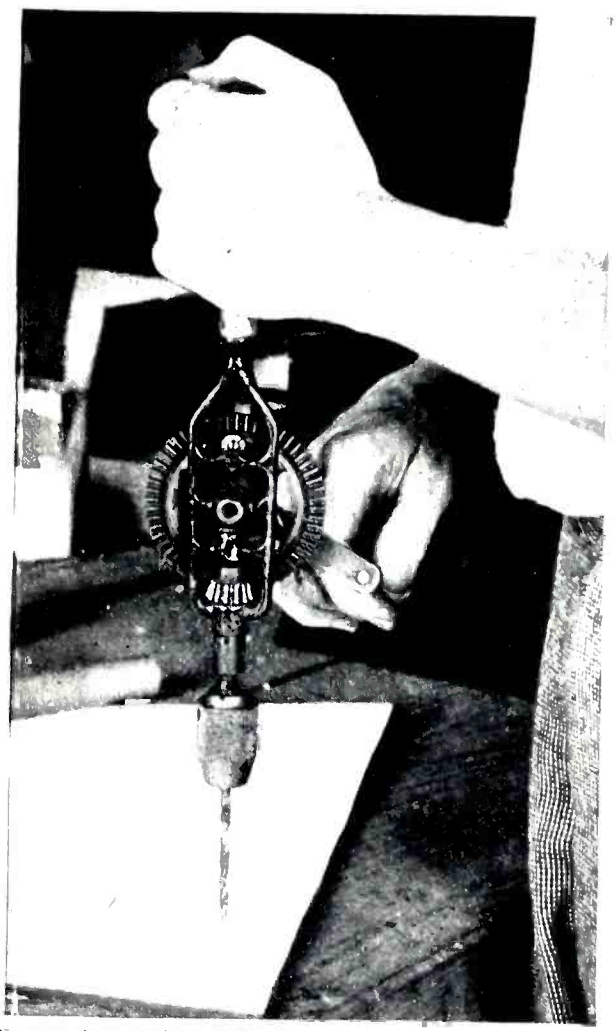
HOW TO DRILL A PANEL

For instance, consider the simple matter of drilling a panel.

I have seen some fans scratch the surface in a crude fashion with a sharp-pointed instrument. A medium-pointed pencil should be used, as the marks may easily be removed. A better method (which requires more patience) is to take a piece of paper the same size as the panel and lay out all holes and measurements in plain sight. Then paste the sheet squarely on the surface of the panel, preferably with ordinary white

paste, which can be removed very easily with a damp cloth. Use a sharp center punch (which may be bought for about twenty-five or thirty cents) and center each hole with a single light blow of a hammer. Sometimes, if the hand is not steady, more than one blow of the hammer may result in several marks on the panel, which would be confusing when the hole is to be drilled.

To lay out holes for mounting a switch arm and contact points, use a compass; after taking the radius of the switch arm from the center of the shaft to the contact end, draw a circle or part of a circle on the paper or panel. Then, measure the diameter of the heads of the contact points.



From a photograph made for POPULAR RADIO

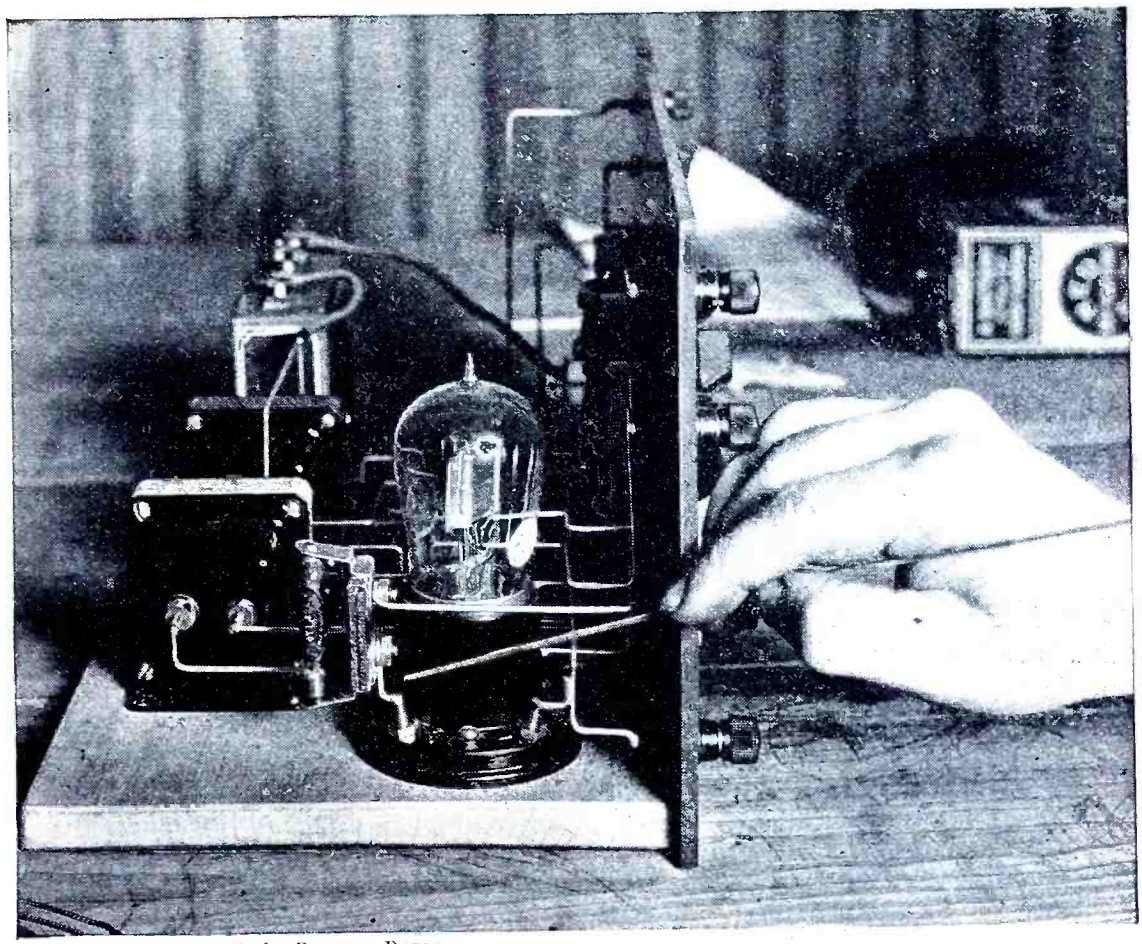
HOW TO DRILL THE PANEL

Note the sheet of paper pasted over the panel. The locations of all the holes are marked out on the paper and then the panel is center-punched and drilled through the paper. This method prevents accidental scratches on the surface of the panel.

Let us assume that it is 3/16 of an inch. The reader will use his own judgment in spacing the contacts, but it is not advisable to space them less than three times the radius of the heads, from center to center. In the case of contact points, the heads of which are 3/16 of an inch, open the compass to 5/16 of an inch, which will secure ample spacing.

If the number of contacts to be used is an odd number (say seven), draw a line with a ruler through the center of the circle perpendicular to the horizontal measurement of the panel; where this line intersects with the circumference at the top of the circle, make a dent with the center punch. Take the compass, set at 5/16 of an inch, and using this dent for the pivot, make a mark with the pencil end of the compass on the circle, on both sides of the punch mark. Then center punch these new intersections, and using either one for a new pivot, make another mark 5/16 of an inch away on the circle.

Do the same thing on the other side of the original dent, and continue until there are three marks on both sides, and, including the first one, the total is seven. Any odd number may be laid off in this manner. The holes for the switch stops may be placed a little closer to each end mark, say 1/4 of an inch. If an even number of holes is required, draw the perpendicular as before, but do not center punch this intersection, but lay off 5/32 of an inch on each side and center punch these marks, continuing as for odd numbers, until the required number has been done. It is an excellent plan to check up the compass after each mark; this will insure accuracy and also a neat job. In drilling holes, always see that the drill is sharp. A little oil will sometimes prevent the back of the panel from chipping out. Do not put heavy pressure on the drill.



From a photograph made for POPULAR RADIO

THIS WIRE SHOULD BE SHORT

See how the grid terminal of the socket is connected to the grid condenser. With a wire as short as this there is no chance for stray capacity effects to cause distortion or weak signals.

HOW TO MOUNT APPARATUS

In mounting apparatus such as variable condensers, variometers or variocouplers that have a ¼-inch shaft, it is advisable to drill a hole at least 9/32 of an inch in diameter so that the shaft will rotate freely. The dial will cover the hole anyway. So far as variable condensers are concerned, a paper template is supplied by the makers, showing how to drill the holes; therefore no instructions on this point are necessary here.

To mount wooden block variometers, it is best to fasten them by means of wood screws up from the bottom of the baseboard instead of from the panel, as the latter sometimes results in warping or bending of the panel—especially in the case of hard rubber.

HOW TO CONNECT LEAD WIRES

When connecting lead wires from coupler taps to contact points it is preferable to solder them at both ends. A heavy wire should be used such as No. 16 or 14 B. & S. gauge. "Spaghetti" is to be avoided on these leads as it tends to increase the distributed capacity, which is undesirable. When buying a variocoupler or other tapped inductance, see that the taps are rigid and not likely to loosen the turns when connecting the leads.

HOW TO HANDLE THE WIRES

It is a good scheme, when building any kind of a set, to bring out the leads, antenna, ground, "A" and "B" batteries and other parts at the rear of the cabinet. Use a strip of bakelite or other insulat-

ing material one inch wide and of the right length for the number of binding posts. The posts should be spaced one inch apart, and an additional hole should be drilled on each end of the strip, about ⅜ of an inch from the end for the mounting screws. Mount the strip on the back of the basboard near the back. Use long wood screws with a thick nut or several washers to raise it about ½ inch, so that the binding post screws will not touch the wooden base. (See the accompanying diagram.)

HOW TO CUT HOLES FOR SCREENS

The use of bezels or screens in vacuum-tube sets is becoming popular, but these items are of little value with sets that use the dry-cell tubes, as the filament is barely visible even upon close examination. But if screens are to be used, a special tool can be obtained from your dealer which cuts a neat round hole. Lacking this, a good method (but one which takes much more time and labor), is to draw the circle on the panel or template (the sheet of paper described before) and take a sharp drill, making a series of holes close together around this circle, taking care not to let the holes go outside of the circumference. When this has been done, a sharp-pointed knife may be used to cut out the section. Then, with a half-round file of the proper size, smooth out the hole, taking precautions not to exceed the required size. Make it just large enough so that the bezel will fit snugly. If you do accidently make the hole a trifle large, a few drops of solder around the inside edge of the bezel will hold it in the panel.

Concerning the use of tin or copper foil on the back of the panel to reduce body effect, I must state that I have had very poor results with it, using a standard, three-circuit tuner. It does help the body-effect problem to some extent, but I find that it also reduces the signal strength slightly, due probably to absorption of current from the apparatus.

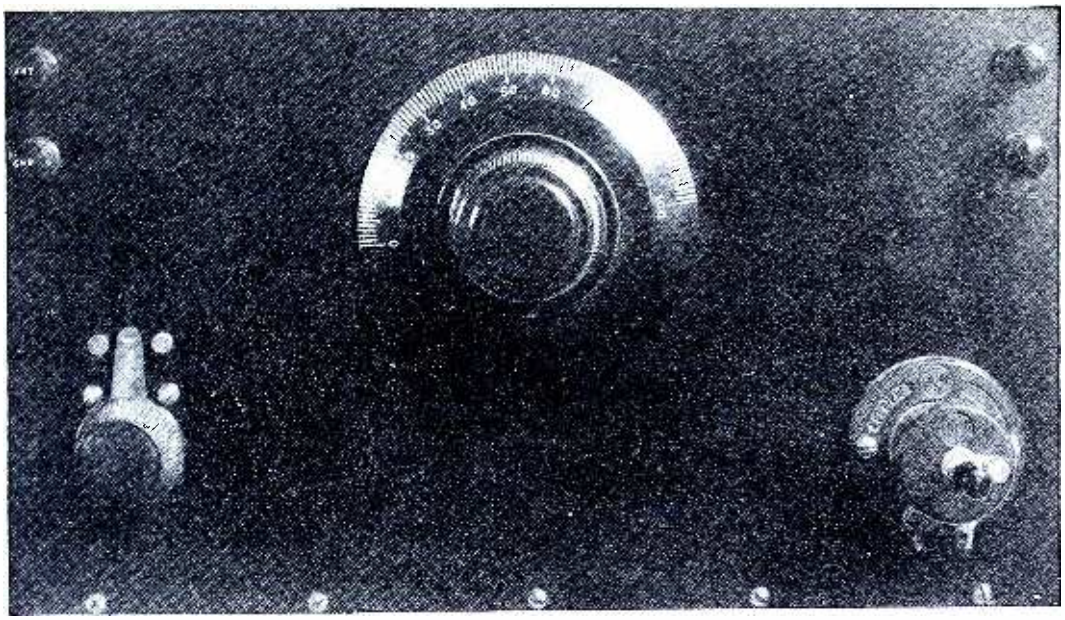
POINTERS ON SHORT LEADS

Much has been said and written about the necessity for short connections, but some of the first radio sets of fans I have seen, look like one of those tropical banyan trees whose structure may be represented by taking a close up of a piece of steel wool. Keep in mind that the shortest distance between two points is a straight line, and unnecessary kinks and bends should be avoided. The lead from the grid-leak and condenser to the socket should be just as short as it is possible to make it; if possible, the grid condenser should be attached directly to the grid post of the socket. The lead from the other side of the grid-leak and condenser should also be short. However, do not sacrifice efficiency by crowding the instruments so as to obtain short leads. A little study before undertaking to build a set, as to the best location for the apparatus without sacrificing neatness, is to be recommended. Do not make too sharp bends in wires; it is both electrically and mechanically wrong. Use your hands for this, avoiding pliers except to straighten the wire.

A NOVEL SCHEME FOR MAKING TAPPED COILS

Instead of making a loop and twisting the wire where a tap is required, get some "O.K." paper fasteners, and after removing the insulation from the wire, slip one of these fasteners over it. When the coil is completely wound, flow a little solder over the wire and fastener with a hot soldering iron. Be sure to use rosin as a flux.

¶ *Do you know how to get the maximum service out of your storage "A" batteries? Most broadcast listeners do not.* POPULAR RADIO *for next month will tell you.*



THE PANEL ARRANGEMENT OF THE CRYSTAL RECEIVER

The antenna and ground binding posts are on the left side of the panel near the top. The set is tuned by the switch at the lower left side of the panel, which changes the wavelength range and the dial in the center which adjusts the variometer. The phones are connected to the binding posts at the right of the panel. Sensitive spots on the crystal are found by means of the knob projecting from the crystal mounting at the lower right.

Simple "How-to-Build" Articles for Beginners No. 3

How to build an efficient crystal receiver

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $10.00*

APPROXIMATE RANGE: *15 miles*

HERE ARE THE ITEMS YOU WILL NEED—

A1, A2 and A3—Dubilier mica fixed condensers, .0001 mfd., .00025 mfd. and .0005 mfd., respectively;
B—switch lever and knob;
C1, C2 and C3—switch points;
D—Sickles diamond-weave variometer;
E—Pacent No. 30 crystal detector;
F—composition panel, 7 by 12 inches;
G—baseboard, 12 by 7 inches.

THE third receiving set of this series is a crystal receiver that employs a variometer of efficient design for tuning, in conjunction with three fixed condensers in order to cover the broadcast wavelengths.

This set was built in the POPULAR RADIO LABORATORY with the express purpose of submitting to the beginner a receiver that will give satisfactory results on local broadcasting at the lowest outlay from an expense point of view.

The set is extremely easy to construct and to operate.

Take this magazine to a dealer and ask him to give you the list of parts that are included at the head of this article. Then take the parts home and set up the

panel as shown in the diagram and the two pictures and mount the instruments as also shown.

Next, wire up the instruments as indicated in the picture diagram. You can't make a mistake; all the connections are clear, and the instruments are marked as they appear in the diagram and in the list of parts.

When you have finished wiring up, all you have to do is to connect the headphones, the antenna and ground to the set.

The antenna and ground connections should be connected to binding posts No. 1 and No. 2. The telephones should be connected to the posts No. 3 and No. 4.

A 100 to 150-foot single-wire antenna will be suitable.

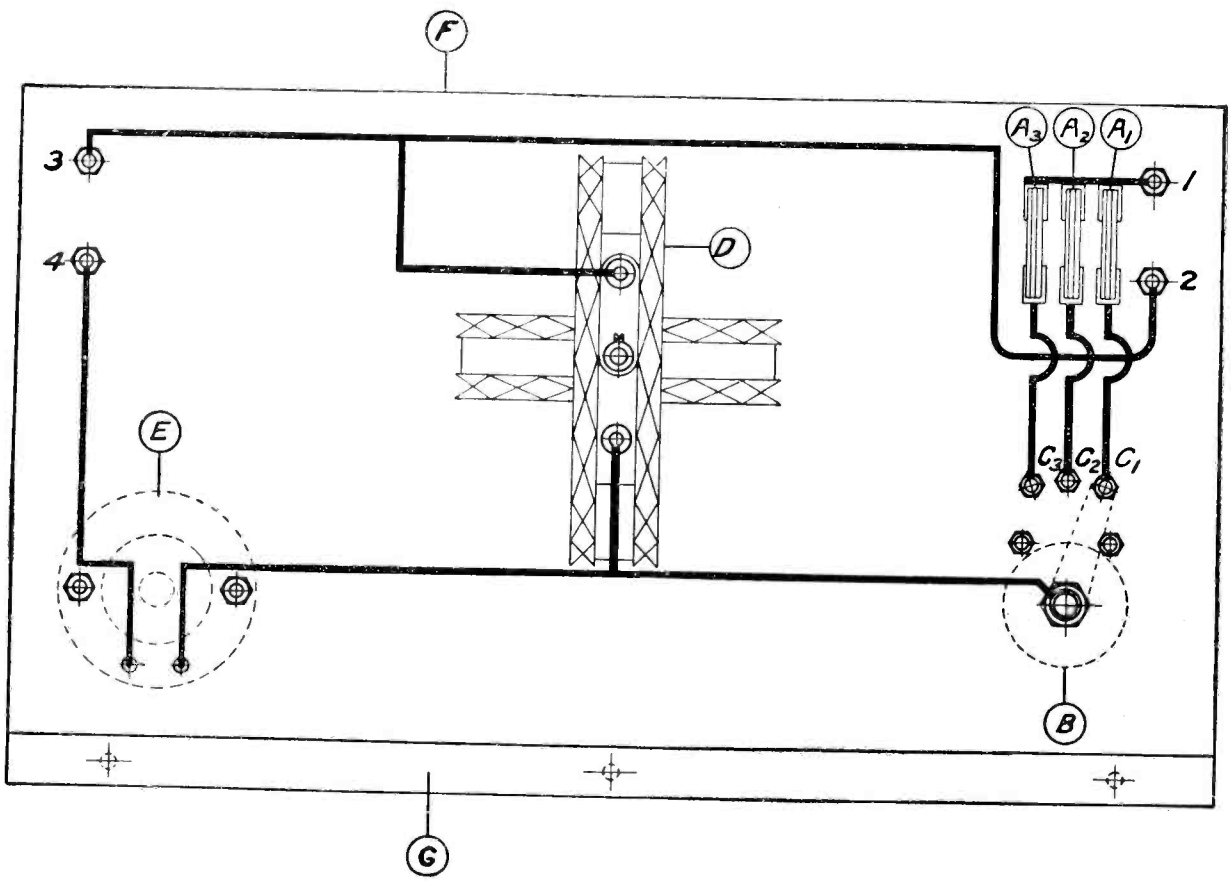
To tune the set, place the switch lever B on the switch point C3 and rotate the dial of the variometer D, at the same time adjusting the crystal detector E. When you finally hear a station, tune in with the variometer and, when you have that instrument tuned in loudest, make a better adjustment of the crystal.

All you have to do after that is to tune with the variometer and the switch lever B.

You will find that you will be able to tune in all the local stations with remarkable clarity and with plenty of signal strength for working several pairs of headphones.

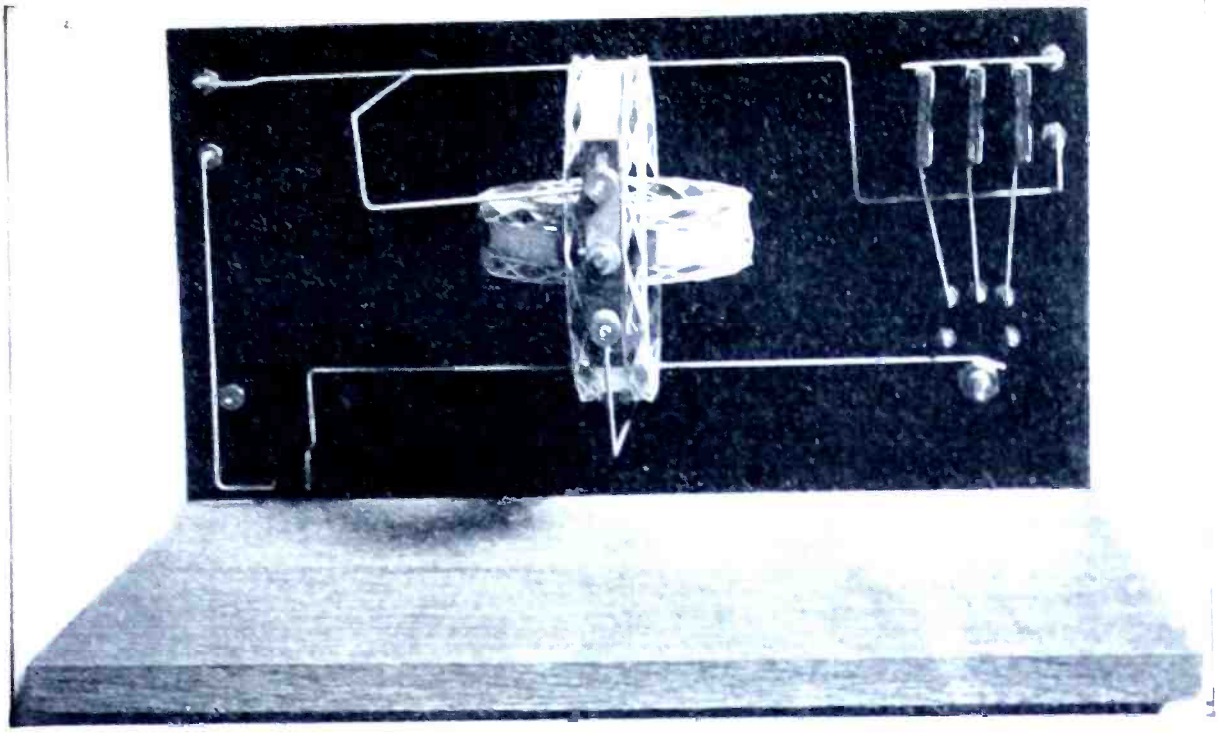
Of course, there are no batteries used and no upkeep cost except for replacing the crystal in the detector when it becomes worn out. This will be once in about every three or four months.

Proper care of the crystal is an important item in crystal sets. Do not



THE "PICTURE DIAGRAM" OF THE HOOK-UP

A glance at the above illustration will convince even the novice that this radio receiver is easily wired. In this form of diagram the instruments are shown in picture form and the connecting wires are drawn in, in the EXACT MANNER THAT THEY SHOULD GO IN THE SET. *The terminals are plainly shown and the instruments are marked with designating letters that reappear in the text and the list of parts.*



THE REAR VIEW OF THE SET

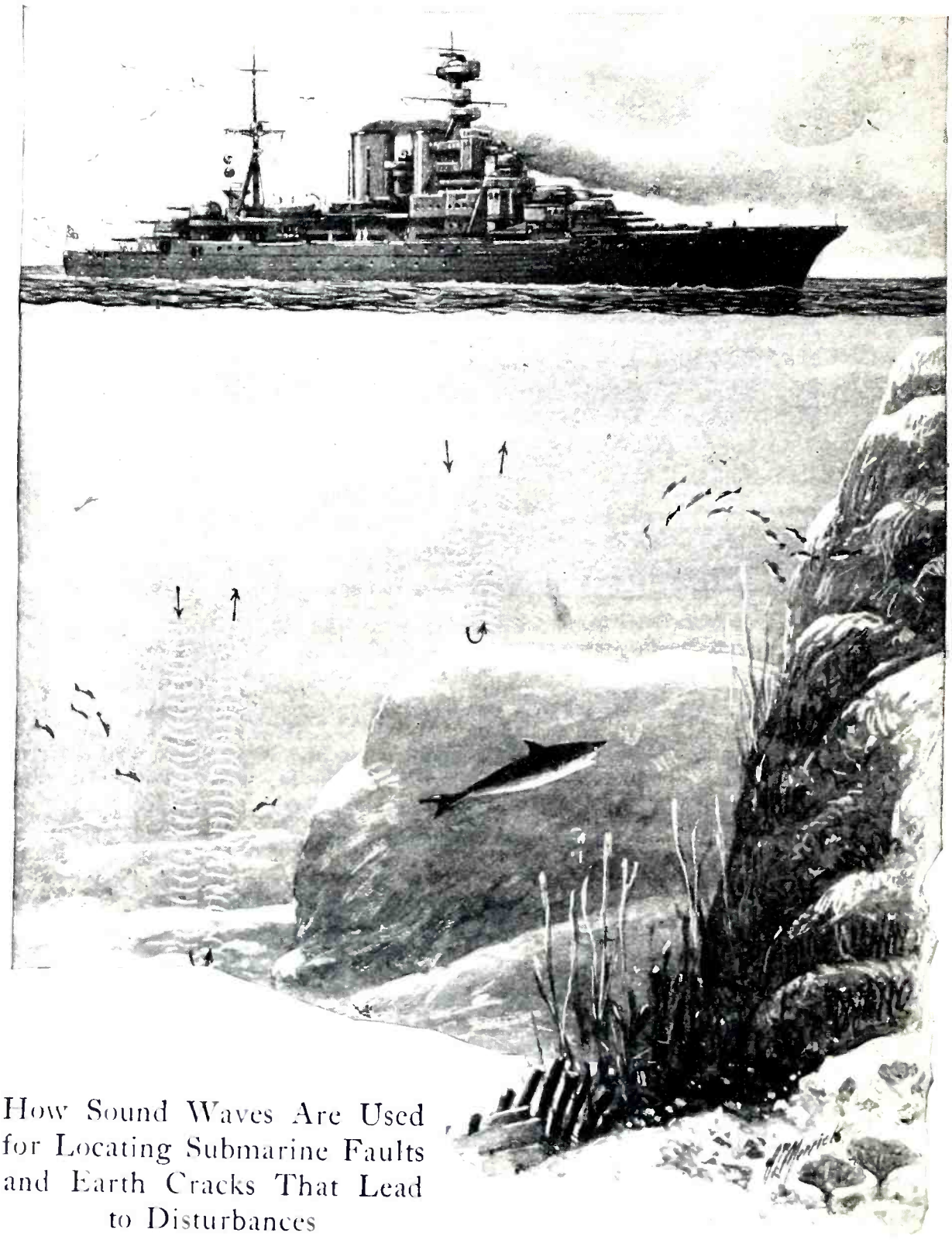
Study this view in connection with the picture diagram at the head of the first lesson. The location and connections of each wire appear clearly. Note that the two wires that connect the crystal detector D into the circuit are run through holes in the panel to the terminals of the detector which are on the front of the panel.

place the bare fingers in contact with the sensitive surface of the crystal, as the slight film of perspiration which may be left on the surface cuts down the signal strength materially. In this set the crystal is protected from dust so that you will have no trouble from this source.

General Electric Co.

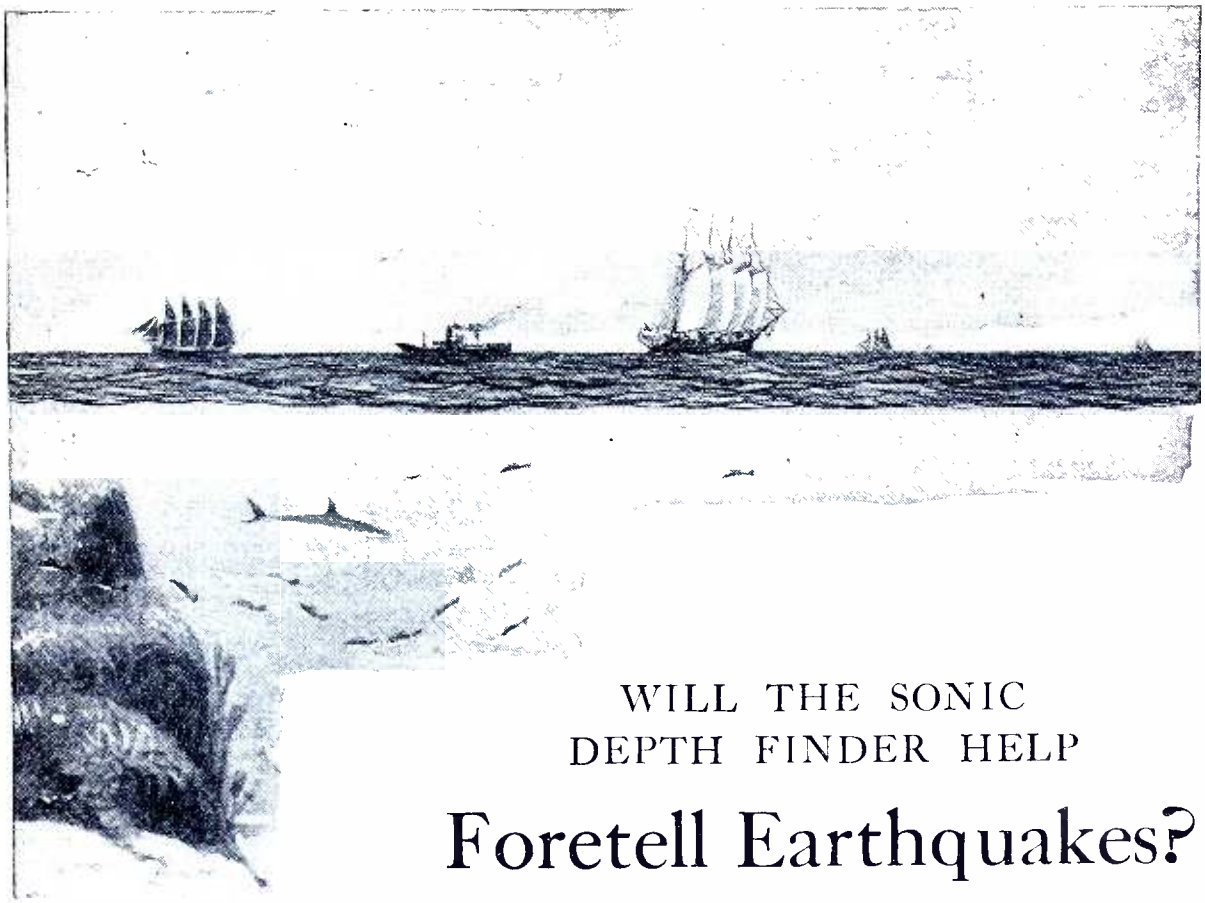
THE DEATH STRUGGLE IN THE FOREST—AS PLAYED BEFORE THE MICROPHONE

The radio drama is developing a new art of making sounds that stir the broadcast listeners' imagination. In this scene from "Pierre of the Plains" onion-skin paper served as dead leaves; the slap-sticks served as horses' hoof-beats.



How Sound Waves Are Used for Locating Submarine Faults and Earth Cracks That Lead to Disturbances

The ship's apparatus projects a powerful wave of sound downward, as shown by the arrows. When the sound wave reaches the bottom, it is reflected upward to the ship again. The length of time required for the round trip of the sound wave is measured with great accuracy and, as the speed of sound in water is known, it is possible to calculate the exact depth of the water.



WILL THE SONIC DEPTH FINDER HELP

Foretell Earthquakes?

How a remarkable field of exploration is being opened up by a newly developed instrument which employs radio apparatus, radio science and radio technique

By CARL H. BUTMAN

TWO destroyers of the United States Navy recently made a complete depth chart of the ocean off the coast of California, from San Francisco to the Mexican Boundary, in 35 days. Submerged mountains and valleys, rifts and plains were surveyed over an area of 34,000 square miles. The submarine topography of this region, one of the most important in the world to the geologist, was laid bare almost as though some mighty giant had sucked up all the water and let us see with our own eyes what it was that lay down below.

To have made this map according to the old-fashioned methods of the sounding lead and line would have taken more than half the lifetime of the men on the two destroyers. Yet it was all complete in the brief space of five weeks; truly a remarkable achievement!

The thing that made this achievement possible was the new sonic depth finder perfected by the United States Navy. A wave of sound is sent downward through the water at a given instant. When this sound wave reaches the bottom of the sea it is reflected upward again toward the surface. The instant of its arrival at the surface is determined.

It is possible, then, to calculate the time needed for the sound to make the complete round trip. And knowing the velocity of the sound in water, it is a simple matter to compute the depth of

the sea at that particular place. Readings can be taken every few minutes from a vessel that continues in motion. Thousands of soundings can be made now where the older methods permitted only one. The bottom of the sea can be charted much more accurately than ever before and at a fraction of the cost.

It is probable that this remarkable new method would never have been developed had it not been for radio. Radio has brought us a tremendously increased knowledge of vibrations of all kinds, including the vibrations of sound. Furthermore, it is radio that has given us reliable sound generators in the form of vacuum-tube oscillators working at audio frequencies. Radio devices serve also to detect the echoed sounds and to amplify them; these, too, being accomplishments that would have been beyond the resources of physics a few short years ago.

On the recent surveys in California and on previous surveys with the sonic depth finder, it was the radio officers of the ships who conducted the work. All in all, although the new method involves sound waves instead of radio waves, it is to be reckoned, really, as one of the achievements of radio science.

The recent depth surveys off the California coast derive especial importance from the fact that this is the part of the world where the geologists are most actively engaged in the study of earthquakes. Many parts of the world have more earthquakes than California but more is known of the geology of California than of any similar area elsewhere. For more than three years a group of scientists working under the inspiration of the Carnegie Institution have been studying very carefully each tiny earth quiver that occurs in all the California region. They have been studying, too, the visible signs of faults and earth cracks on the surface of California and of adjoining states.

Some day it will be possible, they feel sure, to determine the exact nature and cause of earthquakes; perhaps to predict them; at least, to fix upon those particular parts of the country where the danger of destructive earth movements is greatest and those areas where this danger is least.

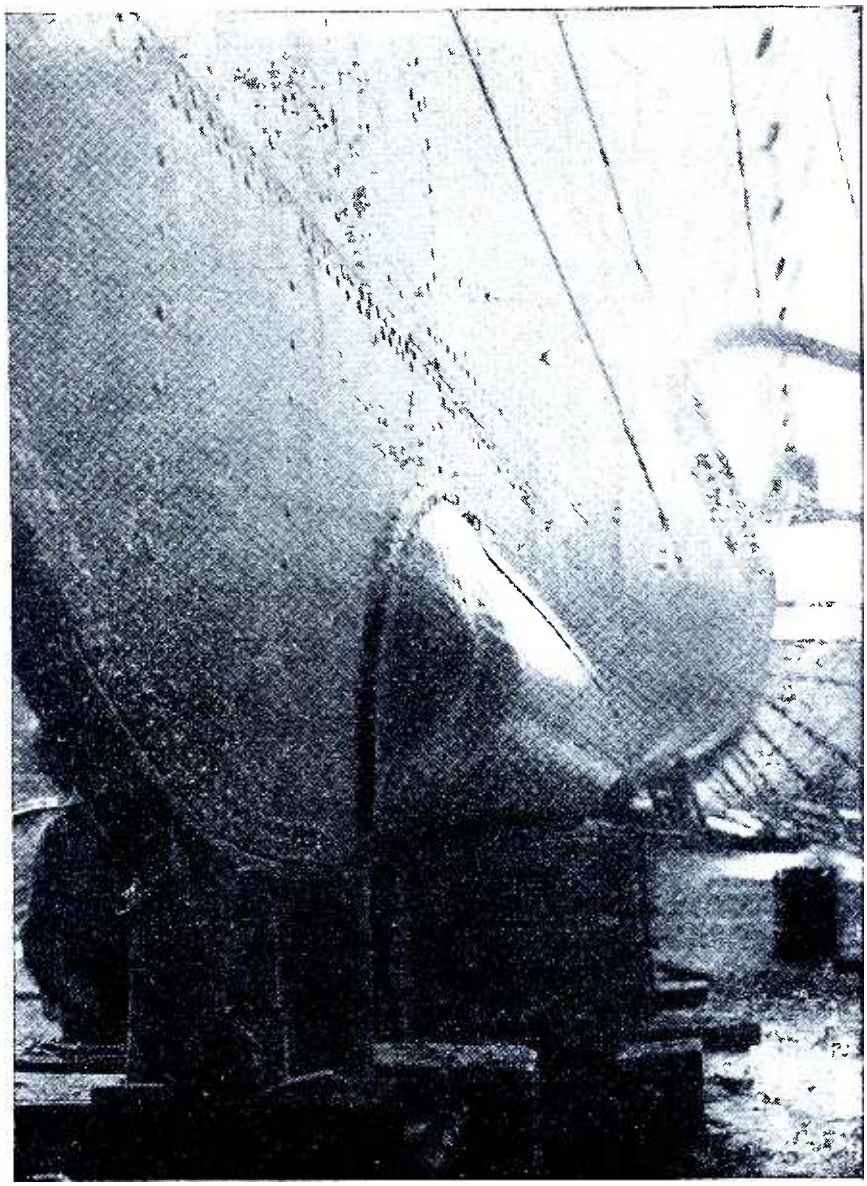
The successful conclusion of such studies would be important not only to California but to the world. The earthquake remains one of those great natural forces which man can neither control, predict nor escape. So far, earthquakes are among the failures of protective science. And the scientists are determined not to fail always.

But the studies that have been going on so assiduously in California have had to stop at the tide line. The great earthrift or "fault" that was responsible for the San Francisco earthquake runs off into the ocean and is lost to observation. Not even the most daring geologist would contemplate diving down a mile or so into the water in order to see what had become of it.

It was quite possible that the key to all the crustal creeps and fault slips and other earth movements that have been observed in California lay in some feature of the earth's surface hidden off there under the sea.

That is why the scientists of the Carnegie Institution asked the Navy Department to make the survey with the sonic depth finder. They wanted to know just what did lie off in those uncharted 34,000 square miles that bordered the visible coast. It might have been worth while to get this information even had it required the two vessels for half a lifetime, as it would have done on the older methods. But as it is, thanks to sound waves—and to radio—it was done in not much over a month.

The lines of soundings run by the two destroyers formed a gigantic gridiron with its bars about ten miles apart. Along these lines individual soundings were made every mile or so out to



WHERE THE MICROPHONES ARE LOCATED

In this "blister" on the ship's side, below the water line, are the microphones that receive the sound waves as they return from the sea bottom.

the 2,000-fathom line, corresponding to a depth of 12,000 feet or nearly two miles. The positions of the destroyers for each sounding were checked by radio-compass bearings obtained from stations on the coast.

The result is that the sea bottom of this area is now charted with an accuracy never before approached except in shallow waters close to the shore. It is most unlikely that any mountain, valley or other earth feature important to the geologists has escaped the closely spaced net that the sonic depth finders have spread over such a large area.

When all the ocean bottoms of the world have been charted with the completeness of this California area a new method will be available to ship captains for the determination of position at sea. By taking soundings at intervals and comparing the results with submarine maps prepared beforehand, it will be possible to locate a ship's position almost as accurately, it is believed, as a land surveyor locates himself by a map ashore. Such surveys, submarine charts and the employment of the depth

finder will be of especial importance in mapping the great ocean trade routes of the world.

To Dr. Harvey C. Hayes, a technical attaché of the Naval Experimental Station at Bellevue, near Washington, D. C., belongs the credit for having developed the sonic depth finder. The first practical test of the invention was made a year ago last June, when the U. S. Destroyer, *Stewart,* ran a line of soundings across the Atlantic Ocean from Newport, R. I., to Gibraltar.

Dr. Hayes was aboard during this trip and supervised the soundings made, the results constituting the first accurate cross section of the Atlantic Ocean ever obtained. It was demonstrated on this cruise that soundings could be taken every minute without sacrifice of accuracy, even in the deepest water.

The chief technical difficulty in developing the depth finder was the exact measurement of the time that elapsed between the instant of sending the signal and the instant of receiving the echo from the sea bottom. Initial experiments with a stop watch proved too inaccurate and an automatic relay later developed was scarcely more satisfactory. The problem was solved, finally, by comparing the interval between the sound and its echo with the known interval between two sound signals as produced on the ship.

The sound is produced by a high-power, vibratory sound transmitter, such as is much used already in submarine signalling. The signals sent out by this are timed by a friction gearing, so that the interval between two signals can be varied accurately. One disk of the friction gear rotates at a constant slow speed; the other disk touches this at a variable distance from the center of the first one. By changing this distance the speed of rotation of the second disk can be controlled at will. Attached to this second disk are the contacts that actuate the sound transmitter and send out the signals.

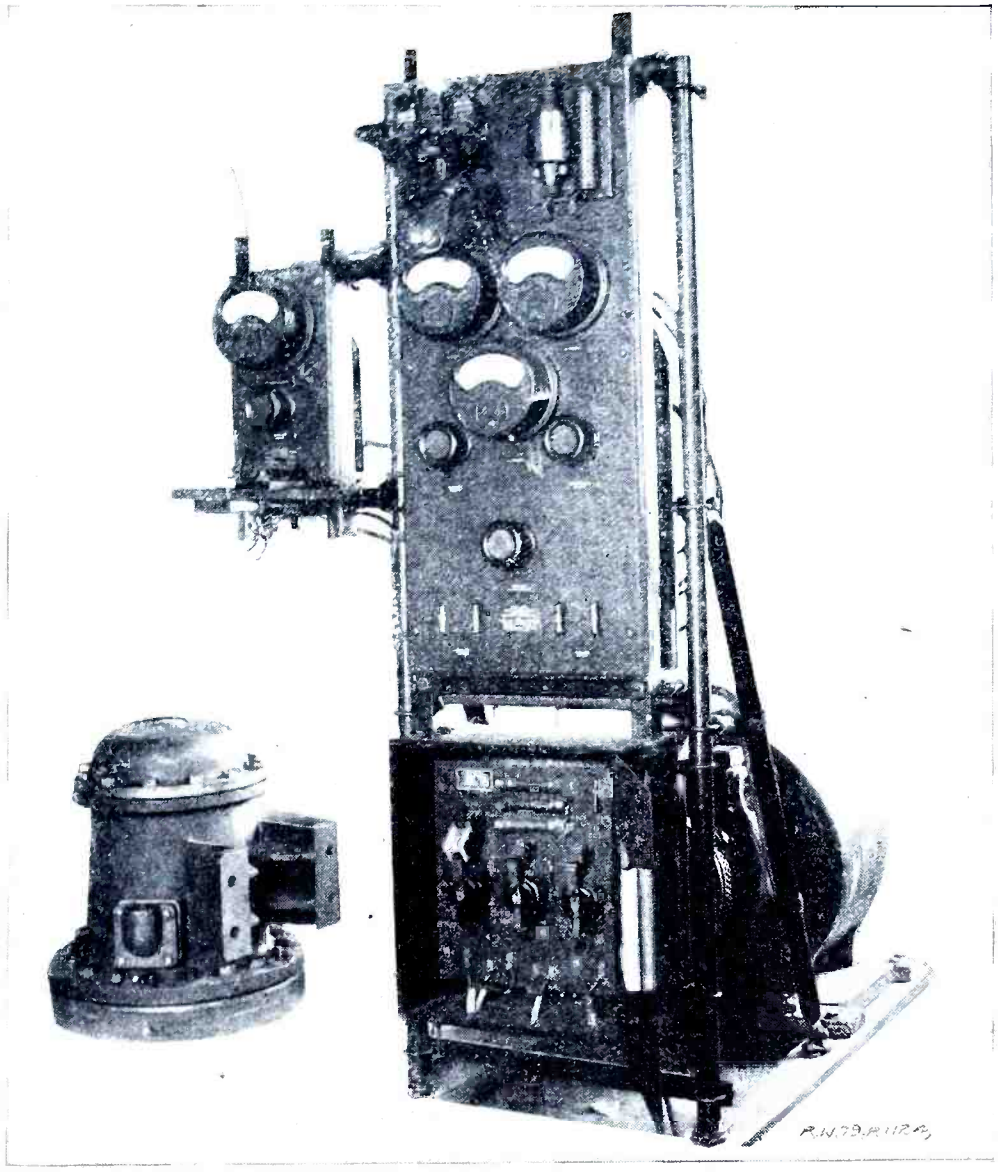
Let us assume, now, that a vessel equipped with the sonic apparatus is steaming over a bottom 2,400 feet (400 fathoms) deep. The two disks are set in motion and the position of the second one is adjusted so that sound signals are sent out at intervals of exactly one and one-half seconds.

The operator wears a pair of telephones like an ordinary head set, except that only one of his telephones is connected to the sensitive sound receiver located on the side of the ship under the water line. The other telephone is coupled inductively to the sound *transmitter.*

The first sound impulse sent out is heard instantly by the operator in the telephone that is coupled to the transmitter. At the same time the sound wave is discharged toward the bottom. The depth being 2,400 feet and the velocity of sound in water being approximately 4,800 feet a second, this sound impulse will be back at the receiver and audible to the operator in his other telephone after an interval of one second. One half second later the next sound impulse will be audible to him in the telephone connected with the transmitter.

The operator recognizes, of course, that these two impulses, one in his left ear, the other in his right ear, do not coincide. Accordingly he changes the speed of the second revolving disk bit by bit until he does hear the two impulses at exactly the same instant. Then he knows that the time interval between the successive impulses as sent out by the revolving disk is exactly the same as the time necessary for one impulse to go to the bottom and come back again. In the case described (the bottom being at 2,400 feet) this time will be just one second.

As the ship passes over bottom of different depth the operator alters the speed of the rotating disk just enough to keep the transmitted sound impulse and the received impulse in synchronism.



WHERE THE SOUND WAVES ARE PRODUCED

The switchboard at the right is the control panel for the sound-producing and transmitting apparatus. At the left, is the sound-producing vibrator. The bottom of this fits against a hole in the ship's bottom so that the diaphragm is in contact with the water.

The time interval between the transmitted impulses is then just equal, at all times, to the time of travel of one impulse to the bottom and back again.

This assumes, of course, that the velocity of sound in water is always the same, which is not quite true. This velocity varies a little with the salinity of the water and with its temperature. It will be necessary in accurate work to determine these characteristics of the water at the time when the soundings are taken and to make a proper correction in the final and complete record.

In shallow water, as at the approaches to harbors and wherever the water is less than about 250 feet deep, the navy uses what is called the "angle" method of sonic depth finding. A sound transmitter is fixed to the ship's bottom nearly amidships. Two lines, each of twelve receiving microphones are then attached to the ship's bottom; one line well aft, the other one well forward. The angle made by the returning sound with the vertical line of its downward projection

is determined by these microphones and from this the depth is deduced.

The microphonic receivers used in this method and also in the timing method employed for greater depths, must have directional properties. The details of the design have not been disclosed by the naval authorities but it is understood that Dr. Hayes, who owns the commercial rights on the apparatus, is about to make a form of it available for use by general shipping.

At present, twelve war vessels of the navy have been equipped with the sonic apparatus, including two battleships, the *West Virginia* and the *Colorado*. The mine-layer *Aroostook* also possesses the equipment, as well as several vessels of the U. S. Coast Guard.

It is believed, indeed, that the sonic principle will prove valuable to these latter vessels in their ice patrol of the North Atlantic. The echo of the sound signal will come back horizontally as well as vertically if there is a wall of ice or any other solid substance to reflect it. It is probable, therefore, that icebergs can be discovered in this way even before they are visible.

One of the most curious uses proposed for the sonic depth finder is in locating oil in the Gulf of Mexico. Oil operators have asked the Navy Department to make a depth survey of that region for the purpose of studying the surroundings of certain "oil spots" that are believed to indicate submarine seepages of oil that are perhaps recoverable by drilling.

But the most direct and doubtless the most valuable use of the sonic apparatus is as an aid to navigation. The commander of the cruiser *Detroit* said recently that he would rather have a sonic depth finder operating on his ship than any other navigation instrument, not even excepting the gyro compass or the radio direction finder. It is freely predicted by naval officers that very shortly the use of the sonic depth finder will be as general on commercial steamships as the radio is today.

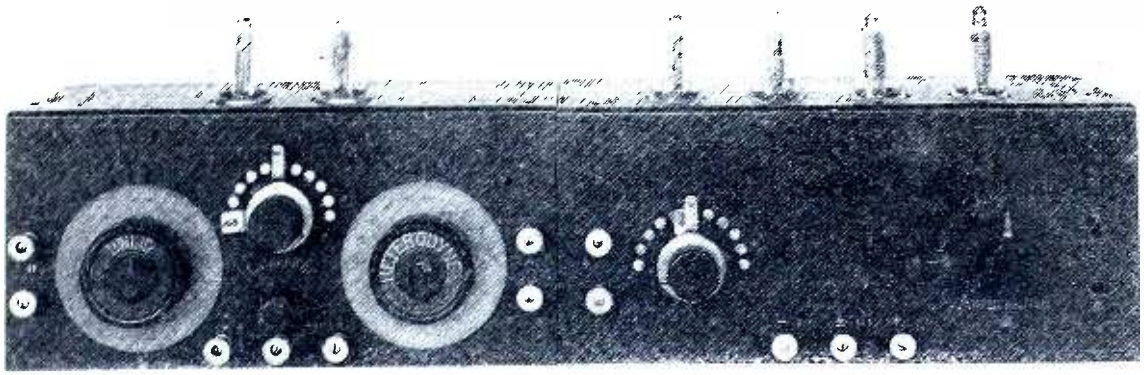
The cost at present is about $12,000, which makes it almost prohibitive for any but survey ships, vessels of war and the largest liners. But there is small doubt that the prospect of wide commercial use will stimulate both the improvement of the apparatus and its eventual manufacture at a much lower cost.

And finally the sonic depth finder is likely to take to the air. It will be remembered that a number of the disasters that have happened to lighter-than-air craft of the Zeppelin type have occurred because the commander did not know accurately the height of his vessel above the land or the sea.

The sonic depth finder will work in the air, say its inventors, as well as it does in water, but its present form is far too heavy for installation on airships. The naval laboratories are now working, it is announced, on a modified form of it which will be tried out aboard the navy's great air cruiser, the *Shenandoah*.

Will Radio Haul Our Trains?

"YES" *answer the scientists. Indeed, there is no more interesting speculation as to the future practical applications of radio than in the essentially practical uses in the field of industry and commerce. How this may come about will be told in a coming issue of* POPULAR RADIO.



THE ORIGINAL ARMSTRONG SUPERHETERODYNE

FIGURE 1: *The inventor himself constructed this receiver in the Paris research laboratory of the Signal Corps during the summer of 1918. It is considerably larger than the new model now used in aircraft.*

The New Type of Superheterodyne

A "fool-proof" receiver of an advanced design that operates on new principles which have been developed by the scientists of the Signal Corps

By CAPT. PAUL S. EDWARDS, U.S.A.

TO broadcast listeners everywhere the United States Army has just contributed a superheterodyne receiving set that is not only a marvel in size, weight and efficiency but also that has led directly to the discovery of some entirely new principles that will vastly improve radio reception.

The increasing interest in the superheterodyne type of receiving circuit since it was first developed makes this record of its development (it was designed for airplane service) an interesting one for the experimenter as well as for the constructor who wants to know how the circuits function; it is of further importance because the outcome of the work of the Signal Corps of the army has produced a highly efficient type of transformer and a radical improvement in the circuit that prevents radiation and makes it applicable to general radio broadcast reception.

The original superheterodyne was conceived and built in the Signal Corps laboratory in Paris during the summer of 1918, by Major Edwin H. Armstrong. Associated with Major Armstrong was Jackson H. Pressley, a young radio engineer who has continued the superheterodyne development for the Signal Corps, as Chief Engineer of the Radio Laboratories at Camp Alfred Vail, N. J.

Figures 1 and 2 show the original Armstrong superheterodyne. This early model used the Signal Corps VT-1 tubes and an elaborately tuned group of air-core intermediate-stage transformers. The latest design of army superheterodyne is the culmination of three years of persistent research and test. Several models have been constructed during this period in an effort to provide for the Air Service an instrument which would meet every condition of that most exacting service. The develop-

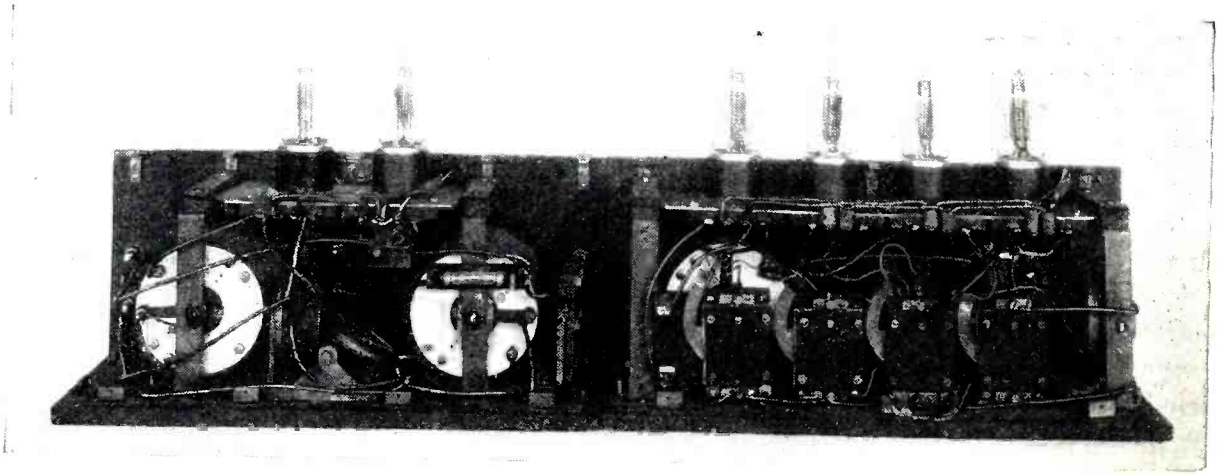
ment cost has been tremendous and will probably exceed the cost of the initial number of instruments required for peace-time purposes. Considering that this development has been practically continuous since the war and has preceded all commercial designs of the superheterodyne, none of which are adaptable for military service in the air or on the ground, the cost has not been unwarranted. The solution of the problem, however, has given to the army a receiver which may be manufactured in huge quantities during an emergency, at a small unit cost.

There is a wide difference in the requirements of the broadcast receiving set, which is operated in the quiet of the home and receives its signals from a powerful, fixed-schedule station, and an army aircraft receiver.

The army receiver is operated in planes that travel at terrific speeds and that are subjected to the vibration and noise of huge twelve-cylinder engines. It must be tuned and adjusted while the pilot or observer is performing his many other duties of the air. Here are a few of the incidental experiences of this new member of the army's radio family:

Two pursuit planes, traveling at a speed of more than one hundred and seventy-five miles an hour have a telephone transmitting equipment of only five watts output, intercommunicated by telephone at distances of more than ten miles while doing loops, tail spins, nose dives and other combat maneuvers. The big Barling bomber cruised all over the middle west and enjoyed excellent reception from a small, portable, ground transmitter of fifty watts output through the noise and interference of her six roaring engines which had one hundred and forty-four spark plugs creating a veritable barrage of static. Innumerable flights have been made in planes equipped with Liberty engines at distances of more than one hundred miles from their base, and perfect reception has been maintained. The small army transmitting sets send out a signal of one-tenth of the power of the average Class B broadcasting station.

The army instrument is divided into several units in order that every inch of available space in the planes may be utilized. The pursuit plane has a minimum of space and the machine gun is the most important instrument of use. The radio is operated from the little tuner shown in Figure 3, and its associated units are hung in the tail, under the seat, or the most convenient out of the way place. The sets on observation and bomber planes also require remote control. In the latter the radio system



THE INSIDE VIEW OF THE ORIGINAL RECEIVER

FIGURE 2: *Note the individual condensers with fixed adjustment for tuning the large, air-core intermediate transformers. Coupling in these transformers was changed by moving the coils along the bakelite supporting rod.*

U. S. Army Air Service

THIS EQUIPMENT ENABLES FLYER TO LISTEN IN WHILE THE MOTORS ROAR

This observer and his pilot are properly equipped for radio work. The headsets are built into the inside of the helmet and the microphones are specially designed to exclude the wind and motor noises.

forms a part of an elaborate communication system within the plane in order that the five or more members of the crew may converse with one another.

Principles Embodied in the New Receiving Circuit

The antenna circuit is tuned to the incoming signal. Loosely coupled with the antenna circuit is an oscillator or separate heterodyne circuit, the frequency of which is adjusted to obtain the desired frequency beat note with the signal frequency. This beat note is not an audio frequency such as is obtained when a CW telegraph signal is heterodyned. Instead, a super-audio-frequency of approximately 50 kilocycles is used. This frequency is selected as permitting the design of an efficient radio-frequency amplifier. The amplifier, operating on a fixed frequency, is far more efficient than any amplifier which could be designed to amplify, directly, the high signal-wave-frequencies and covering a wide wave-frequency band. The latter also would be more critical and would require a potentiometer or other means for controlling oscillations set up in the amplifier. The intermediate-frequency amplifier is made sharply resonant, which provides the great selectivity obtained.

The signal frequency and the heterodyne frequency are combined to provide a beat note corresponding to their difference in frequency, or approximately fifty kilocycles. However, all the Signal Corps has done so far is to modulate the signal frequency at the rate of fifty kilocycles. This latter frequency is not available to the radio-frequency amplifier until the modulated wave is rectified, in the same way in which ordinary audio-frequency is not available in an ordinary radio receiver until the wave frequency has been passed through the detector tube. Accordingly, the voltage due to the combined currents set up across the antenna-tuning inductance is impressed upon a detector tube.

The frequency obtained by this rectifying operation is then connected to the in-put of a three-stage radio-frequency amplifier. Three

iron-core radio-frequency transformers and one special radio-frequency transformer are used in the radio-frequency amplifier. The special transformer controls the resonant frequency of the amplifier. The frequency carried through the amplifier consists of the fifty-kilocycle radio frequency and the audio-frequency modulation due to telephone or tone telegraph provided at the radio transmitter which has persisted through all the transformations so far.

In order to obtain the audio frequency it is necessary to again rectify the signal, so the output of the radio-frequency amplifier connects to a second detector tube. This recovers the audio (voice or tone) modulation which is then passed through either one or two stages of audio-frequency amplification as desired, in order to secure sufficient volume to enable the signal to be heard above the wind and engine noises in the airplane.

Fairly loud signals are usually required in the air in order to be audible above the engine and the wind noises not entirely excluded by the receiver helmet, as well as the static and other interference that is picked up by the sensitive receiving equipment. The receiving equipment is selective enough to eliminate most of the interference from radio sets that operate on other wave frequencies.

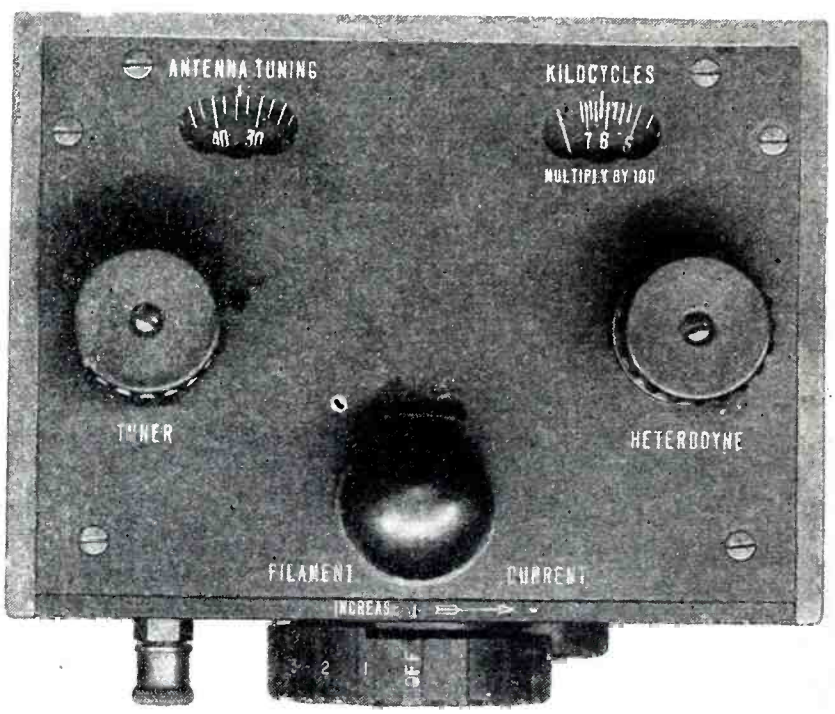
As the receiving equipment does not provide in any way for an audio-frequency beat note with the signal it is impossible to receive CW telegraph signals. The heterodyne calibration does not show the frequency of the oscillator but it does indicate the proper heterodyne adjustment to receive a signal of the wave frequency indicated on the heterodyne scale. The actual heterodyne frequency is approximately fifty kilocycles lower than the reading.

The Receiving Tuner

The antenna circuit consists of a variable air condenser and variometer that are connected on the same shaft, so as to turn together. The tuner rotary switch automatically connects the variable inductance and capacity in series for high wave frequencies, and in parallel for lower wave frequencies. The heterodyne oscillator circuit includes a fixed inductance and variable air condenser in the grid circuit. The fixed inductance has a tap used for the higher frequency scale, connected automatically by the heterodyne rotary switch. The grid circuit includes a grid-leak and condenser so that the radio-frequency oscillations build up a steady negative grid bias to reduce the oscillator plate current. The filament current is limited by means of a fixed resistance in series with the rheostat which controls all the receiving tubes together. The plate and filament supply for the oscillator is obtained from the amplifier by means of the four-point socket connection.

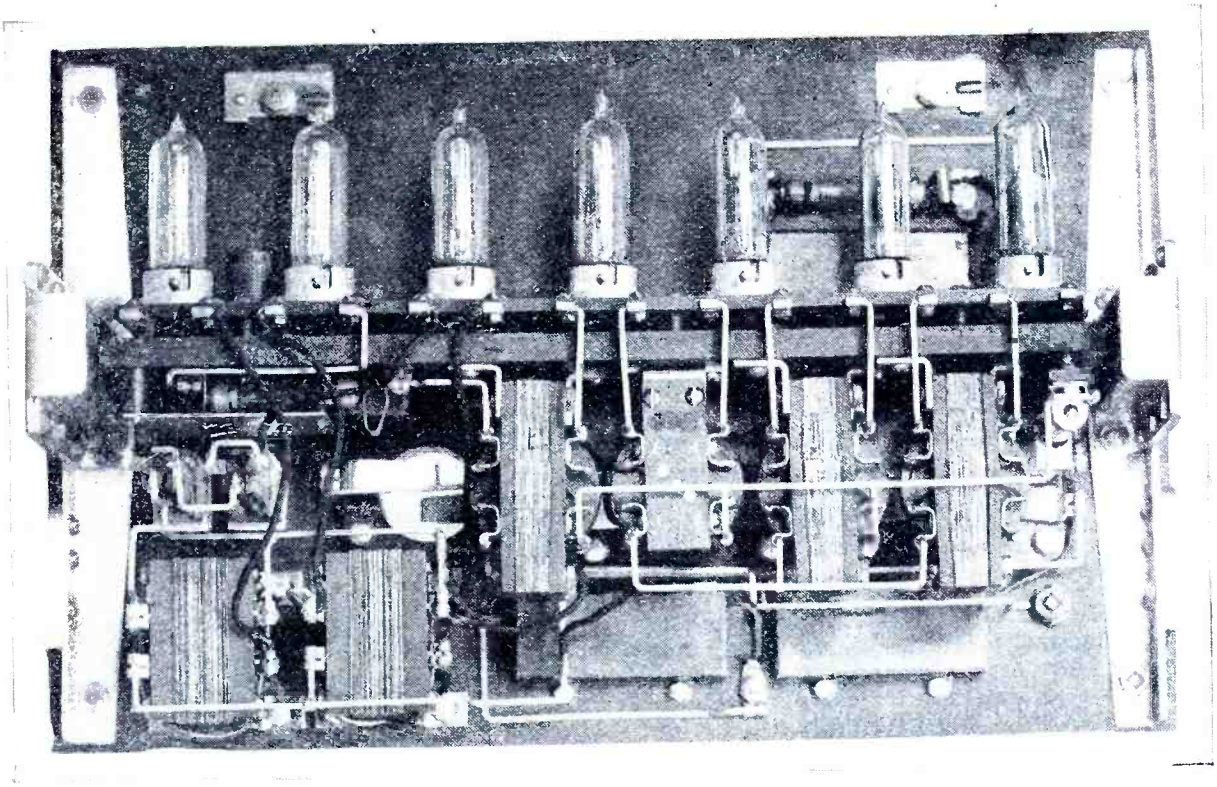
Radio-audio-frequency Amplifier

The radio-audio-frequency amplifier is shown in Figure 4. The first tube on the right is a detector tube and has the usual grid-leak



THE TUNING UNIT OF THE NEW SUPERHETERODYNE

FIGURE 3: *On the left is the knob which adjusts the wavelength and on the right is the control for the heterodyne oscillator. Notice that the instruments are calibrated to read in kilocycles instead of wavelength.*



THE NEW SUPERHETERODYNE AMPLIFIER

FIGURE 4: *The tubes are arranged in a row on the shelf and the iron-core intermediate-frequency transformers are fastened to the lower side of the shelf. The two audio-frequency transformers are located in the lower left end of the panel.*

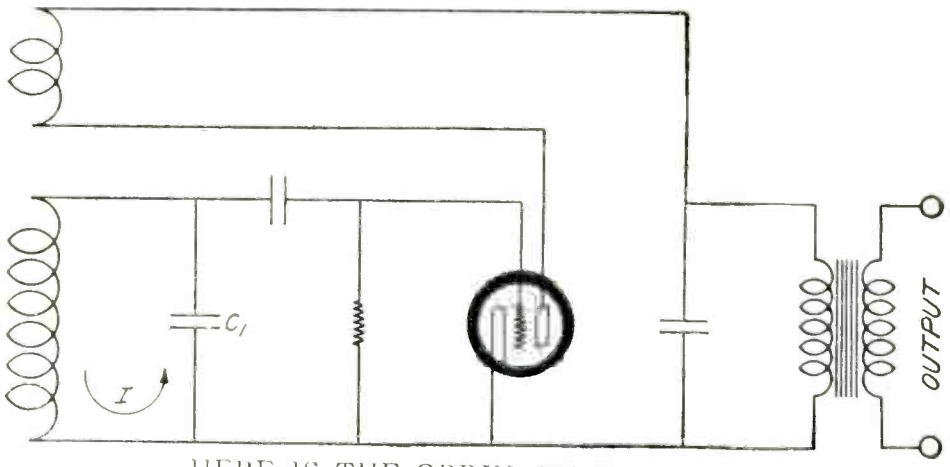
and condenser in the grid circuit. The detector plate circuit is coupled to the first intermediate-frequency-amplifier tube by means of iron-core radio-frequency transformer. The detector plate circuit also includes a 0.5 megohm resistance to reduce the plate current to the proper value for a detector tube. The coupling between the third and fourth tubes is by means of a special radio-frequency transformer which forms a highly selective circuit. The fifth and sixth tubes (audio amplifier and detector, respectively) are interchanged on the tube shelf from the usual order, so as to make the filament wiring more convenient, which is arranged to provide the proper grid-biasing potentials. The fourth tube then has its radio-frequency output connected to the sixth tube, which is a detector tube.

The detector-tube plate circuit includes the primary of an audio-frequency amplifying transformer, with a condenser across the winding to prevent the audio amplifier from howling. The detector tube is connected by means of the transformer to the fifth tube, which is used as an audio amplifier.

Jacks are provided in the plate circuits of the two audio-amplifier tubes so that either one or two stages of audio can be used as desired. A 10,000 m.m.f. condenser provides a by-pass from the common plate-circuit bus to the filament, reducing the undesired coupling arising from the use of a common plate battery and leads. The filament circuits are arranged in a series grouping so as to utilize the voltage drop across successive tubes to provide suitable negative grid-biasing voltage for the amplifier tubes, thereby eliminating the necessity for a "C" battery.

The constants of the circuit are omitted from this article for several reasons. They would be of small interest to the prospective builder of a superheterodyne mainly because the wavelength band of the set is far in excess of the present broadcast band. The construction, while simple, would not be economical if a single model is made. The set would not lend itself to broadcast use due to the fact that the oscillator would probably create objectionable interference with neighboring sets. This latter condition does not seriously matter among airplanes.

Mr. Pressley, Chief Engineer of the Radio Laboratories, has built an experimental model of a superheterodyne set which has an entirely novel non-radiating circuit, uses one less tube and does not use the second-harmonic principle. It is marvelous for its ease of operation and tremendous amplification. The set has so much amplification with two stages of audio that the UV-201-a tube in the second stage will not handle the output when fully tuned in on a local station. This experimental set uses the same intermediate transformer as is used in the aircraft receiver. A small loop is used for the antenna. This experimental model has been tested in the POPULAR RADIO LABORATORIES recently; at the insistence of the technical staff and with the permission of Mr.



HERE IS THE ORDINARY HOOK-UP

FIGURE 5: *This is the usual oscillating circuit with tickler coil feed-back. The current flows as shown at I. Another circuit connected to any point on the coil will affect the frequency of oscillation.*

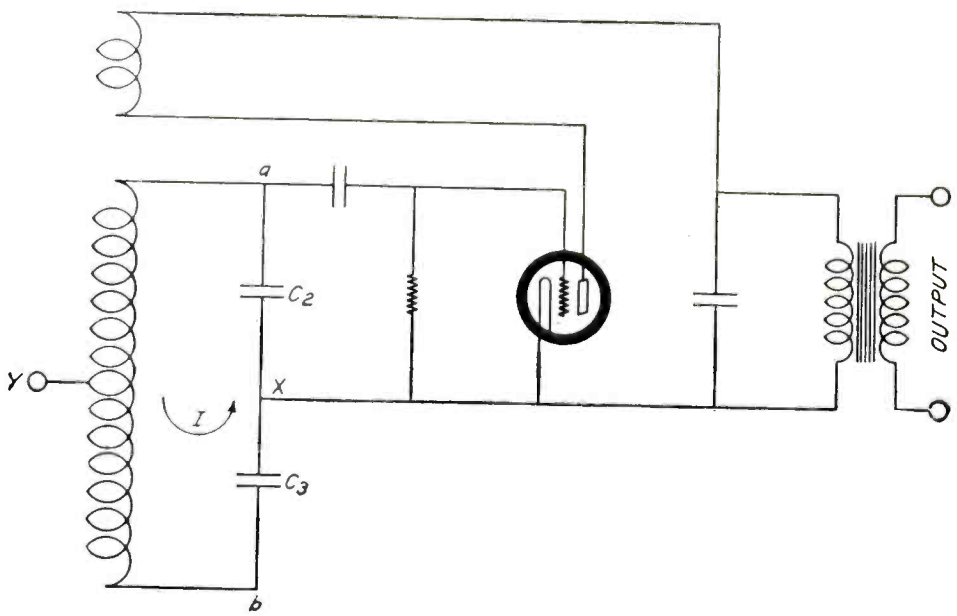
Pressley, the inventor of the new circuit, a complete "How-to-build" article on the set will be given in the next (December) number of this magazine. This article will give a complete description of construction and a list of parts that will be commercially procurable.

A brief description of this new Pressley system is given as follows:

In Figure 5 is shown a simple oscillating circuit with tickler-coil feed-back. The current flows as shown at I.

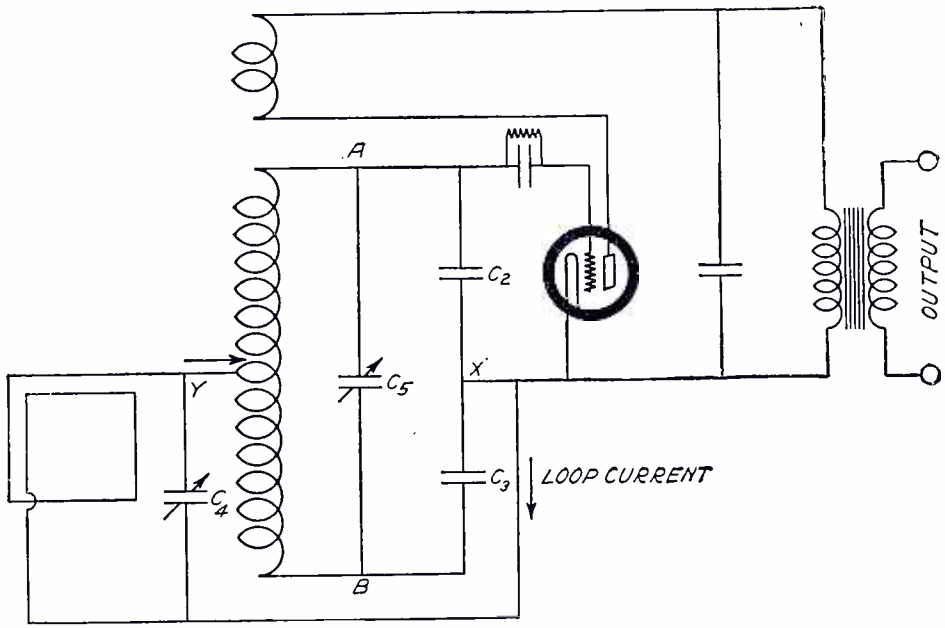
In Figure 6 is shown a simple oscillating circuit with tickler-coil feed-back except that C has been replaced by the two equal condensers C2 and C3. It should be noted that the same current as shown at I (oscillating) flows through the coil and condensers.

The voltage between points *a* and *b* equal volts across C2 plus the voltage across C3. Also the voltage across C2 equals the voltage across C3 since C2 is equal to C3 and the same current flows through both condensers. This means that the voltage between grid and filament is one half the voltage between points *a* and *b*. But since the voltage between points *a* and *b* is also the voltage across the coil, if this coil is tapped at its center, the voltage between the tap Y and the grid will be one half the voltage across the coil or one half the voltage across the two condensers.



HOW A TUBE IS SAVED AND RADIATION ELIMINATED

FIGURE 6: *In this arrangement, the oscillating current still flows as shown at I, but the point X between condensers C2 and C3 (which are of equal capacity) and the point Y (at the center of the coil) are at the same potential. Another circuit connected across X and Y would not affect the circuit shown (in frequency or current strength).*



HOW THE NEW CIRCUIT IS TUNED

FIGURE 7: *This drawing shows how the loop is attached to the circuit in Figure 6, at points X and Y. Condenser C4 tunes the loop and condenser C5 adjusts the oscillator. The current from the oscillator cannot affect the loop tuning circuit connected across points X and Y.*

a is a common junction for coil and condenser.

b is a common junction for coil and condenser.

With respect to point *a* (the grid) point X has been shown to be at half the potential as point *b*.

With respect to point *a* (the grid), point Y has been shown to be at half the potential as point *b*.

Therefore, points X and Y are at *same* potential and if these two points are connected together either by a short-circuit, or through a tuned circuit, no current will flow, which means that there is no coupling between the two circuits. Also connecting points X and Y to another circuit will in no way affect the oscillation circuit (frequency or current strength).

It is between points X and Y of the oscillating circuit that the loop or antenna circuit is connected as shown in Figure 7.

The loop current as shown by the lines with arrows divides equally in the oscillation coil and the condensers C2 and C3, one half going through C2 and one half going through C3. The current going through C2 gives rise to a voltage between the grid and filament which is detected and then amplified by the intermediate-frequency amplifier. It might seem that half the power is lost through this division of current but this is not true.

To obtain a large frequency band for tuning, C2 and C3, which are fixed, should be quite small.

Then C5 can be used to tune the oscillator and C4 the loop.

By a similar reasoning process as above it will be seen that the loop current will not flow into condenser C5, for the loop points A and B are at the same potential.

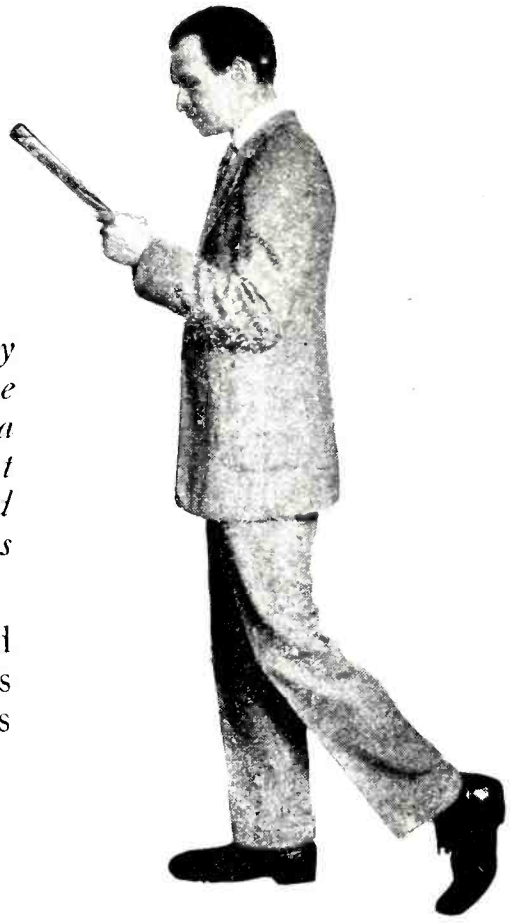
Consequently we have two circuits completely independent of each other which operate with the same vacuum tube.

How to Build the New Superheterodyne Receiver

IN POPULAR RADIO *for December—out November 20th—will be published a complete description of this new and extraordinarily efficient set, together with full constructional details. The article has been prepared exclusively for this magazine by Capt. Paul S. Edwards, one of the radio experts of the Signal Corps, U. S. A., under whose direction this new receiver was developed.*

A NOVEL WAY TO LEARN THE

CODE



¶ *The average man can get a pretty good working knowledge of the code by studying one half hour a day for thirty days. Within that time he can learn to transmit and receive at the rate of fifteen words a minute—*

¶ Here is a short cut that enabled one man to receive eighteen words a minute with only twenty hours of study

By HARRISON H. BROWN

AS the radio code is received by way of the ears, it is obvious that the proper way to learn it is by *sound* and not by *sight*.

The best method of learning the code is to have an expert send each letter over and over again until the beginner knows that letter by sound without stopping to think that it is made up of just so many dots and dashes.

Most radio fans are not so fortunate as to have an expert operator at their command to teach them the code.

Here is a novel way to learn the code that will give the proper swing to the letters. By this method you can practice when you are walking to the office or on the stroll after lunch. If you recite a code letter according to this system for every step you take on even one long afternoon walk, you will get a good working knowledge of the code.

To begin with, the number and relation of the dots and dashes that make up each letter of the code alphabet should be memorized until you can give the code equivalent of any letter without looking at the paper. Be sure to consider the dots and dashes as combinations of the words "dit" and "dah" rather than as so many periods and dashes.

In general, consider one step equal to a dash, three dots or a space.

Thus, letter B would be *dah-dit-dit-dit* with the *dah* long enough to last for one step and the three *dits* following evenly during the next step.

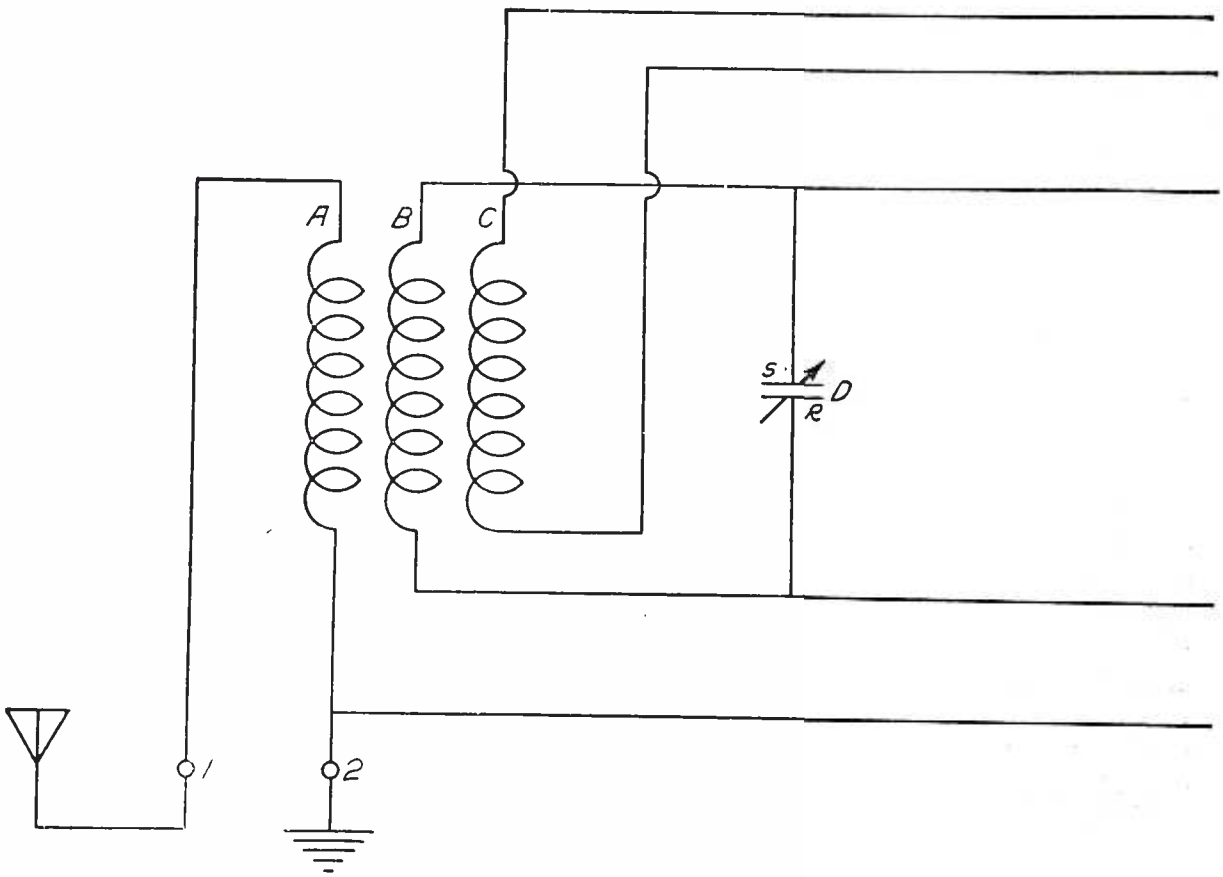
There are exceptions, of course, but the chart shows how to time the dots and dashes with your steps.

Remember always to leave a space one step long between letters. And when you get to the point where you are making words and sentences, leave a two-step space between words.

Try it!

LETTER					
A	DIT-DAH				
B	DAH-	DIT-DIT-DIT			
C	DAH-DIT-	DAH-DIT			
D	DAH-	DIT-DIT			
E	DIT				
F	DIT-DIT-	DAH-DIT			
G	DAH-	DAH-DIT			
H	DIT-DIT-DIT-DIT				
I	DIT-DIT				
J	DIT-DAH-	DAH-	DAH		
K	DAH-DIT-	DAH			
L	DIT-DAH-	DIT-DIT			
M	DAH-	DAH			
N	DAH-DIT				
O	DAH-	DAH-	DAH		
P	DIT-DAH-	DAH-DIT			
Q	DAH-	DAH-	DIT-DAH		
R	DIT-DAH-	DIT			
S	DIT-DIT-DIT				
T	DAH				
U	DIT-DIT-	DAH			
V	DIT-DIT-DIT-	DAH			
W	DIT-DAH-	DAH			
X	DAH-	DIT-DIT-	DAH		
Y	DAH-	DIT-DAH-	DAH		
Z	DAH-	DAH-	DIT-DIT		

The even swing of march time forces you to recite the code letters properly.



THE ELECTRICAL WIRING DIAGRAM FOR THE RECEIVER

FIGURE 1: *This includes all the connections for the various instruments and parts that go to make up the completed receiver. Study Figures 1 and 2 carefully and you will find it a simple matter to do the wiring.*

HOW TO BUILD A

LOW-LOSS TUNER

FOR SHORT-WAVE RECEPTION

Do you want to receive distant stations while the locals are on the air? This receiver will give you the results you are after whether you are a transmitting amateur or a broadcast listener. It can be made to cover any wave band.

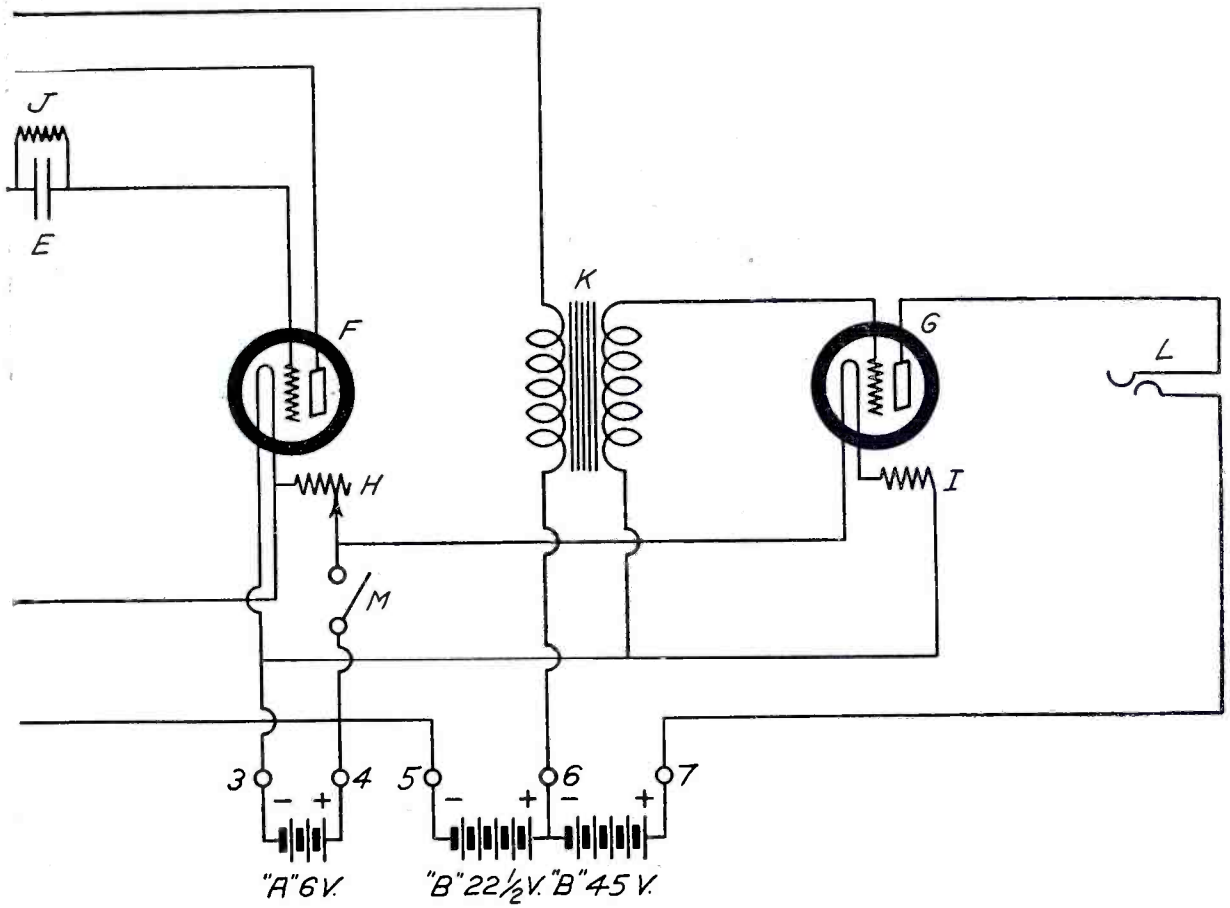
By ALFRED P. LANE

COST OF PARTS: *About $35.00*

RECEIVING RANGE: *Up to 1,500 miles*

HERE ARE THE ITEMS YOU WILL NEED—

A, B and C—Radio Engineering Lab. "low-loss" tuner with two E-Z-Toon dials;
D—General Instrument .0005 mfd. variable condenser with E-Z-Toon dial;
E—N. Y. Coil mica fixed condenser, .00025 mfd. with clips for tubular grid-leak;
F and G—Na-ald standard sockets;
H—Bradleystat (new type);
I—Amperite No. 1-A with mounting;
J—Daven 2-megohm grid-leak;
K—Dongan audio-frequency transformer;
L—Harris and Birdseye single-circuit jack;
M—Harris and Birdseye filament-control switch;
N—composition panel, 7 by 15 inches;
O—hardwood sub-base, ½ by 7 by 14¼ inches;
P—composition binding-post strip;
Q—standard cabinet;
R—angle brackets for binding-post strip;
7 Eby binding posts, bus-wire, screws, etc.



THE "low-loss" idea is rapidly gaining ground with radio fans because it is logical. Time was when the value of a radio receiver was measured largely by the number of switch points, tuning controls and other nickel-plated gadgets that decorated the front of the panel. Real efficiency was not to be found in the sets of that day because even radio engineers knew little about dielectric losses, capacity effects and other factors now considered so important in radio design.

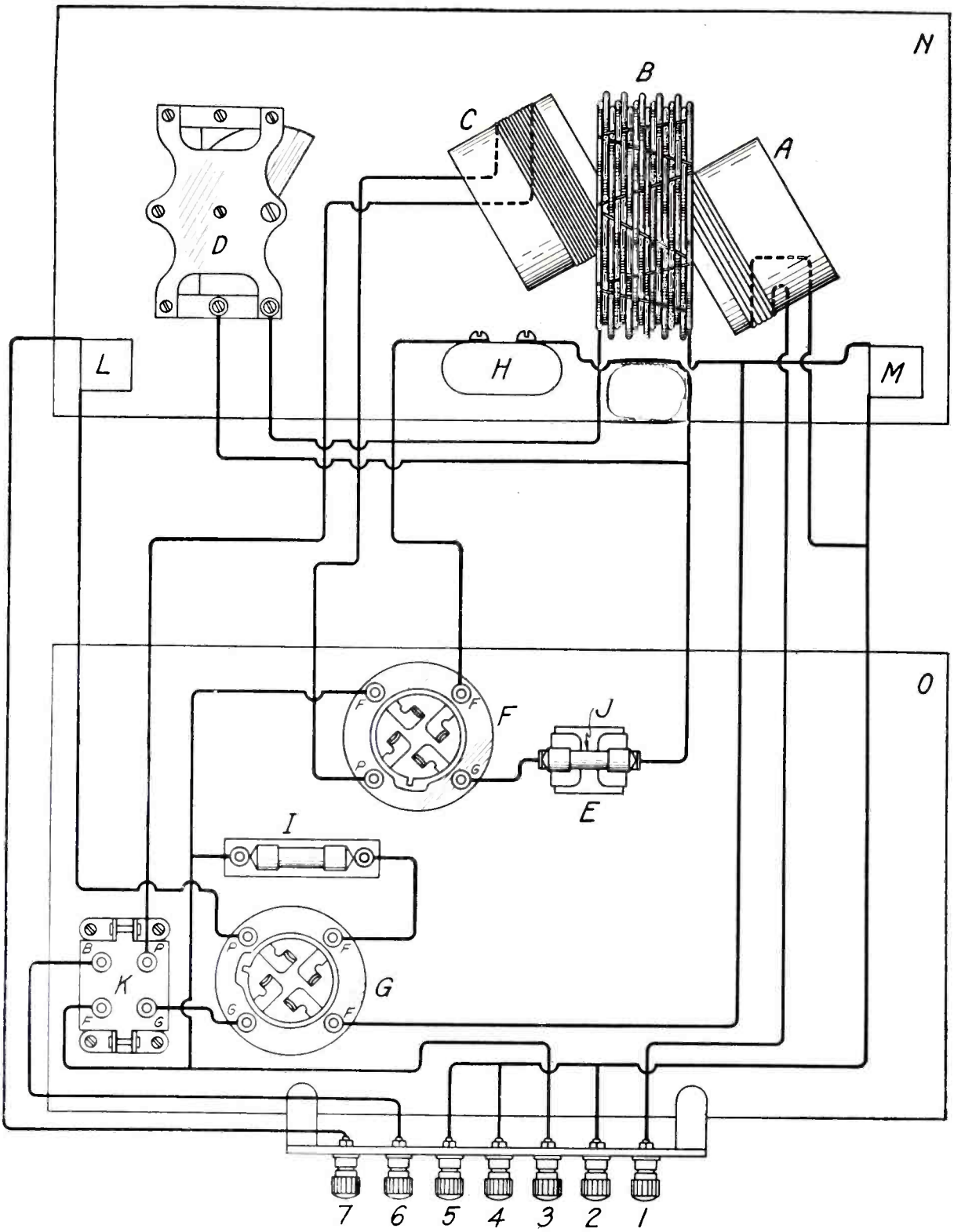
The receiver described in this article was constructed with the "low-loss" idea in mind and, consequently, simplicity and efficiency have been the keynote. It should appeal particularly to three distinct classes of radio enthusiasts.

First: To the man who now owns a receiver that covers the usual broadcasting wavelengths but who wants to know what is to be heard on the waves below the tuning range of his present set; especially the short-wave broadcasting from stations such as WGY and KDKA.

Second: To the amateur who owns a transmitting station. He will find this an ideal receiver for continuous-wave reception on all wavelengths from about 60 meters up to 275 meters.

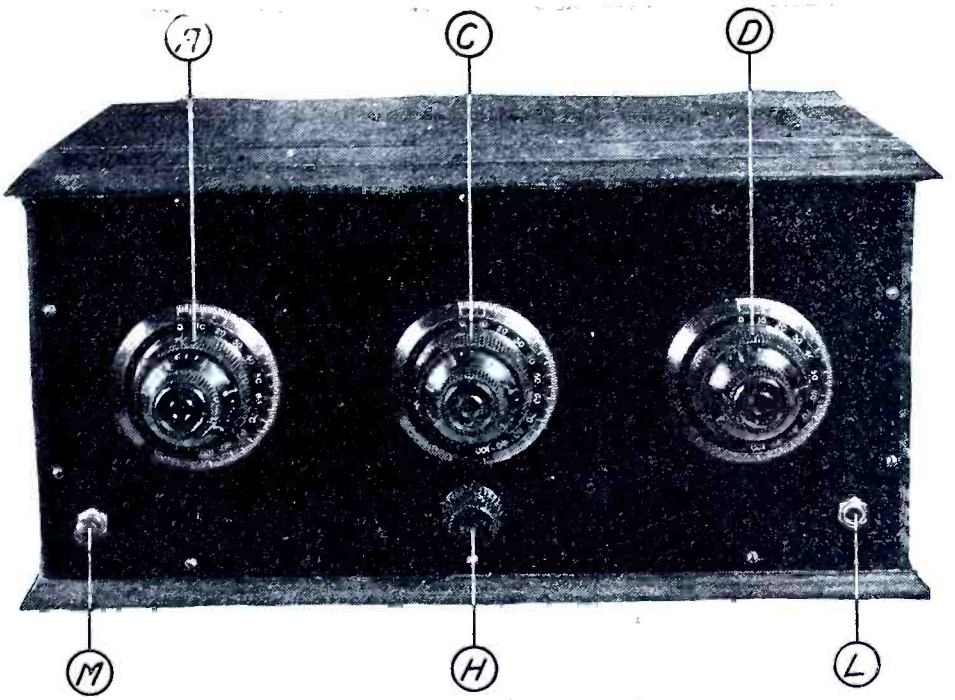
Third: To the man who has no set and who wants to build one. The tuning unit A-B-C in the list of parts, can also be supplied wound for the wavelengths from 250 meters up to 550 meters. With headphones, he will find that this receiver is so efficient that it will almost equal any of the radio-frequency sets for bringing in distant stations and, in addition, it will be found considerably more selective.

There is nothing novel in the circuit employed, as it is the standard three-circuit, regenerative hook-up. The primary consists of six turns of wire which is enough to secure sufficient transfer of energy to the secondary circuit. The coupling can be set as loose as desired.



THE "PICTURE DIAGRAM" THAT SHOWS WHERE EACH WIRE GOES

FIGURE 2: *After the mechanical construction work is completed, set this illustration in front of you while you wire the set. The upper rectangle represents the back of the panel with the tuning instruments mounted on it and the lower rectangle shows the base, to which are attached the sockets, the transformer, the amperite, and the binding-post panel.*



THE FRONT VIEW OF THE "LOW-LOSS" RECEIVER

FIGURE 3: *The arrangement is symmetrical so that the receiver presents an attractive appearance. Dial A controls the coupling between the primary and the secondary circuit; dial B adjusts the regeneration and dial C operates the tuning condenser.*

for this reason there is little or no radiation to disturb your neighbor's reception.

High resistance in the secondary circuit always results in broad tuning and weak signals, and in this receiver the resistance has been reduced to the minimum. The secondary coil is wound with heavy wire in a basket-weave form to reduce the distributed capacity between turns and it is mounted so that there is no winding form or other dielectric in the magnetic field.

A jack is not included in the detector circuit because practically all listening is done on one stage of audio amplification anyway, and it simplifies the wiring to leave it out.

The vernier dials specified are a big help in tuning the receiver, as they have no play in them and, while it is relatively simple with this type of receiver to locate a station, the final adjustment that brings the signals to maximum intensity calls for close work. In the reception of continuous-wave signals, the vernier dial on the secondary condenser permits minute changes to be made in the tone of the beat note and aids in separating two stations that are transmitting on nearly the same wavelength.

The wiring diagram of the circuit is shown in Figure 1.

The Parts Used in Building the Set

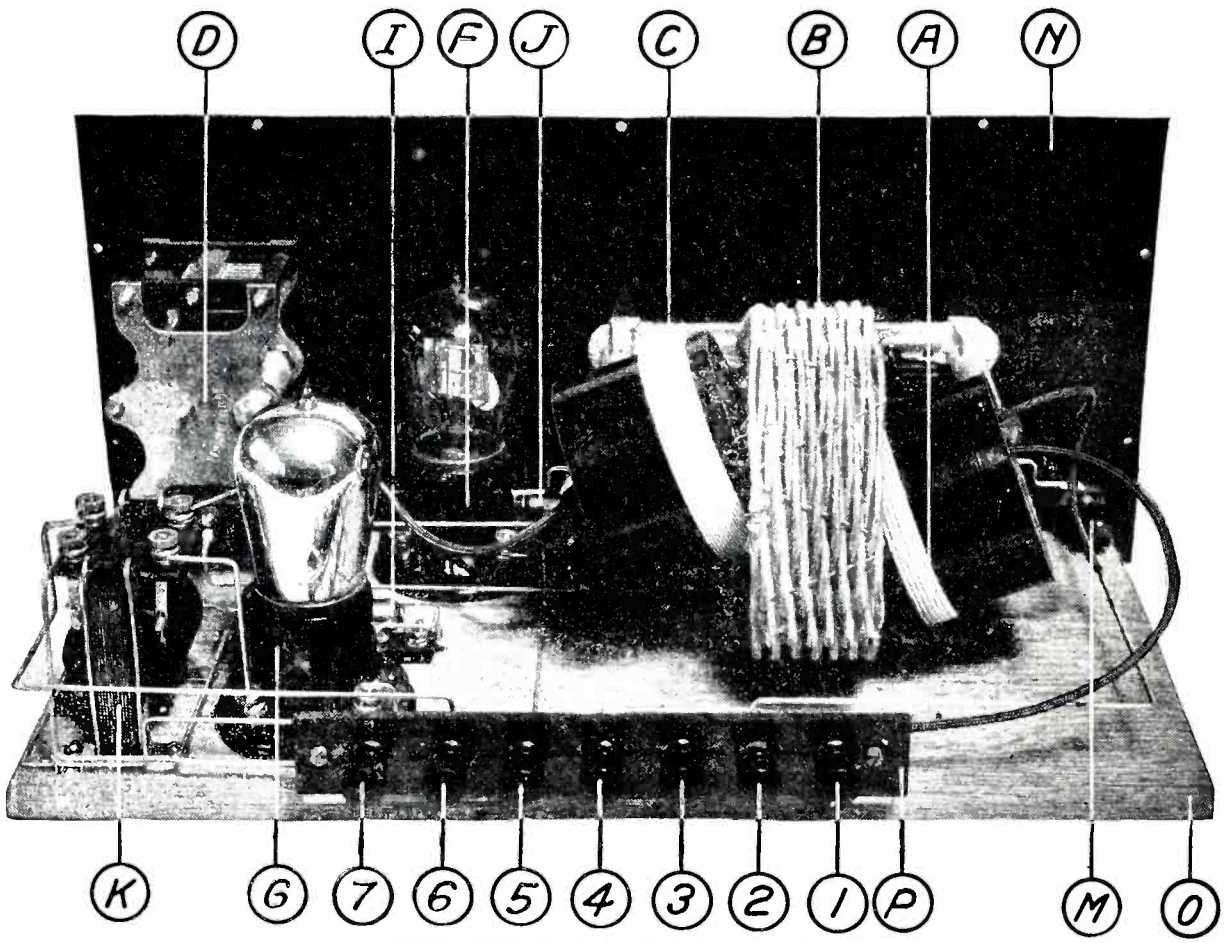
In all the diagrams in this article each part bears a designating letter. In this way the prospective builder of the set may easily determine how to mount the instruments in the correct places and connect them properly in the electric circuit. The same designating letters are used in the text and in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



THE REAR VIEW OF THE SET

FIGURE 4: *This illustration shows the general arrangement of all the instruments fastened to the panel or base. Figures 5 and 8 give the exact locations for these instruments. Note the angles of coils A and C—these are partly turned toward the up and down positions referred to in the text.*

prepare the panel N. (Shown in Figures 4, 5, 6 and 7.)

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

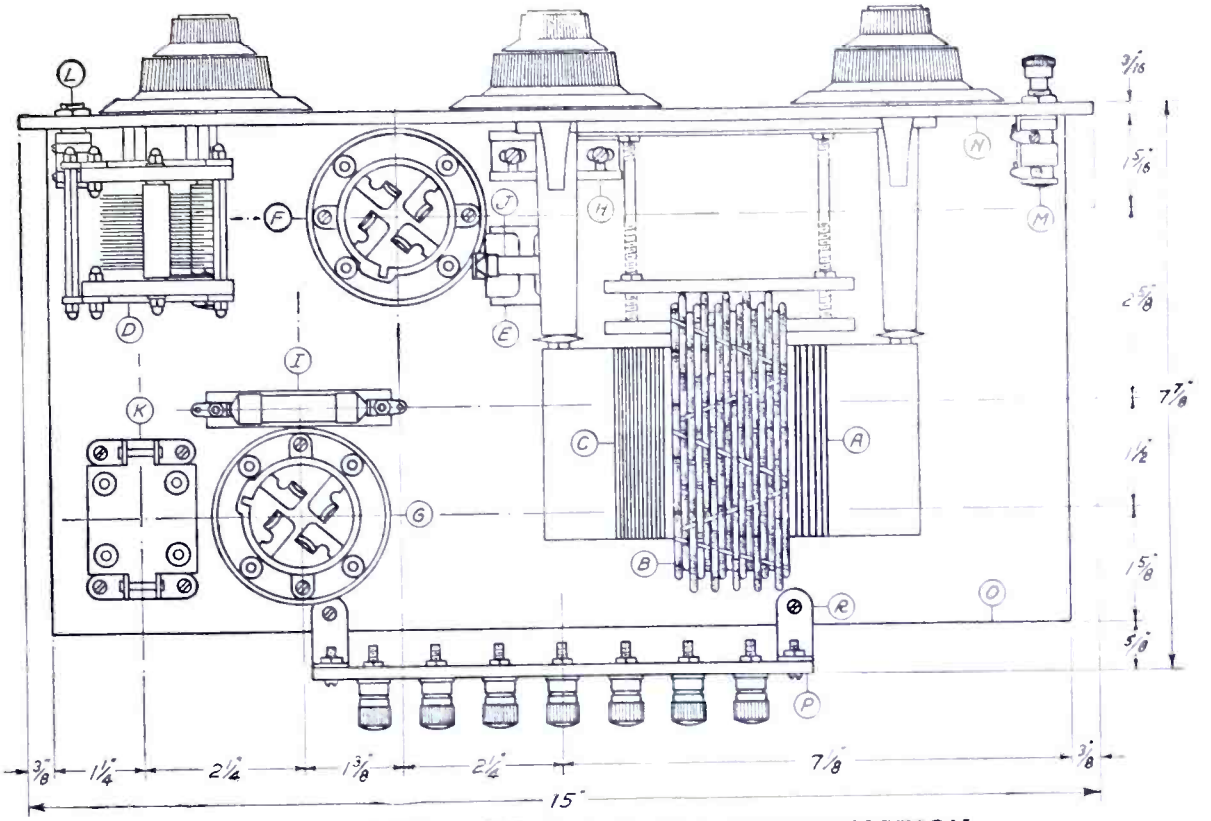
Then, square up the edges smoothly with a file. The centers for boring the holes (which are necessary for mounting the instruments) should be laid out on the panel as shown in Figure 8. A convenient method of doing this is to lay out all center holes on a piece of paper the same size as the panel; then 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. It is desirable to make the holes for the condenser shaft D and for the shafts that rotate coils A and C at least one-sixteenth of an inch larger than the shafts so that they will not rub on the edges of the holes.

When the panel is drilled, it may be given a dull finish by rubbing lengthwise with fine sandpaper until the surface is perfectly 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.

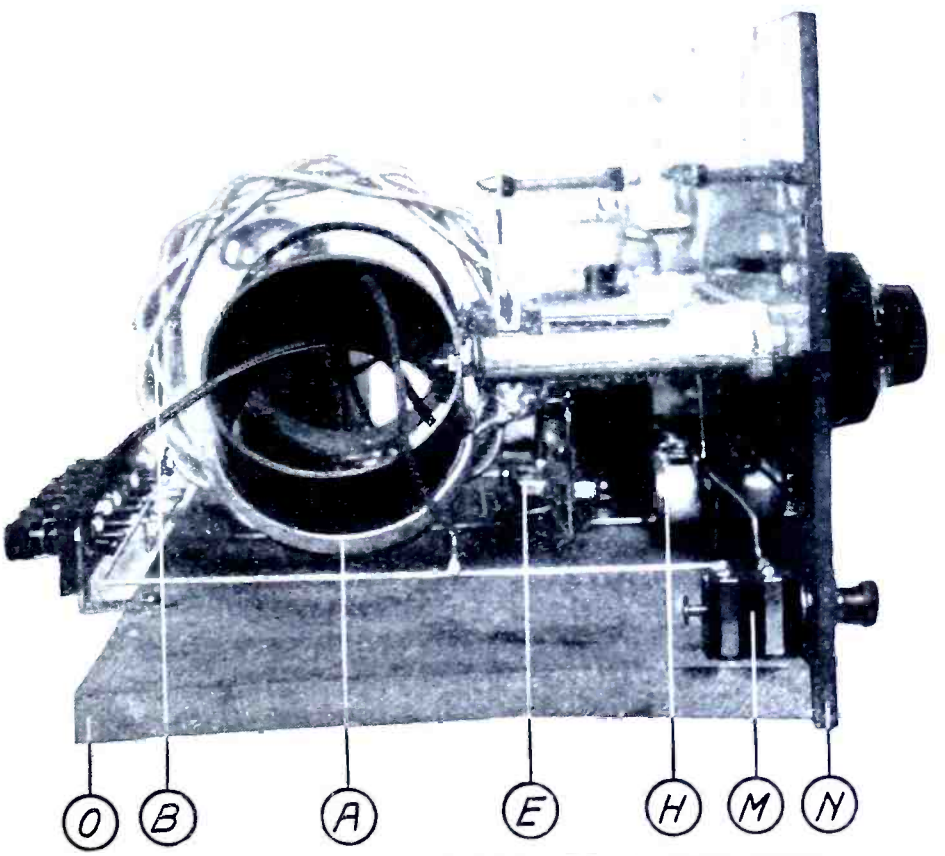
The sub-base O (see Figures 4, 5, 6 and 7) should be cut to size, 7 by 14¼ inches. If a piece of ½-inch hardwood, surfaced on both sides, can be obtained, the work of squaring up and finishing the edges will be a minimum.

After the panel N and the sub-base O have been prepared, fasten the panel at right angles to the sub-base with round-headed brass wood screws. (See Figures 3, 4, 5, 6 and 7.) It is well to try the panel with the sub-base attached to it in the cabinet to see that it fits properly. When you are satisfied that the panel and sub-base are right, then proceed to



THE WORKING DRAWING FOR CONSTRUCTION

FIGURE 5: *Here are shown the correct positions for all the instruments which are mounted on the baseboard.*



VIEW OF THE SET, AS SEEN FROM THE LEFT

FIGURE 6: *This illustration shows the way to mount the tuning unit and the filament switch.*

mount the parts of the set in the order indicated.

First, tighten up the switch M and the jack L on each end of the panel, and fit the rheostat H as shown in Figures 3, 6 and 7. (Note that the new-type Bradleystat requires only one hole through the panel in order to mount it.) Now, study Figures 2 and 5 carefully and screw the sockets F and G, the amperite with mounting I, and the transformer K to the sub-base as indicated in these drawings. Set the transformer K so that the "G" and "P" terminals are on the right side (as seen from the rear). The detector-tube socket F should be placed so that the filament terminals are nearest the panel. Socket G, the amplifier-tube socket, should have the filament terminals at the right (as seen from the rear). Next, tighten up the binding posts on the strip P and mount the strip at the rear edge of the sub-base as shown in Figures 2, 4, 6 and 7. This completes the construction work on the sub-base and the condenser D can be mounted on the panel N as shown in Figures 2, 4 and 7.

The tuning unit A-B-C, as supplied by the manufacturer, is fitted with a connector strip that is fastened across the aluminum frame. This connector strip should be disconnected, removed and discarded, as it simplifies the wiring to connect the flexible leads from coils A and C directly in the primary and tickler circuits and the secondary circuit can be made shorter by soldering directly to the ends of coil B.

After the tuning unit A-B-C is ready, mount it on the panel N with two screws as shown in Figures 2, 4, 5, 6 and 7. Be sure to place it with the primary coil A at the right (as seen from the rear). The primary coil is the one that has but six turns of wire.

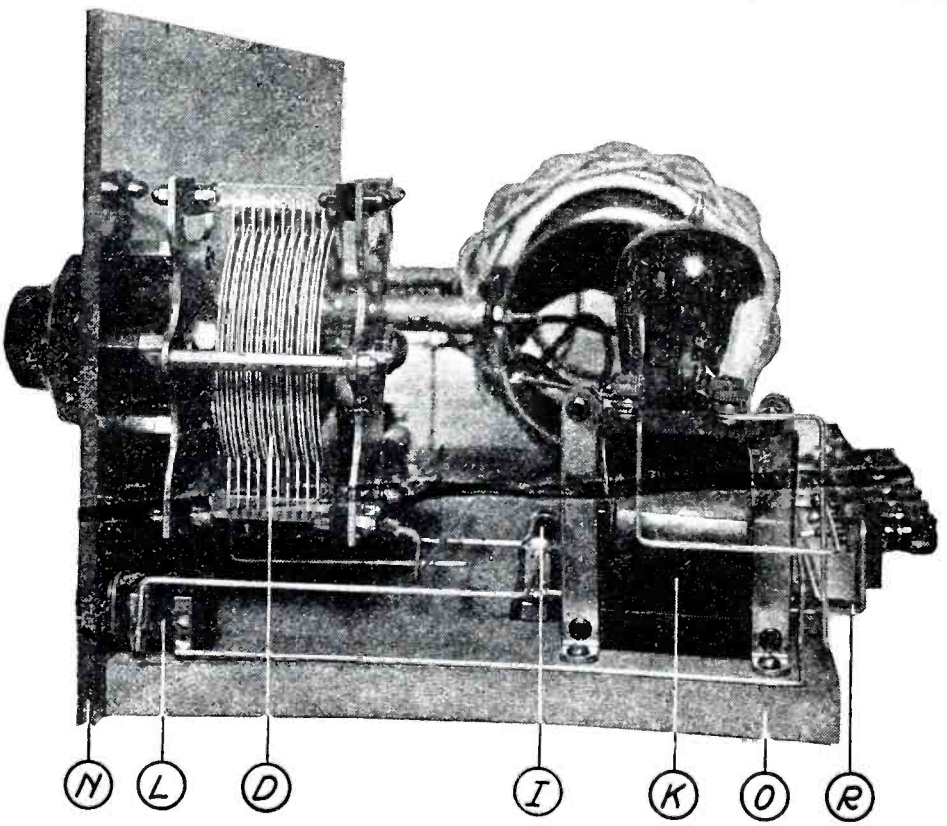
The set is now complete except for the dials, which are to be fitted on the shafts of coils A and C and condenser D. To mount each of these dials it is only necessary to loosen up the screw at the bottom of the hole in the larger of the two knurled surfaces and press the dial on the shaft until it almost touches the panel. Then, set the screw down tight again. Be sure to set the dial on the shaft of condenser D so that the plates are all out when zero on the dial is at the top. The dial on the shaft of coil A should be at zero when the coil is turned to the bottom. The one on coil C should be at zero when the coil is turned up.

The grid condenser E has not been mentioned as it is held in place by the wiring.

How to Wire the Set

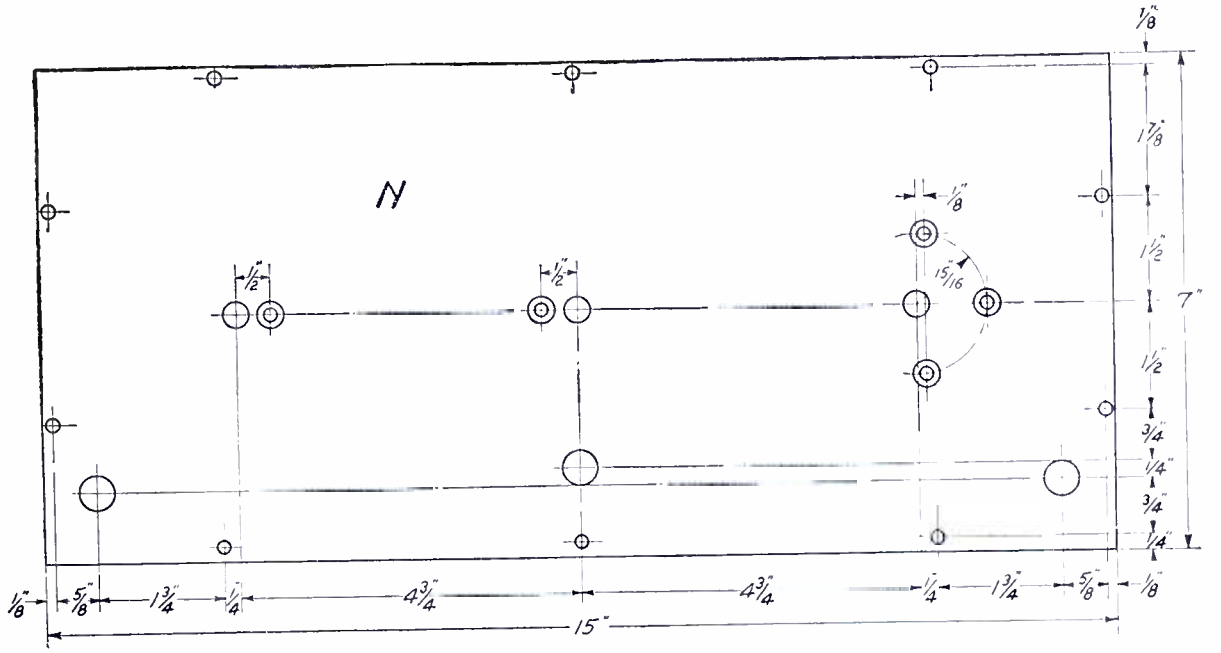
Either square or round tinned bus-wire can be used to wire the set, but it will be found that the round wire is easier to handle and when the job is finished, it will look just as neat.

First, connect one of the flexible wires from coil A to binding post No. 1. It makes no difference which wire is taken. Now, run a wire from binding post No. 5 around to the terminal farthest from the panel or switch M (see Figures 1, 2 and 6). The remaining flexible lead from coil A should be soldered to this wire as shown in Figure 6. With small pieces



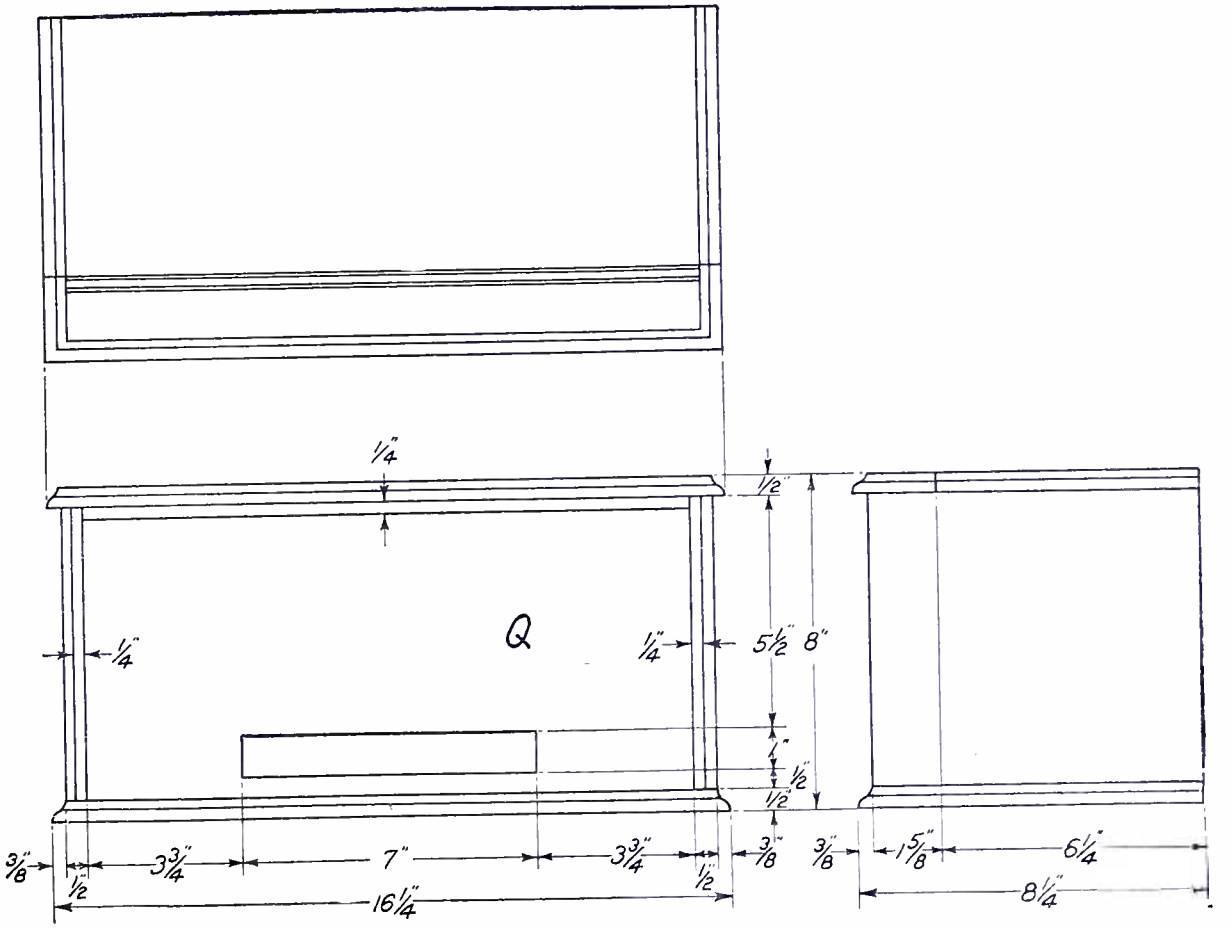
VIEW OF THE SET, AS SEEN FROM THE RIGHT

FIGURE 7: *This view shows the location of the tuning condenser, the audio transformer and the jack.*



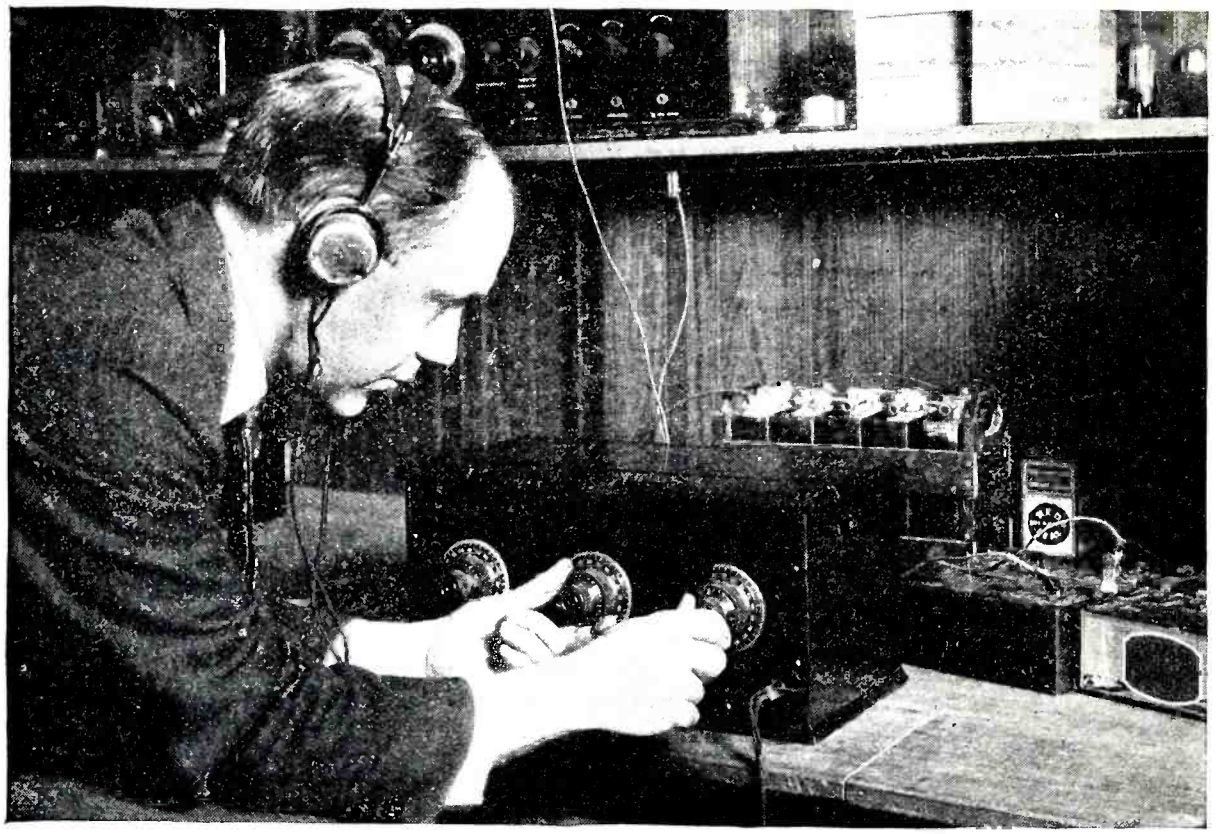
THE DRILLING PLAN FOR THE PANEL

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



THE DIMENSIONS FOR THE CABINET

FIGURE 9: *This diagram (which contains the top, front, and side measurements for the cabinet) may be turned over for construction to a competent cabinet maker. Or, it may be purchased complete from many different concerns that specialize in radio cabinets, as it is a standard size.*



GREAT SELECTIVITY IS A FEATURE OF THIS RECEIVER

Micrometer adjustment of each tuning control makes it possible to sort out the transmitting stations and get just the one you want. With the broadcast tuning unit (A, B, and C) it gives the same degree of selectivity on the broadcast wavelengths.

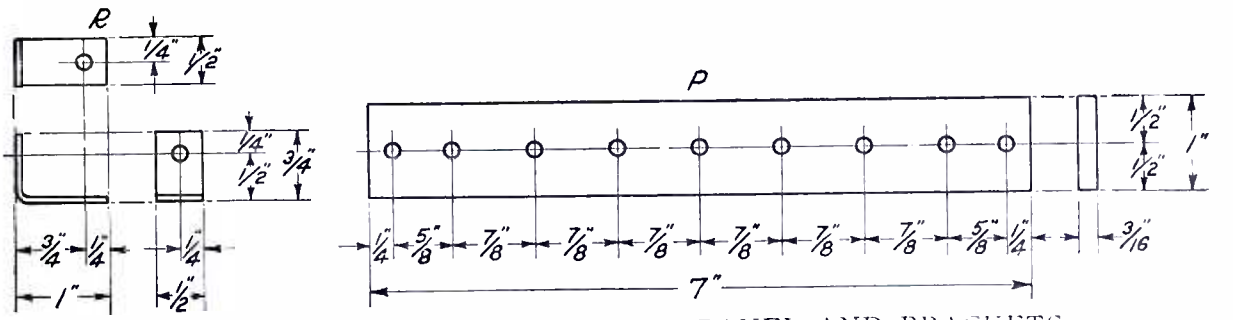
of wire, connect binding posts Nos. 2 and 4 to the wire from binding post No. 5. This completes the primary wiring. The next circuit to be wired up is the one that supplies the current to the filaments of the tubes. The remaining terminal of switch M should be connected to the nearest terminal of the rheostat H and the wire continued around to the negative filament terminal of the amplifier-tube socket. (See Figures 1 and 2.) Now, run a wire from binding post No. 3 to the right end of the amperite mounting (as seen from the rear) and continue it around to the left-hand terminal of socket F, which is nearest the panel. (As seen from the rear.) Next, connect the remaining terminal of rheostat H to the other terminal of socket F nearest the panel and then connect the right end of the amperite I (as seen from the rear) to the terminal nearest it on socket G. This completes the filament wiring. The grid side of the secondary circuit should now be wired. First, connect a piece of wire to one terminal of grid condenser E and the other end of the wire to the grid terminal of the socket F. Make this connection just as short as possible. (See Figures 1, 2 and 4.) The grid condenser should be in a horizontal position with the clips for the grid-leak up. Now, connect a wire from the other terminal of the grid condenser to the right terminal of the coil B (as seen from the rear) and from this wire run a branch over to the insulated stationary plates of condenser D. From the other terminal of coil B run a wire to join that connected to the negative filament lead from tube F (see Figures 1 and 2) and connect the rotary plates of condenser D into this same side of the detector-tube filament wiring. The secondary circuit is now complete.

The tickler coil C has two flexible leads. The one that is soldered to the end of the coil nearest coil B should be connected to "P" terminal of transformer K. (See Figures 2 and 4.) The other lead from coil C goes direct to the plate terminal of socket F. Now, connect binding post No. 6 to the "plus" terminal of transformer K. The grid terminal of transformer K is next connected to the grid terminal of socket G. Then connect the "A" terminal of transformer K to the filament circuit. (See Figures 1 and 2.)

The plate circuit of the amplifier tube, consisting of jack L, binding post No. 7, and the plate terminal of socket G, when connected as shown in Figures 1, 2 and 6, complete the wiring of the set.

Operating Data

The set is designed to use a UV-200 or C-300 in the detector socket F and a UV-201-a or C-301-a in the amplifier socket G. After



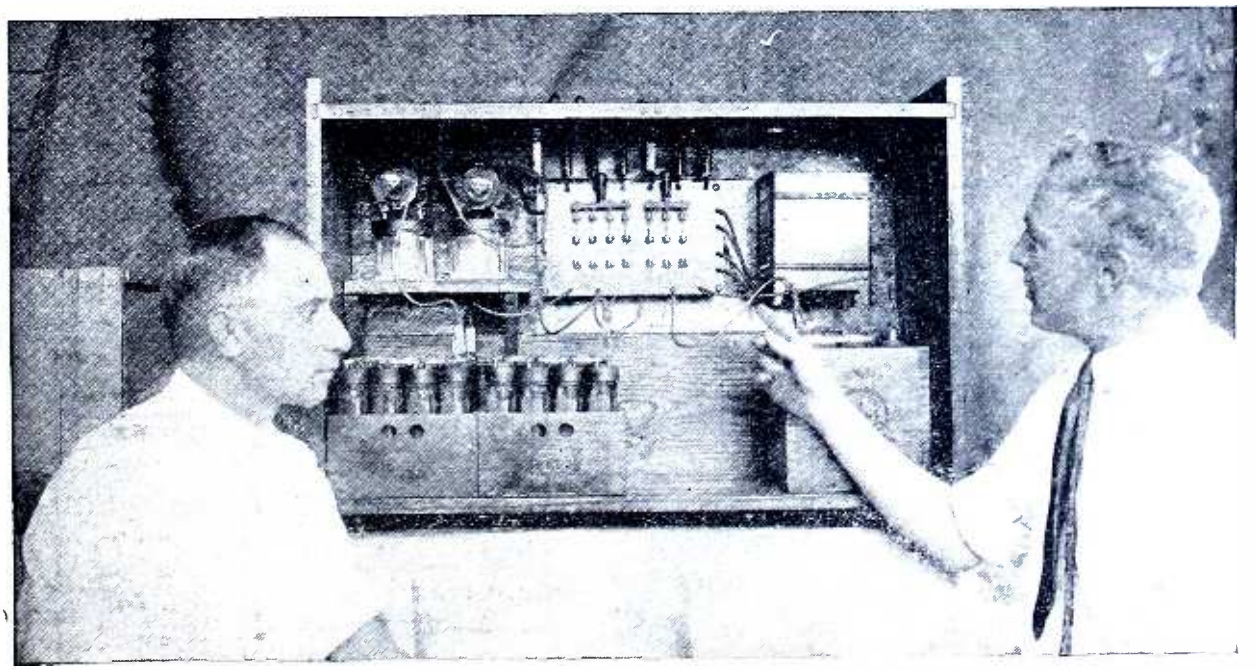
DETAILS OF THE BINDING-POST PANEL AND BRACKETS

FIGURE 10: *This drawing gives the necessary data for making the small panel to which the binding posts are fastened and for the brackets that support this panel.*

the wiring has been rechecked to make sure that it is correct, connect up the "A" and "B" batteries and the antenna and ground to the binding posts, as shown in Figure 1. Then, insert the tubes in the proper sockets and push filament switch M in. Both tubes should light and the brilliance of the detector tube in socket F should be regulated by rheostat H. Now, turn dial A to about 35 degrees and then turn dial C slowly up from zero until a click is heard in the phones, which should be plugged into jack L. The click indicates that the detector tube is oscillating and, when dial D is turned, you will hear many continuous-wave amateur signals all along the lower portion of the scale. If the set refuses to oscillate, turn dial A back slightly and increase the coupling of the tickler coil by turning dial C to a higher value. After experimenting a bit you will find a setting for dials A and C and rheostat H that will allow the set to oscillate evenly while dial D is turned through the whole wavelength range so that you can tune in any signal just by turning dial D.

To tune in broadcasting on waves from 275 meters down and amateur phone stations, dial C should be turned back toward zero until the oscillations just cease.

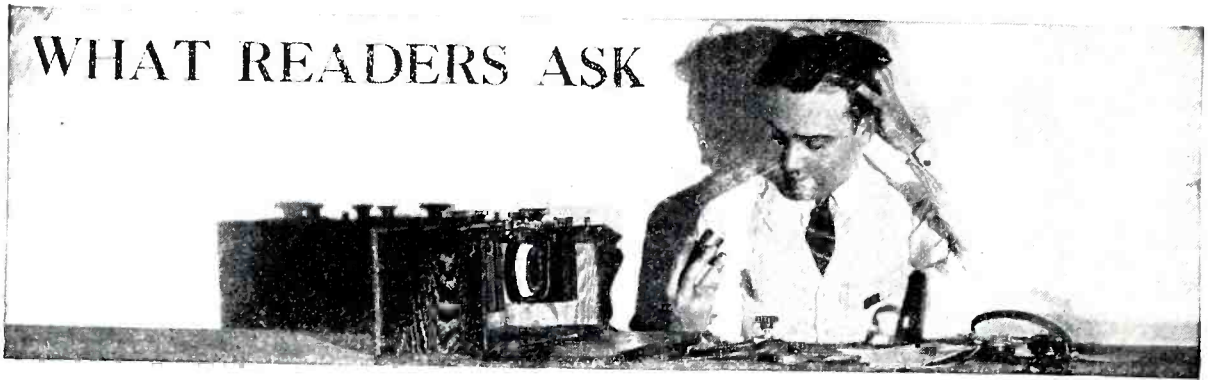
The man who wants a radio receiver for use on the short waves that is especially designed for simplicity, maximum range and selectivity, will find this "low-loss" receiver ideal.



HERE IS A GOOD WAY TO ARRANGE YOUR BATTERIES

What to do with the batteries and charging equipment is a problem that bothers many radio set owners. Walter P. Fuchs of Evansville, Indiana, has solved the problem neatly. The switches in the center throw the "A" and "B" batteries on charge or connect them to the receiving set.

WHAT READERS ASK



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.

A Simplified Reflex Receiver Employing One Vacuum Tube and a Crystal Detector

QUESTION: Will you please give me a circuit that uses the reflex principle, and that employs a honeycomb coil and a variometer for tuning? I want to use only one tube and a crystal detector. I suppose I will have to have an audio-frequency transformer also.

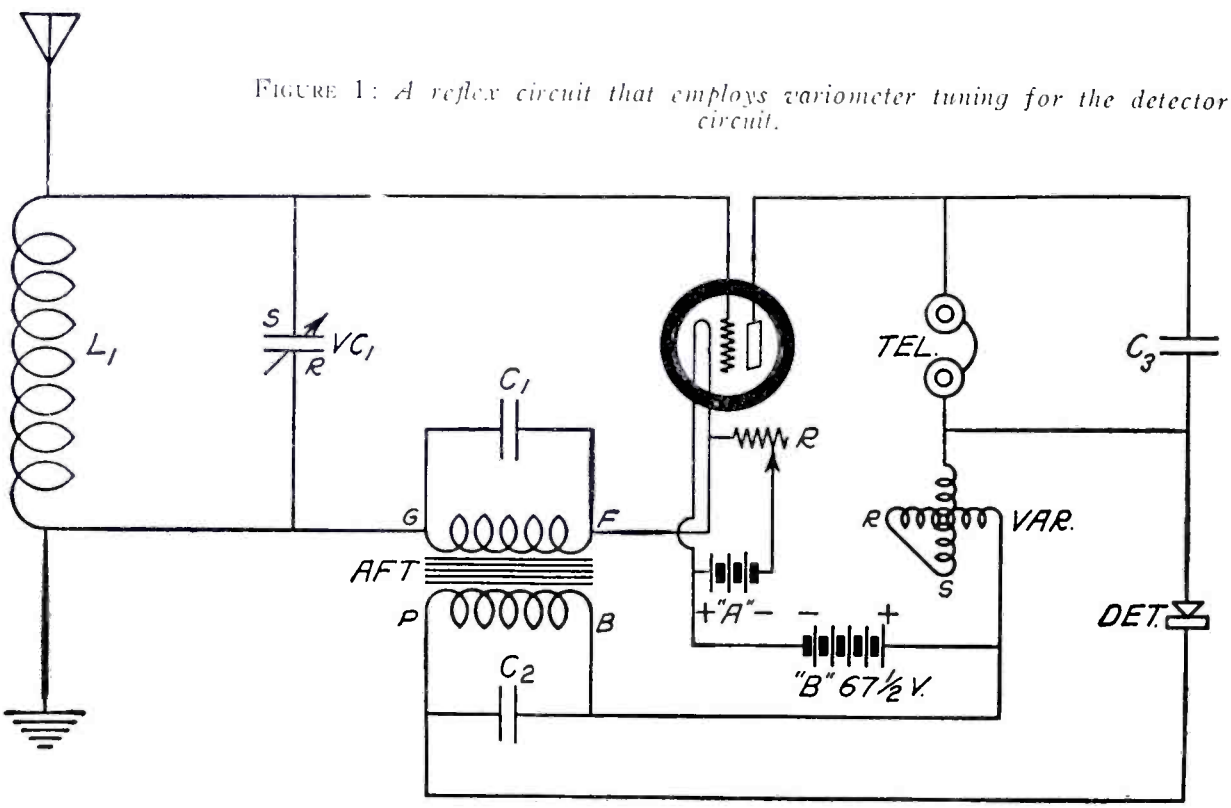
A. L. R.

ANSWER: In Figure 1 you will find a circuit diagram that should give you good results with the instruments that you have on hand. The full list of parts, together with their proper constants, are given below:

L1—honeycomb coil, size L-35;
VC1—variable condenser, .0005 mfd.;
C1—mica fixed condenser, .001 mfd.;
C2—mica fixed condenser, .00025 mfd.;
C3—mica fixed condenser, .0005 mfd.;
R—filament rheostat, 30 ohms;
VAR—variometer;
AFT—audio-frequency amplifying transformer;
DET—crystal detector;
TEL—telephones.

You should use a hard tube in this set. The battery voltages for the "A" and the "B" batteries should be as denoted on the diagram.

FIGURE 1: *A reflex circuit that employs variometer tuning for the detector circuit.*



Short-wave Super-regenerative Circuit

QUESTION: Kindly give me a circuit that embodies the super-regenerative principle for work on low wavelengths. I would also like to get enough information on the constants that I should use so that I can experiment. Will you also let me have a list of the parts that you think I should use in making up such a hook-up.

HARRY S. CRAMER

ANSWER: Refer to Figure 2 and you will see there the hook-up that you want. The parts to be used in this outfit are the following:

L1—primary coil;
L2—secondary coil;
L3—tickler coil;
L4—honeycomb coil, size L-1500;
L5—honeycomb coil, size L-1250;
VC1—variable condenser, .0005 mfd.;
VC2—variable condenser, .0005 mfd.;
VC3—variable condenser, .0005 mfd.;
VC4—variable condenser, .001 mfd.;
C1—mica fixed condenser, .0005 mfd.;
C2 and C3—mica fixed condensers, .001 mfd.;
GC—mica fixed condenser, .00025 mfd.;
GL—grid-leak, variable;
R—filament rheostat, 30 ohms;
TEL—telephones.

Coils L1, L2, and L3 are wound on bakelite tubes, 3 inches in diameter. Coil L1 consists of 8 turns of No. 18 DSC copper wire. Coil L2 consists of 25 turns of the same sized wire. Coil L3 consists of 20 turns of the same sized wire.

The three coils are mounted in much the same manner as honeycomb coils, so that the coupling between them can be varied.

A hard tube, such as the Deforest DV-3, the UV-201-a, or the C-301-a may be used.

Hint for Lead-in Insulator

QUESTION: Do I have to solder the antenna wire to the insulator which is located at the point where the lead-in and antenna proper join? I have made the antenna and lead-in wire of one piece.

K. KNIGHTON

ANSWER: No; this is not necessary. All you need to be sure of is that the wire is twisted tightly so that it will not slip through the ring in the insulator.

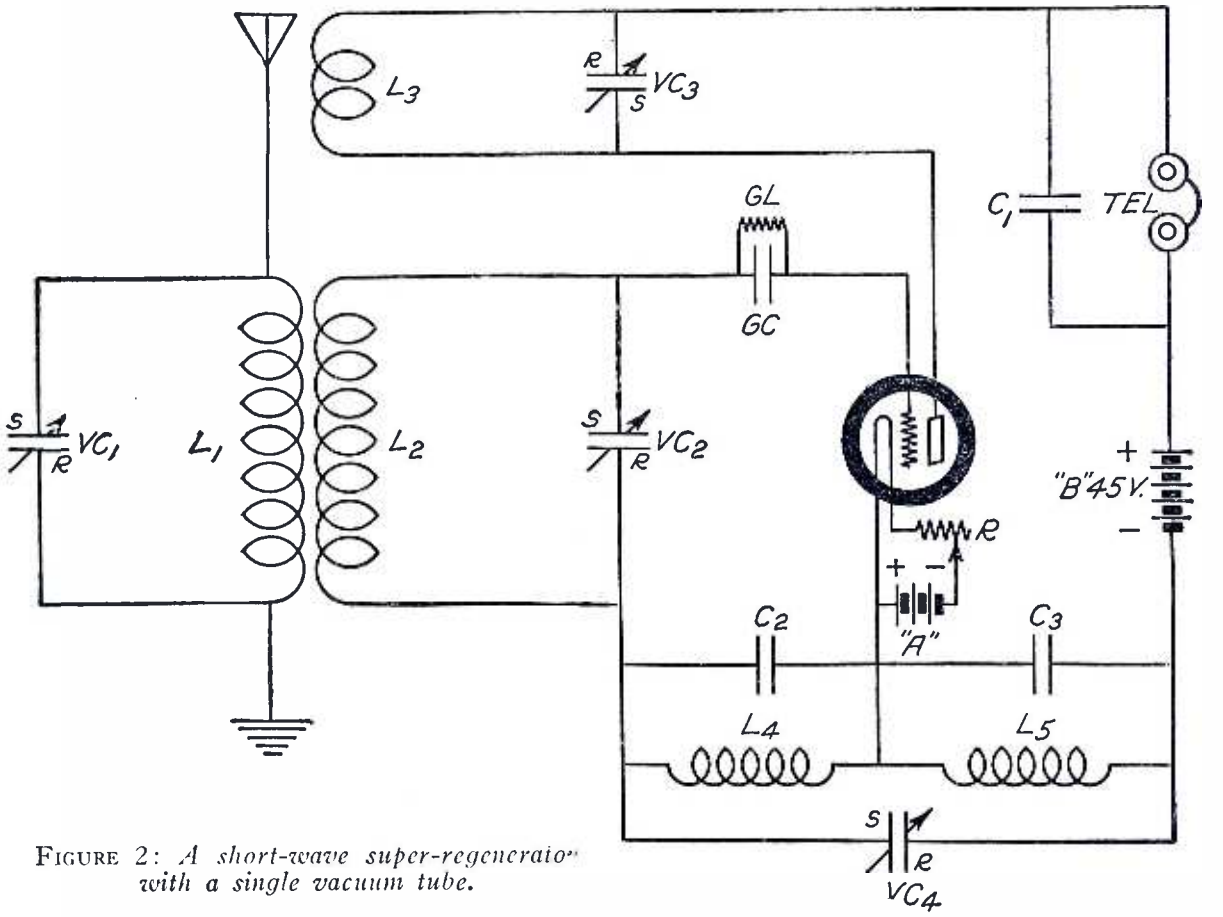


FIGURE 2: *A short-wave super-regenerator with a single vacuum tube.*

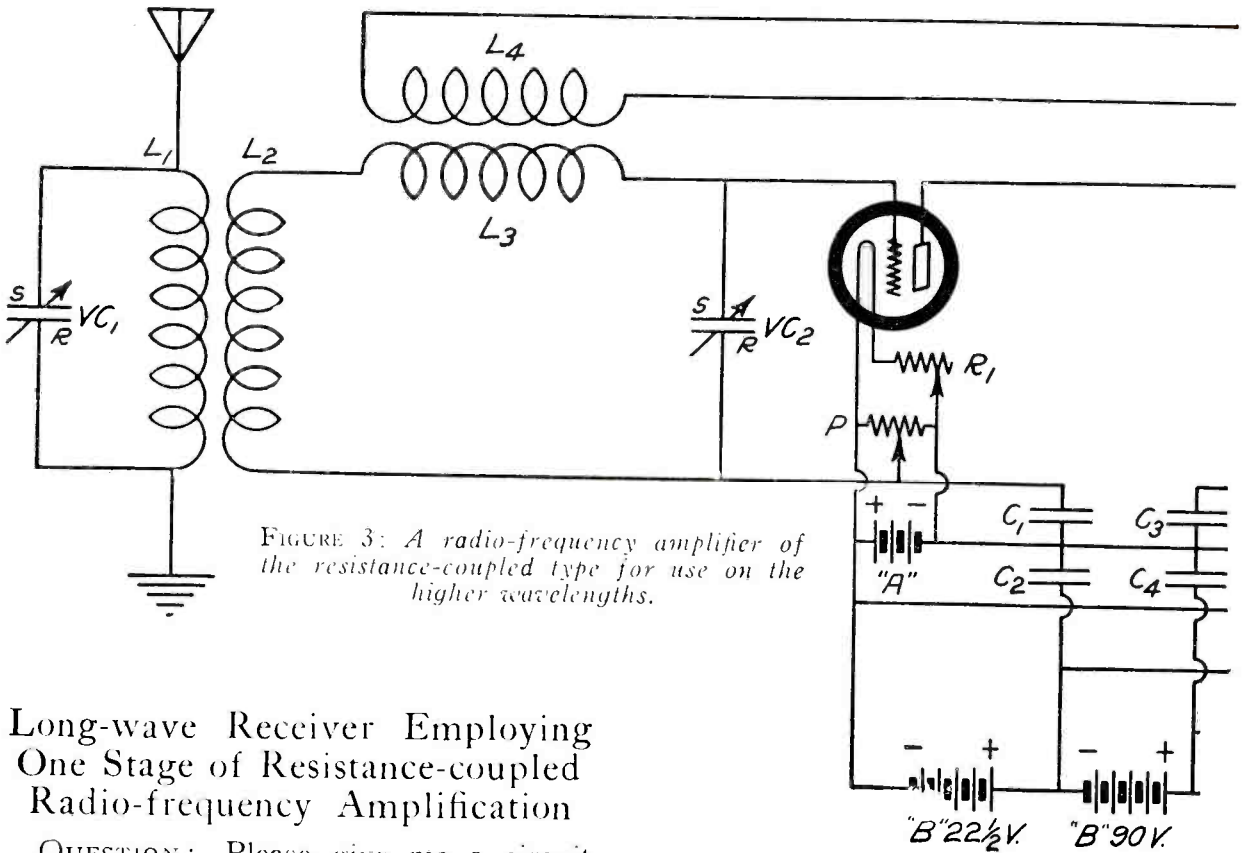


FIGURE 3: *A radio-frequency amplifier of the resistance-coupled type for use on the higher wavelengths.*

Long-wave Receiver Employing One Stage of Resistance-coupled Radio-frequency Amplification

QUESTION: Please give me a circuit suitable for honeycomb coils and using one stage of resistance-coupled amplification in the radio-frequency circuit.

J. AUSTIN ENGLAND

ANSWER: You will find a circuit in Figure 3 that will meet your requirements. The parts you will require in the construction of the receiver are given below:

L1, L2, L3 and L4—honeycomb coils (various sizes for various long ranges);
VC1—variable condenser, .001 mfd.;
VC2—variable condenser, .0005 mfd.;
C1, C2, C3 and C4—paper fixed condensers, .5 mfd.;
GC—mica fixed condenser, .00025 mfd.;
C5 and C6—mica fixed condensers, .0005 mfd.;
R1 and R3—filament rheostats, 20 ohms;
R2—filament rheostat, 6 ohms;
P—potentiometer, 400 ohms;
R4—fixed resistance, 25,000 ohms;
GL—variable grid-leak;
AFT—audio-frequency amplifying transformer;
TEL—telephones.

The coils L1, L2 and L4 should be used in the same sizes that are used for the ordinary three-coil set for the various wavelength ranges. The coil L3 should be of size L-150 throughout the wavelength range; it remains fixed.

The second tube should be a soft tube. Tuning is accomplished in the same manner that is employed with the triple-coil honeycomb set. The set will not function with much success, however, on wavelengths lower than 5,000 meters. This is because the resistance coupling is not effective at the lower waves.

Mounting Instruments on a Wooden Board

QUESTION: Does it matter whether the instruments are fastened directly on a wooden sub-base, or should they be mounted on rubber or bakelite panels?

H. J. B.

ANSWER: They may be mounted directly on the base. It is not necessary to mount any instruments on panels except when the terminals of the instruments can touch the base itself.

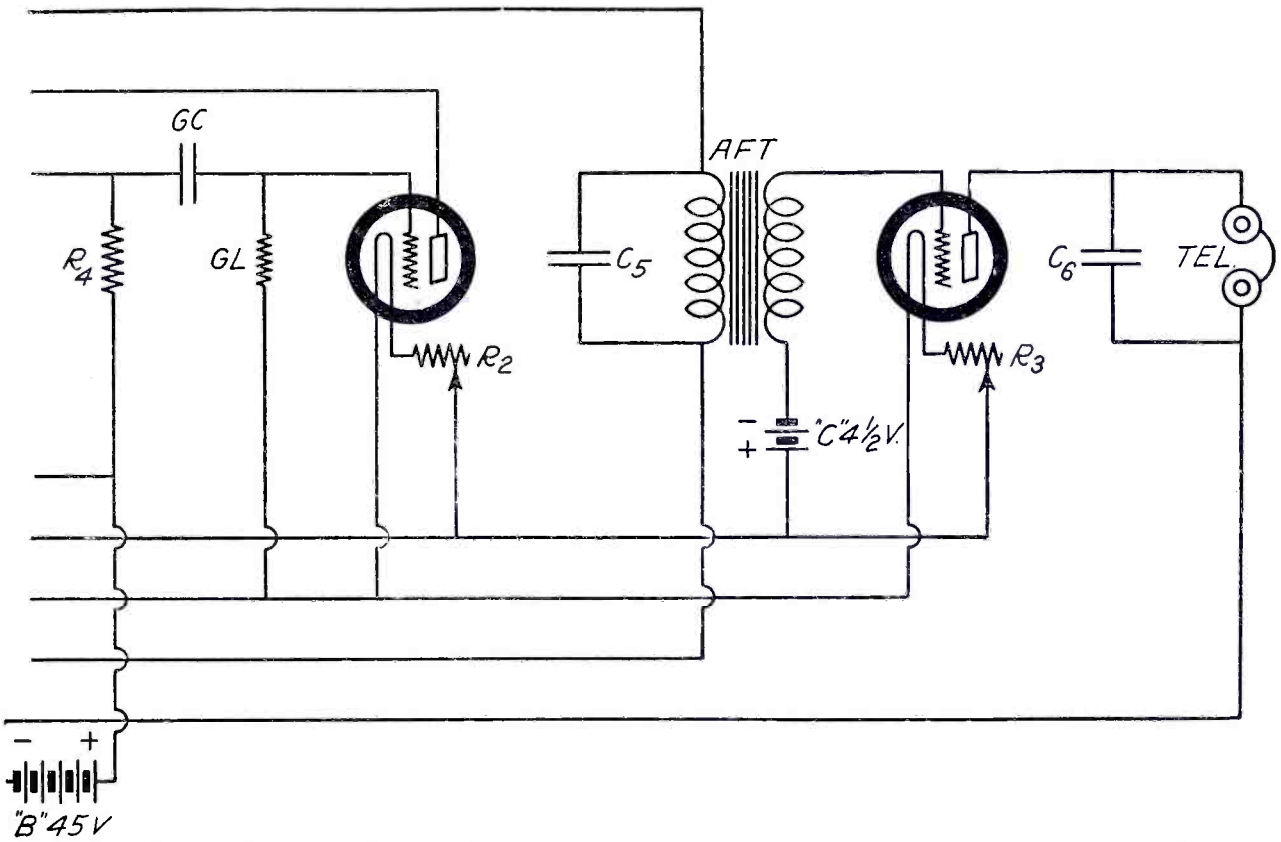
Nearly all instruments are made with suitable insulated bases, so that they can be fastened in any way you desire.

Tubes for Winding Coils

QUESTION: What is the best tube of the three for winding forms for coils: cardboard, hard rubber, or bakelite?

WALTER G. TRUMBULL

ANSWER: A good grade of hard rubber is superior.



Grid-condenser Capacity for Receiving Sets

QUESTION: What is the usual capacity of a grid condenser for use in a regenerative receiver?

HOWARD POTTER

ANSWER: A fixed condenser of .00025 mfd. will be suitable for most circuits used for reception.

The Resistance of a Condenser

QUESTION: What is meant by the "resistance" of a condenser? I do not understand what this means. I thought that a condenser had "capacity" and that a rheostat had "resistance," but I never knew that a condenser also had "resistance."

J. D. ANDREWS

ANSWER: It is true that a condenser is used on account of its capacity. Likewise, a rheostat is used on account of its resistance, and a coil on account of its inductance.

But none of these instruments possess these qualities singly; they possess all three qualities to a certain extent. Thus, a good condenser will have a certain capacity, and the resistance and inductance will be as small a value as possible. The resistance of the condenser is due to losses in the instrument from dielectric absorption and resistance between the plates and connections. The new type of instruments usually have these losses reduced as low as possible. The inductance of such an instrument is very low. Rheostats should have the desired amount of resistance and low inductance and the capacity is negligible.

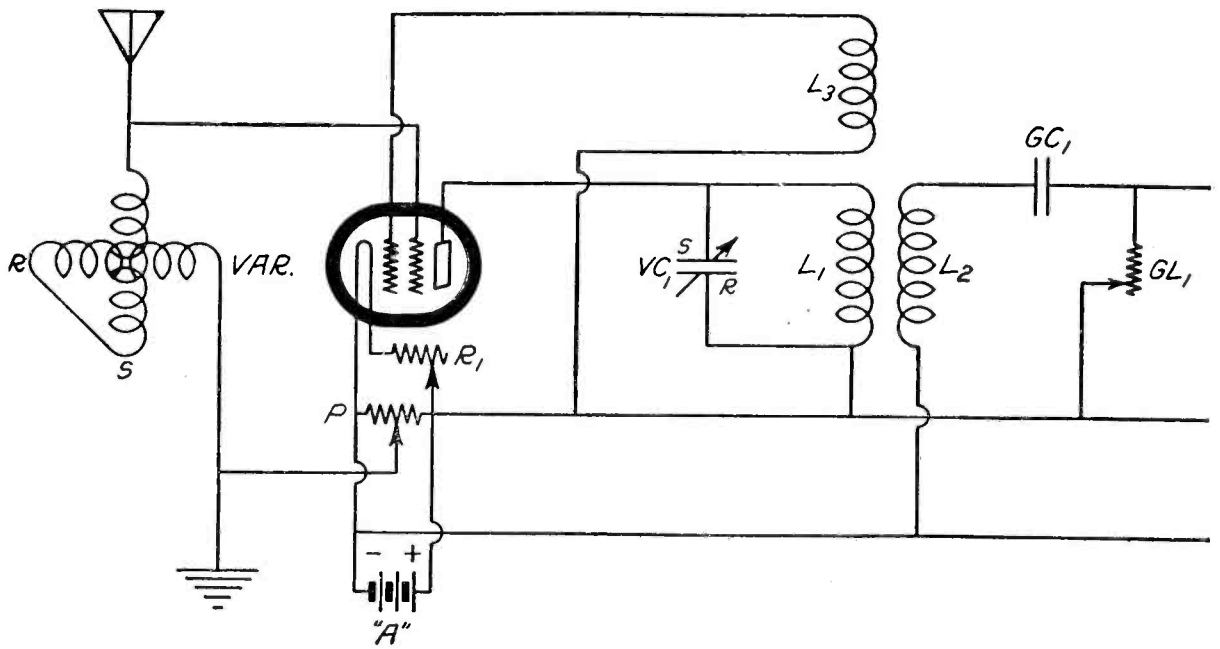
Coils, on the other hand, if they are good ones, have the correct amount of inductance with a minimum of resistance and distributed capacity.

How to Avoid Body Capacity While Tuning

QUESTION: I have a one-tube regenerative receiver and I find that I have quite a lot of hand capacity around the tuning condenser dial. How can I eliminate this trouble? It makes it extremely difficult to tune in distant stations and I have to hold my hand in position or the station will suddenly fade out.

H. G. ALLEN

ANSWER: Reverse the connections of the variable condenser and ground the secondary of the coupler so that the rotor of the condenser will be a ground potential. This means that you should ground the side of the coupler secondary that goes to the filament circuit. This will eliminate your trouble.



Regenerative Circuit for Four-electrode Tubes and Two-stage Amplifier Using No "B" Batteries

QUESTION: Will you kindly give me a hook-up for using four-electrode tubes in a regenerative circuit with a two-step amplifier? I refer to the method called the Solodyne principle, discovered by two English experimenters. Can you let me have this particular hook-up together with some information as to where I can get the special tubes in America? I have inquired at a number of stores that sell radio apparatus but nobody seems to know anything about them.

ALFRED BOICE

ANSWER: The circuit for the Unidyne or Solodyne is given in Figure. 4.

The parts you will need are the following:

VAR—variometer;
L1 and L2—honeycomb coils, size L-75;
L3—honeycomb coil, size L-100;
VC1—variable condenser, .0005 mfd.;
GC1—mica fixed condenser, .00025 mfd.;
GC2—mica fixed condenser, .002 mfd.;
C—mica fixed condenser, .0005 mfd.;
GL1 and GL2—variable grid-leaks;
R1, R2 and R3—filament rheostats, 20 ohms;
AFT—audio-frequency amplifying transformer;
P—potentiometer, 400 ohms;
TEL—telephones.

The tubes recommended are the Nutron four-element tubes. The circuit functions satisfactorily without "B" batteries, but, of course, it cannot give the maximum volume that is obtained with a set that *does* use "B" batteries.

The set has its use, however, where portability is a consideration.

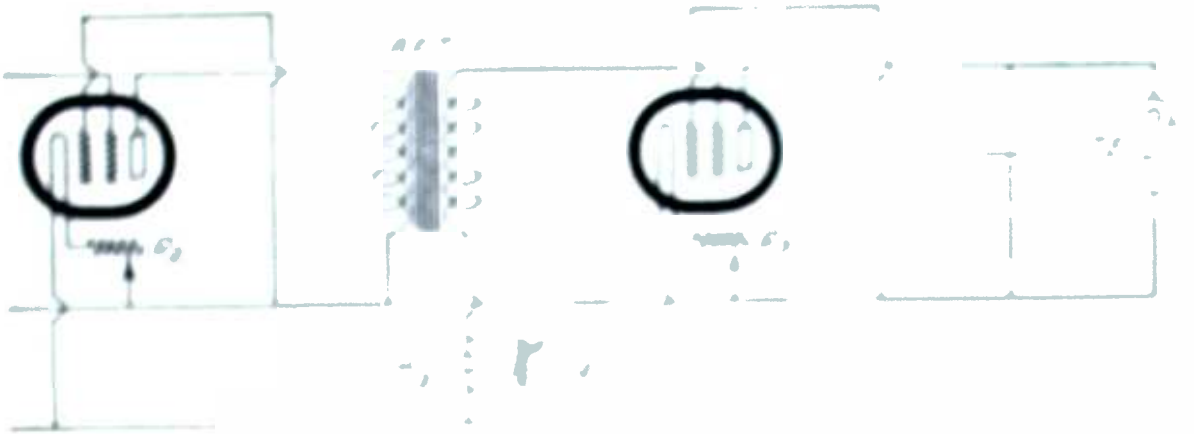
Two-electrode and Three-electrode Vacuum Tubes

QUESTION: Which type of vacuum tube is the most efficient as a detector in a radio receiving circuit, the three-electrode tube employing the grid, or the two-element tube? Which gives the greatest amplification?

ARTHUR G. SAYER

ANSWER: The two-element tube acts as a rectifier of radio-frequency currents, and its detector action consists solely of this action. The three-element tube acts as both a rectifier and an amplifier, and therefore, produces greater results in reception strength.

The first mentioned tube utilizes the rectified incoming energy to produce the sound waves emitted from the telephones, and the second type of tube utilizes the radio-frequency incoming energy to relay or "trigger off" or control a local direct current so that the direct current will have an amplitude which follows, more or less closely, the variations of the radio-frequency current. This pulsating current with its radio-frequency component is called the plate current, and its energy is many times greater than the energy of the incoming impulses. When the plate current is led through the windings of the telephones it, therefore, produces a greater signal than in the case of the rectified incoming impulses of the two-element type of tube. The three-element tube is superior as a detector and is essential as an amplifier.



CONDUCTED BY DR. E. E. FREE

Do the Sun-spot Magnets Indicate a Radio Cycle?

IT has long been known that the dark flecks which occasionally appear on the surface of the sun—the so-called sun-spots—are in reality vast whirling storms like our terrestrial cyclones but so vast that a dozen complete earths might be dropped into the gaping vortex of some of the more colossal of these solar whirlwinds. Now it has been discovered that the sun-spots are not only tremendous material disturbances; they are also great magnets, containing intense magnetic fields.

This conclusion results from the long-continued work of Dr. George Ellery Hale and his associates at the great Observatory of the Carnegie Institution at Mt. Wilson, California.* By examining the light rays received from these spots—for the spots are not black, but are merely not so bright as the rest of the sun's surface—Dr. Hale has been able to show that this light has been affected by magnetism, just as light is affected if it is produced here on earth between the poles of a powerful electromagnet.

Not only does this prove the spot to be the site of an intense magnetic field, but detailed examination of a large number of sun-spots has shown that they usually occur in pairs, one of the spots possessing a north magnetic polarity while the other has the character of a south magnetic pole. This behavior appears, too, to be closely associated with the cycle according to which the number of sun-spots increases and decreases in a period of eleven years.

During one of these solar-spot cycles the spots will have their magnetic polarities in one direction, say with the north magnetic pole at the end of the spot toward the sun's north pole. At the time of sun-spot minimum this reverses. When the spots begin, thereafter, to increase in number, it is found that the spot possessing a north magnetic polarity is now the one toward the sun's *south* pole instead of toward its north pole.

All this indicates a most complicated situation, probably related, Dr. Hale believes, to something that is going on deep inside the sun. What that something is it is not yet possible even to guess.

There are, however, some facts already evident and which have much interest for radio engineers. For example, the mere fact that the sun-spots are powerful magnets may be important to us. All radio engineers now agree that the magnetic and electric condition of the earth has very important effects on radio transmission. Great disturbances on the sun, including large and numerous sun-spots, have been observed to coincide many times with the so-called "magnetic storms" that put telegraph lines out of commission and disturb radio all over the earth. If the sun-spots are the seat of tremendous magnetic activity all this becomes quite understandable.

There are some suggestive facts, also, about the sun-spot cycle of eleven years. We have just passed through the minimum of this cycle. 1924 is the year of least sun-spots. The number will now begin to increase slowly until about 1929. Thereafter it will decrease again until the next minimum year in 1935.

Similarly, there were previous minima in 1913, 1901, 1890, 1879, 1868, and so on. Every eleven years there is a year of fewest sun-spots; half-way between these minimum years there are years of many sun-spots. Nobody knows the reasons for this cycle. It is one of the many remaining mysteries about the sun.

May it not be possible that this recurrent sun-spot cycle has its influence on radio? It is noticeable, for example, that this summer of 1924 has been unusually free of static. This is also the year of minimum sun-spots, which means, we may suspect, the year of minimum magnetic disturbance on (or in) the sun.

Unfortunately we possess no accurate records of the prevalence of static in past years or, indeed, of the course of any radio phe-

* Dr. Hale's work has been described briefly in *Nature* (London), in *Scribner's Magazine* (New York) and elsewhere. The most recent non-technical description of it is in the chapter entitled "Sun-spots as Magnets" in "The Depths of the Universe," by George Ellery Hale, Charles Scribner's Sons, New York, 1924, pages 62-98.

nomenon from year to year. It seems not impossible, however, that a less magnetic disturbance on the sun may mean less static here, or may affect in some other way the nature or radio transmission on earth.

It used to be believed that the increase and decrease in the number of sun-spots controlled the weather on earth. This is not now believed to be true, at least in any important and unequivocal way. It is more reasonable to assume that the increase and decrease of sun-spots may affect radio. Dr. Hale has proved that the spots are great magnets. Variable magnetic fields of such great intensity can hardly be without their electromagnetic effects at distances so short, relatively, as that of the sun from the earth.

Will Radio Waves Return to Us in 360,000,000,000 Years?

STUDENTS of the Einstein theory are already familiar with the idea that the universe in which we live is really not infinite but consists of a great "continuum," curved in the fourth dimension, so that a light ray or a radio message going out from the earth or from any star in what seems to us a straight line will really bend around (in the fourth dimension) and come back ultimately to its starting point.

At the recent meeting of the British Association for the Advancement of Science, at Toronto, Canada, Dr. Ludvik Silberstein of Rochester, New York, reduced this idea to definite distances, using as his means of measurement certain properties of the light rays that reach the earth from distant stars.

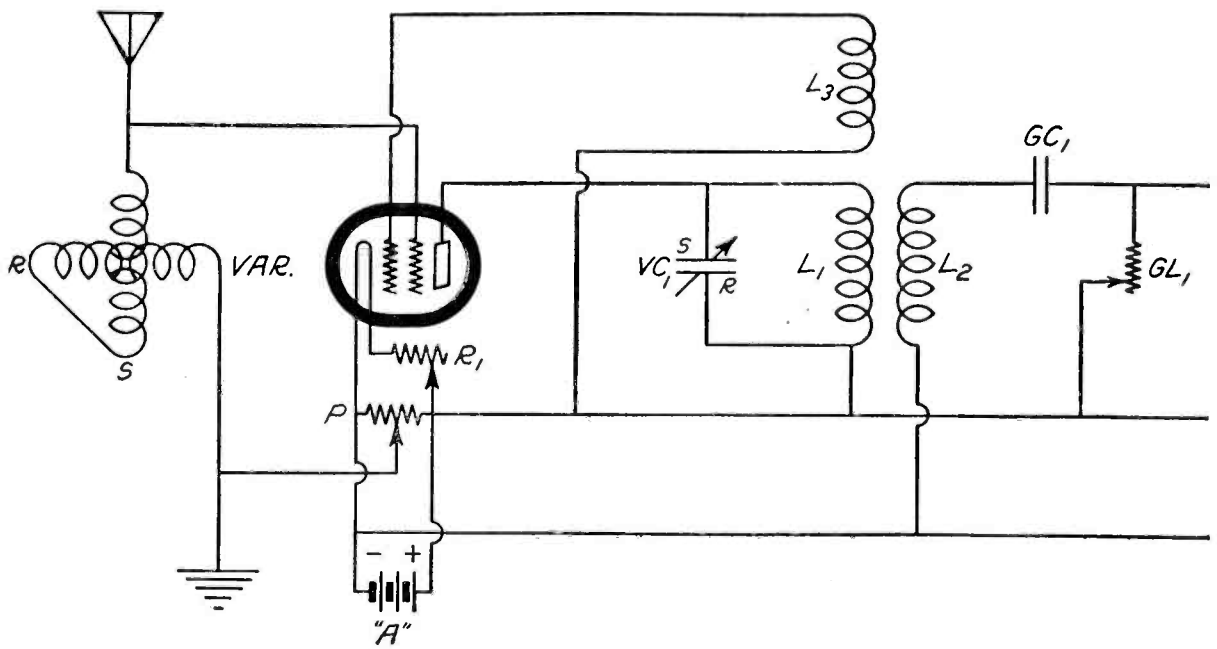
The full trip around the universe and back measures, he concluded, the stupendous distance of 360,000,000,000 light-years, which means that light rays or radio waves would take that long to go and to return. If the radio messages now leaving the earth are not absorbed on the way they will come back in that time, Dr. Silberstein thinks, to where the earth is now. Of course, the earth will not be here then—probably there will not even *be* any earth then.

It is interesting to note that the depths of the universe explored so far by our telescopes, vast as they seem to us, constitute but a tiny fraction of the space occupied by this universal "continuum" to which we belong. The most distant heavenly body so far discovered lies,

Courtesy of Henry Woodhouse

IS THIS A TERRESTRIAL EFFECT OF SUN-SPOTS?

This remarkable photograph shows an appearance of the northern lights or aurora borealis in Norway in March, 1910. Scientists believe that the aurora may be one of the effects due to the solar storms that cause sun-spots.



Regenerative Circuit for Four-electrode Tubes and Two-stage Amplifier Using No "B" Batteries

QUESTION: Will you kindly give me a hook-up for using four-electrode tubes in a regenerative circuit with a two-step amplifier? I refer to the method called the Solodyne principle, discovered by two English experimenters. Can you let me have this particular hook-up together with some information as to where I can get the special tubes in America? I have inquired at a number of stores that sell radio apparatus but nobody seems to know anything about them.

ALFRED BOICE

ANSWER: The circuit for the Unidyne or Solodyne is given in Figure. 4.

The parts you will need are the following:

VAR—variometer;
L1 and L2—honeycomb coils, size L-75;
L3—honeycomb coil, size L-100;
VC1—variable condenser, .0005 mfd.;
GC1—mica fixed condenser, .00025 mfd.;
GC2—mica fixed condenser, .002 mfd.;
C—mica fixed condenser, .0005 mfd.;
GL1 and GL2—variable grid-leaks;
R1, R2 and R3—filament rheostats, 20 ohms;
AFT—audio-frequency amplifying transformer;
P—potentiometer, 400 ohms;
TEL—telephones.

The tubes recommended are the Nutron four-element tubes. The circuit functions satisfactorily without "B" batteries, but, of course, it cannot give the maximum volume that is obtained with a set that *does* use "B" batteries.

The set has its use, however, where portability is a consideration.

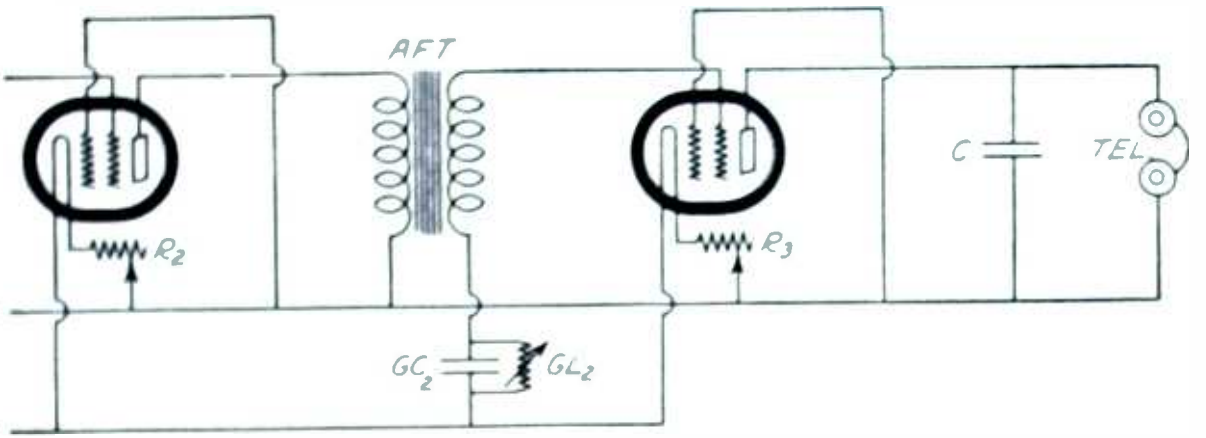
Two-electrode and Three-electrode Vacuum Tubes

QUESTION: Which type of vacuum tube is the most efficient as a detector in a radio receiving circuit, the three-electrode tube employing the grid, or the two-element tube? Which gives the greatest amplification?

ARTHUR G. SAYER

ANSWER: The two-element tube acts as a rectifier of radio-frequency currents, and its detector action consists solely of this action. The three-element tube acts as both a rectifier and an amplifier, and therefore, produces greater results in reception strength.

The first mentioned tube utilizes the rectified incoming energy to produce the sound waves emitted from the telephones, and the second type of tube utilizes the radio-frequency incoming energy to relay or "trigger off" or control a local direct current so that the direct current will have an amplitude which follows, more or less closely, the variations of the radio-frequency current. This pulsating current with its radio-frequency component is called the plate current, and its energy is many times greater than the energy of the incoming impulses. When the plate current is led through the windings of the telephones it, therefore, produces a greater signal than in the case of the rectified incoming impulses of the two-element type of tube. The three-element tube is superior as a detector and is essential as an amplifier.



Removing Dirt from Between Condenser Plates

QUESTION: How shall I get the dirt from the plates of the condensers? I have thought of washing them out with water, but upon consideration I thought the moisture might harm the instruments. How would gasoline or ether do for this purpose?

W. R. THOMAS

ANSWER: We recommend that you get an ordinary pipe cleaner such as used for cleaning the stems of smoking pipes. These can be inserted between the plates and the dirt removed. There is a condenser plate cleaner somewhat on this order which is now on the market.

Filament Current Critical on DX Stations

QUESTION: Why is it that the filament control on my set is so critical on distant signals? I find that to get the clearest reception on local stations I have to turn the filaments down so that I cut out a lot of noise and tube disturbance. This, as I have said, gives me the best reception on locals. But, when I try for distance, I have to turn the tube (detector tube) nearly all the way up, just below the point where it lets out a loud hissing sound.

I would like to know what causes this condition.

F. D. HAFTER

ANSWER: You are probably using a soft tube [illegible] that such a [illegible] much more critical and therefore [illegible] enough to take advantage of the [illegible] of the gassy contents.

In this [illegible] plate current response is much greater to very weak grid impulses than when the filament emission is curtailed so that ionization of the gas is reduced.

On local signals you have to cut down the filament emission by turning down the filament because the strong plate current, once it is started tries to keep on flowing when ionization is present. This of course, tends to blur over the signals and introduces distortion.

When Is a "C" Battery Necessary?

QUESTION: I have been experimenting with a "C" battery on my receiver and it does not seem to improve the results. In fact the signals seem to be weaker with the "C" battery connected in the circuit than when I cut it out of the circuit entirely. I connected it between the jack and the transformer, and I was careful to connect it with the negative side toward the transformer as shown in a diagram I saw.

A. B. I.

ANSWER: You have placed the "C" battery in the plate circuit instead of the grid circuit. In other words you connected it between the B battery and the plate. When connected in this way its only effect would be to increase or decrease the effective plate voltage slightly. The proper place for the "C" battery is between the amplifying transformer and the filament circuit in the *secondary or grid circuit* of the transformer. Be sure to connect the minus side toward the terminal of the transformer.

CONDUCTED BY DR. E. E. FREE

Do the Sun-spot Magnets Indicate a Radio Cycle?

IT has long been known that the dark flecks which occasionally appear on the surface of the sun—the so-called sun-spots—are in reality vast whirling storms like our terrestrial cyclones but so vast that a dozen complete earths might be dropped into the gaping vortex of some of the more colossal of these solar whirlwinds. Now it has been discovered that the sun-spots are not only tremendous material disturbances; they are also great magnets, containing intense magnetic fields.

This conclusion results from the long-continued work of Dr. George Ellery Hale and his associates at the great Observatory of the Carnegie Institution at Mt. Wilson, California.* By examining the light rays received from these spots—for the spots are not black, but are merely not so bright as the rest of the sun's surface—Dr. Hale has been able to show that this light has been affected by magnetism, just as light is affected if it is produced here on earth between the poles of a powerful electromagnet.

Not only does this prove the spot to be the site of an intense magnetic field, but detailed examination of a large number of sun-spots has shown that they usually occur in pairs, one of the spots possessing a north magnetic polarity while the other has the character of a south magnetic pole. This behavior appears, too, to be closely associated with the cycle according to which the number of sun-spots increases and decreases in a period of eleven years.

During one of these solar-spot cycles the spots will have their magnetic polarities in one direction, say with the north magnetic pole at the end of the spot toward the sun's north pole. At the time of sun-spot minimum this reverses. When the spots begin, thereafter, to increase in number, it is found that the spot possessing a north magnetic polarity is now the one toward the sun's *south* pole instead of toward its north pole.

All this indicates a most complicated situation, probably related, Dr. Hale believes, to something that is going on deep inside the sun. What that something is it is not yet possible even to guess.

There are, however, some facts already evident and which have much interest for radio engineers. For example, the mere fact that the sun-spots are powerful magnets may be important to us. All radio engineers now agree that the magnetic and electric condition of the earth has very important effects on radio transmission. Great disturbances on the sun, including large and numerous sun-spots, have been observed to coincide many times with the so-called "magnetic storms" that put telegraph lines out of commission and disturb radio all over the earth. If the sun-spots are the seat of tremendous magnetic activity all this becomes quite understandable.

There are some suggestive facts, also, about the sun-spot cycle of eleven years. We have just passed through the minimum of this cycle. 1924 is the year of least sun-spots. The number will now begin to increase slowly until about 1929. Thereafter it will decrease again until the next minimum year in 1935.

Similarly, there were previous minima in 1913, 1901, 1890, 1879, 1868, and so on. Every eleven years there is a year of fewest sun-spots; half-way between these minimum years there are years of many sun-spots. Nobody knows the reasons for this cycle. It is one of the many remaining mysteries about the sun.

May it not be possible that this recurrent sun-spot cycle has its influence on radio? It is noticeable, for example, that this summer of 1924 has been unusually free of static. This is also the year of minimum sun-spots, which means, we may suspect, the year of minimum magnetic disturbance on (or in) the sun.

Unfortunately we possess no accurate records of the prevalence of static in past years or, indeed, of the course of any radio phe-

* Dr. Hale's work has been described briefly in *Nature* (London), in *Scribner's Magazine* (New York) and elsewhere. The most recent non-technical description of it is in the chapter entitled "Sun-spots as Magnets" in "The Depths of the Universe," by George Ellery Hale, Charles Scribner's Sons, New York, 1924, pages 62-98.

nomenon from year to year. It seems not impossible, however, that a less magnetic disturbance on the sun may mean less static here, or may affect in some other way the nature or radio transmission on earth.

It used to be believed that the increase and decrease in the number of sun-spots controlled the weather on earth. This is not now believed to be true, at least in any important and unequivocal way. It is more reasonable to assume that the increase and decrease of sun-spots may affect radio. Dr. Hale has proved that the spots are great magnets. Variable magnetic fields of such great intensity can hardly be without their electromagnetic effects at distances so short, relatively, as that of the sun from the earth.

Will Radio Waves Return to Us in 360,000,000,000 Years?

STUDENTS of the Einstein theory are already familiar with the idea that the universe in which we live is really not infinite but consists of a great "continuum," curved in the fourth dimension, so that a light ray or a radio message going out from the earth or from any star in what seems to us a straight line will really bend around (in the fourth dimension) and come back ultimately to its starting point.

At the recent meeting of the British Association for the Advancement of Science, at Toronto, Canada, Dr. Ludvik Silberstein of Rochester, New York, reduced this idea to definite distances, using as his means of measurement certain properties of the light rays that reach the earth from distant stars.

The full trip around the universe and back measures, he concluded, the stupendous distance of 360,000,000,000 light-years, which means that light rays or radio waves would take that long to go and to return. If the radio messages now leaving the earth are not absorbed on the way they will come back in that time, Dr. Silberstein thinks, to where the earth is now. Of course, the earth will not be here then—probably there will not even *be* any earth then.

It is interesting to note that the depths of the universe explored so far by our telescopes, vast as they seem to us, constitute but a tiny fraction of the space occupied by this universal "continuum" to which we belong. The most distant heavenly body so far discovered lies,

Courtesy of Henry Woodhouse

IS THIS A TERRESTRIAL EFFECT OF SUN-SPOTS?

This remarkable photograph shows an appearance of the northern lights or aurora borealis in Norway in March, 1910. Scientists believe that the aurora may be one of the effects due to the solar storms that cause sun-spots.

according to Dr. Harlow Shapley of Harvard University, about 220,000 light-years from the earth. This is only a little more than one millionth of Dr. Silberstein's figure for the entire universe.

According to this, our progress in exploring the universe in which we live has been about the same as that of a man who set out to explore the whole earth and succeeded in advancing only one hundred feet away from his door.

This idea of an explorer on the earth gives us, by the way, an easy mental picture of what the mathematicians really mean by "curved space," by the "continuum," by the "four-dimensional universe" and similar phrases.

To a man the earth *seems* flat. If you start out to walk across it you seem to be walking on a plane. If you walk far enough in a straight line (assuming that no oceans interfere) you will return, in the end, to the place from which you started.

To an ignorant man this would seem in the highest degree mysterious. You walk away. You keep going always in the same direction. Yet in the end you arrive back where you began.

We know the key to the mystery because we have learned that the earth is not really flat; that it is, in fact, a sphere and that a walker really walks around it. The earth *seems* to have only two dimensions; to be a plane. Actually it has *three* dimensions; the apparent plane is really curved imperceptibly in the third dimension.

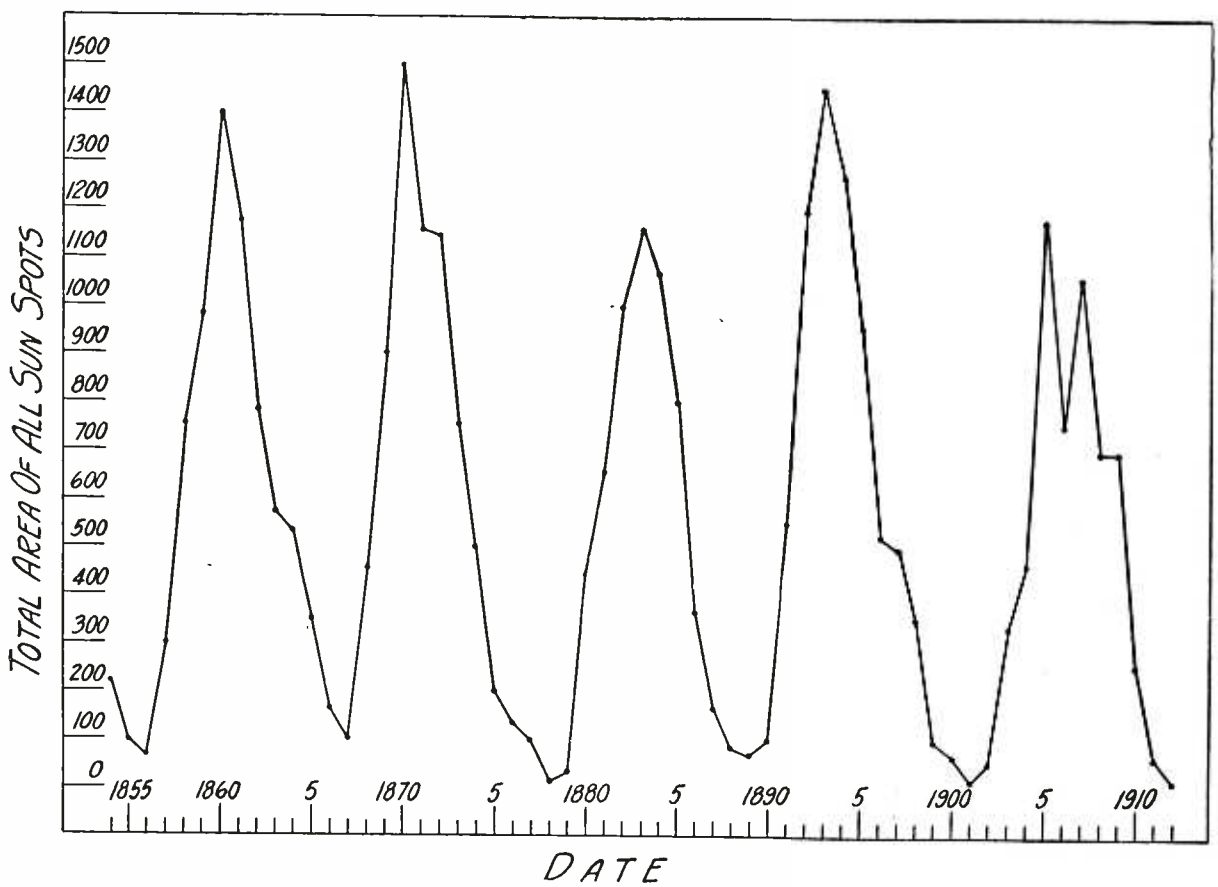
Just so, say the mathematicians, it is with the universe. It *seems* to us that it has three dimensions; actually it has at least four. It is curved in the fourth dimension just as the earth's surface is curved in the third. So the light ray or radio path that seems to be straight is really curved and will return ultimately to its beginning exactly as does the path of the traveller around the earth.

The Radio Phonograph Arrives

THE prediction, made some months ago in this Department* that there would soon be a practicable application of the almost forgotten Poulsen telegraphone or iron-wire phonograph has been fulfilled. In a recent article Mr. I. R. Lounsberry describes the successful experiments of himself and Mr. W. R. Seigle.†

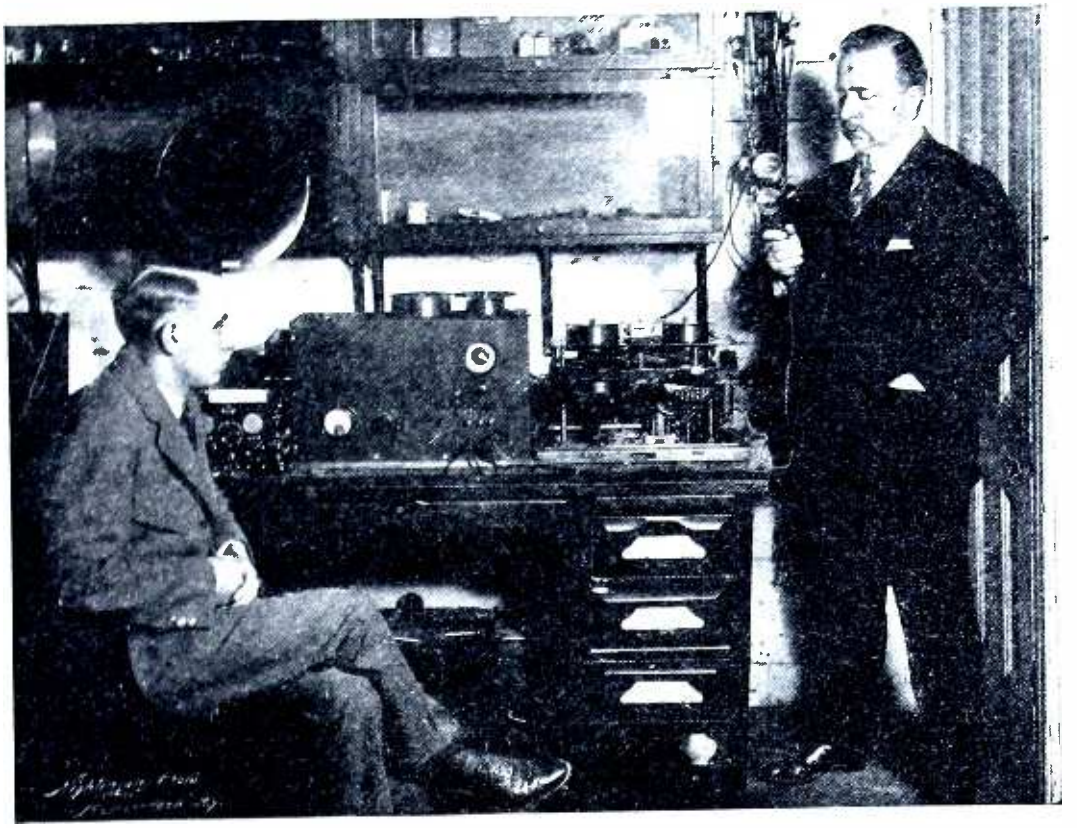
* "Will We Have the Radio Phonograph," POPULAR RADIO for April, 1924, page 409.

† "Making Permanent Records of Radio Programs," by I. R. Lounsberry, *Radio Broadcast* (Garden City, New York), vol. 5, pages 363-368 (September, 1924).



HOW SUN-SPOTS VARY WITH THE YEARS

This curve, redrawn from Dr. Hale's book, shows the relative frequency of sun-spots during each year of the period between 1854 and 1912. The eleven-year cycle —which may be also a radio cycle—is clearly evident.



Courtesy of *Radio Broadcast*

THE IRON-WIRE RADIO RECORDER IN ACTION

This apparatus—christened the "phonowire"—records radio programs or any other sounds by magnetic records on a long roll of iron wire. The spools for the wire are visible on the top of the apparatus.

The new device has been christened the phonowire. Radio amplifiers increase the energy of incoming radio signals so that they can be impressed, magnetically, on a long roll of iron wire which unwinds automatically between the poles of magnets on the field of which the signal impulses are superposed. This produces a permanent magnetic record in the wire. By running the wire through a pick-up apparatus, which consists, once more, of a special radio amplifier, the magnetic record can be recovered from the wire and translated into sound. In this manner it will be possible, Mr. Lounsberry asserts, to make records of any radio program and to run off these records at any later time, just as one can do with a phonograph record.

Radio Messages from Mars

At approximately seven o'clock on the evening of August 22, 1924, the planet Mars came closer to the earth than at any time in over a century past and closer than it will be to us for some 120 years in the future. Seldom has an event in astronomy—barring only the eclipses of the sun—attracted so much public attention. Mars was front-page news in practically every metropolitan newspaper in the world.

No "messages" seem to have been received. The technical staff of *Popular Wireless* (London) took the trouble to build a special receiver containing the extraordinary number of twenty-four vacuum tubes, especially to listen to Mars on the very long wavelengths which someone supposed—no one knows why—to be the favorite signal frequency of our sister planet.* Something described as "a curious noise" was actually heard in this remarkable receiver, which is by no means surprising. A great many "curious noises" might well be audible in any 24-tube receiver!

Quite apart from its purpose as an interplanetary explorer this set is of considerable interest to radio engineers. A detailed description of its construction will be awaited with curiosity. It is said to have 20 stages of radio-frequency amplification; two of them coupled by tuned plate circuits, the remainder by transformers. Special transformer shielding was an absolute essential. The twenty-first tube is the detector and the three remaining ones are three stages of audio-frequency amplification, these being inserted or removed, at will, by means of switches. It is stated that with but 18 tubes, all working at very low filament temperature, American broadcasting was received at loudspeaker strength on a 12-inch by 36-inch loop antenna.

* "The P. W. 24-Valve Set. Listening-In for Mars," by G. V. Dowding. *Popular Wireless* (London), vol. 5, pages 863-864 (August 16, 1924).

Mars is drawing away from the earth only slowly and it is expected that important astronomical observations will be possible for a number of months longer. What we will learn as a result of these observations it is still too soon to say. It is upon work like this that the scientists really depend for knowledge about our sister planet, not upon any hope of radio messages.

Indeed, as M. Camille Flammarion pointed out in POPULAR RADIO last month, it is almost inconceivable that the Martians (if there be any) could be enough like us to send intelligible radio messages to us or to understand any that we might send to them.

Abrams "Radio Cures" Prove False in Tests

RADIO engineers have heard much in the past two years about the methods of diagnosing and treating disease invented by the late Dr. Albert Abrams of San Francisco and now known as "E. R. A.," these letters standing for "Electronic Reactions of Abrams."

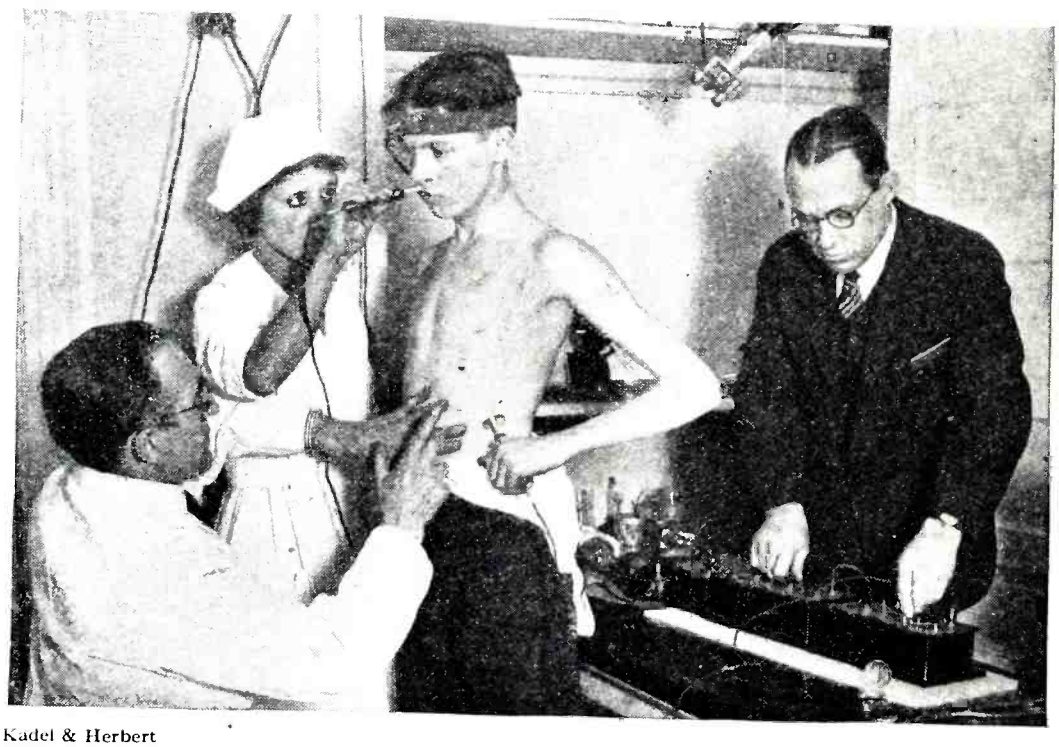
The idea underlying these methods is that disease produces certain alterations in the blood and that these alterations are discoverable by means of certain "electronic" or "vibrational" reactions that can be detected in a blood sample. Briefly, the diagnostic procedure is this:

A sample of the blood of the patient is taken and is placed in an instrument which is essentially a two-plate condenser, the blood sample (on a piece of filter paper) occupying the space between the two plates. Connected with this instrument by wires are two ordinary resistance boxes labeled in ohms and another instrument the exact nature of which is not disclosed. The wires then go to a human subject, whose body becomes a part of the "circuit." There is no visible source of electromotive force.

The "reactions" are not measured instrumentally, but are detected by means of certain alterations of skin condition on the abdomen of the human subject who is in the "circuit." For example, a glass rod drawn slowly over the skin of the subject is supposed to "stick" a little at the areas where the reaction is occurring. Dr. Abrams furnished his disciples a chart showing what was indicated by a "sticking" of the rod on each of various areas of the abdomen.

There are, of course, many other details, but these are the essentials. The methods have been taken up by many persons, in and out of the medical profession. Radio engineers have been drawn into the matter by the claim that the "reactions" were really due to radio waves of some hitherto undiscovered kind, these waves being supposed to emanate from the "electrons" of the disease-indicating substances in the blood sample.

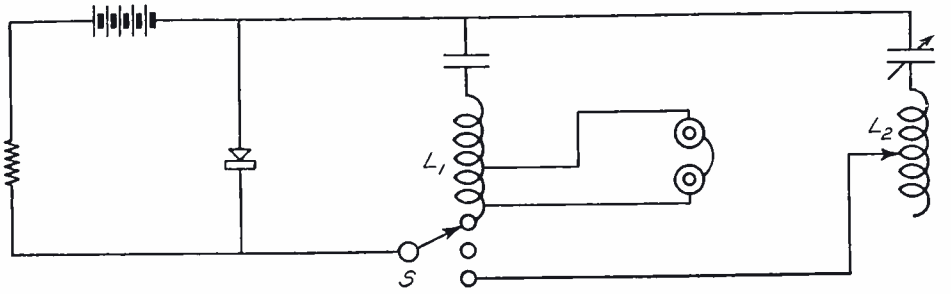
This was the situation some months ago when the *Scientific American* organized an investigation of the claims for E. R. A. and appointed a committee of disinterested scientists



Kadel & Herbert

HOW THE ABRAMS TESTS ARE MADE

The sample of the patient's blood, inserted in the apparatus, is supposed to record its diseased or healthy condition by means of "reactions" observable on the skin of the "subject's" abdomen. The tests of the committee of the "Scientific American" resulted in the conclusion that these "reactions" are illusory.



HOOK-UP FOR LOSSEV'S OSCILLATING CRYSTALS

The crystal rectifier is a zincite-steel contact. The switch, S, permits transferring the circuit from the inductance L1 to the inductance L2. All hook-ups used with these crystals are substantially similar to those used with the familiar arc oscillators.

to study the whole matter. The final report of this committee, now published, is entirely adverse to the claims of the Abrams practitioners.*

The report brands the methods as "utterly worthless." The official statement, signed by all members of the committee, is as follows: "This committee finds that the claims advanced on behalf of the Electronic Reactions of Abrams, and of electronic practice in general, are not substantiated; and it is our belief that they have no basis in fact. In our opinion the so-called electronic reactions do not occur, and the so-called electronic treatments are without value." "At best," says Mr. Lescarboura in his full account of the investigation, "it is all an illusion. At worst, it is a colossal fraud."

The detailed story of the investigation leaves little doubt that this verdict is just and was the only possible one. The "radio cures" must join the vast army of other exploded delusions.

The New Crystal Oscillators

SOME attention has been attracted recently in European radio circles by the crystal oscillators built by a young Russian engineer, M. O. V. Lossev, attached to the Soviet radio laboratory at Nishni Novgorod.† A zincite crystal and a steel catwhisker are used. A battery or other source of current and a resistance are in series with the crystal. Inductances and condensers are arranged in parallel with it. The result is that oscillations are set up, so that the circuit may be used either as a transmitter or as a receiver, using the heterodyne principle or some other one in which a local oscillator is employed.

In spite of the glowing phrases in which the revolutionary nature of these circuits is heralded, it does not seem that they constitute, at present at least, any remarkable advance. The hook-ups given are substantially the same as are used with any spark oscillator. It seems probable that M. Lossev has merely duplicated with zincite and steel terminals the familiar properties of any properly arranged spark circuit; for example, the standard Poulsen arc. Indeed, according to Mr. Pocock's article cited in the footnote, Dr. W. H. Eccles demonstrated the possibility of arc oscillations on a galena crystal as long ago as 1910.

This does not mean that M. Lossev's work deserves no attention. So long as the basic theory of the rectifying crystal is unknown *any* work with it may prove to be important. But it does mean that we are getting a little tired of having some new "revolution" sprung on us every week or two. Scientific revolutions do not happen quite so often or quite so easily.

The Vacuum Tube as an "Electrical Microscope"

THE prediction made some months ago by Mr. John Stone Stone that the vacuum tube would prove to be a veritable electrical microscope, as powerful an implement of science as have been the optical microscope, the telescope and the spectroscope,* bids fair soon to be fulfilled.

The conversion of light rays into audible signals by vacuum tubes has been accomplished by General Ferrié and M. Jouaust,† the vacuum tube has been applied in Paris to the measurement of small changes in the electricity of the atmosphere‡; in British laboratories the tube has been used not only for the measurement of microscopic electrical quantities but also for detecting very tiny move-

* "Our Abrams Verdict," by Austin C. Lescarboura. *The Scientific American* (New York), vol. 131, pages 158-160, 220-222 (September, 1924).

† The best description of these circuits is by I. Podliasky, "A Generator-amplifier Without Tubes," *Radio-Électricité* (Paris), vol. 5, pages 248-250, 181-182 (July 10 and 25, 1924). The pages of the latter reference are marked in the issue as given here but are evidently wrong. There was an earlier and briefer notice of M. Lossev's work, also by M. Podliasky, in *Radio-Électricité* for May 25, 1924, vol. 5, page 196. Other recent articles are: "Oscillating and Amplifying Crystals," by Hugh S. Pocock, *Wireless World* (London), vol. 14, pages 299-300 (June 11, 1924); "What One Can Do With a Crystal Rectifier," anonymous, *L'Électricité Pour Tous* (Bruxelles), vol. 6, pages 311-312 (July, 1924); "Oscillating Crystals, Transmitting and Amplifying Without Valves," by J. H. T. Roberts, *Popular Wireless* (London), vol. 5, pages 743-744 (July 19, 1924); "The Crystodyne Principle," anonymous, *Radio News* (New York), vol. 6, pages 294-295 (September, 1924).

* POPULAR RADIO for February, 1924, page 202.

† POPULAR RADIO for April, 1924, page 408, and for October, 1924, page 406.

‡ "On a Triode Tube Electrometer and Its Application to the Measurement of the Electric Gradiant of the Atmosphere," by P. Lejay, *Comptes Rendus de la Academie des Sciences* (Paris), vol. 178, pages 1480-1482 (March 28, 1924).

ments of experimental apparatus, very small changes of pressure or temperature.*

Short distances may be measured, for example, by attaching the moving member to one plate of a condenser to which an oscillating tube circuit is connected. An infinitesimal movement of this condenser plate will be apparent instantly in an altered oscillation of the tube. An even more delicate method devised by Mr. Thomas himself depends on the inductive coupling between a part of the tube circuit and the eddy currents set up in a metal plate attached to the moving part of the apparatus. If the moving metal plate be made the diaphragm of a pressure chamber, this device becomes a very delicate pressure gauge.

As to just what extent these developments in the use of vacuum tubes will be adapted to ordinary commercial engineering measurements is problematical, but the vacuum tube will undoubtedly fill an increasingly important position as an aid to the advanced physicist.

It is even conceivable that the laboratory of the future will become a radio room where every physical measurement or scientific calculation will depend on the particular properties of various types of vacuum tubes.

* A number of these methods are summarized in an article entitled "Some Applications of the Thermionic Electric Triode to Purposes Other Than Radio Communication," by H. A. Thomas, *Experimental Wireless* (London), vol. 1, pages 636-642 (August, 1924).

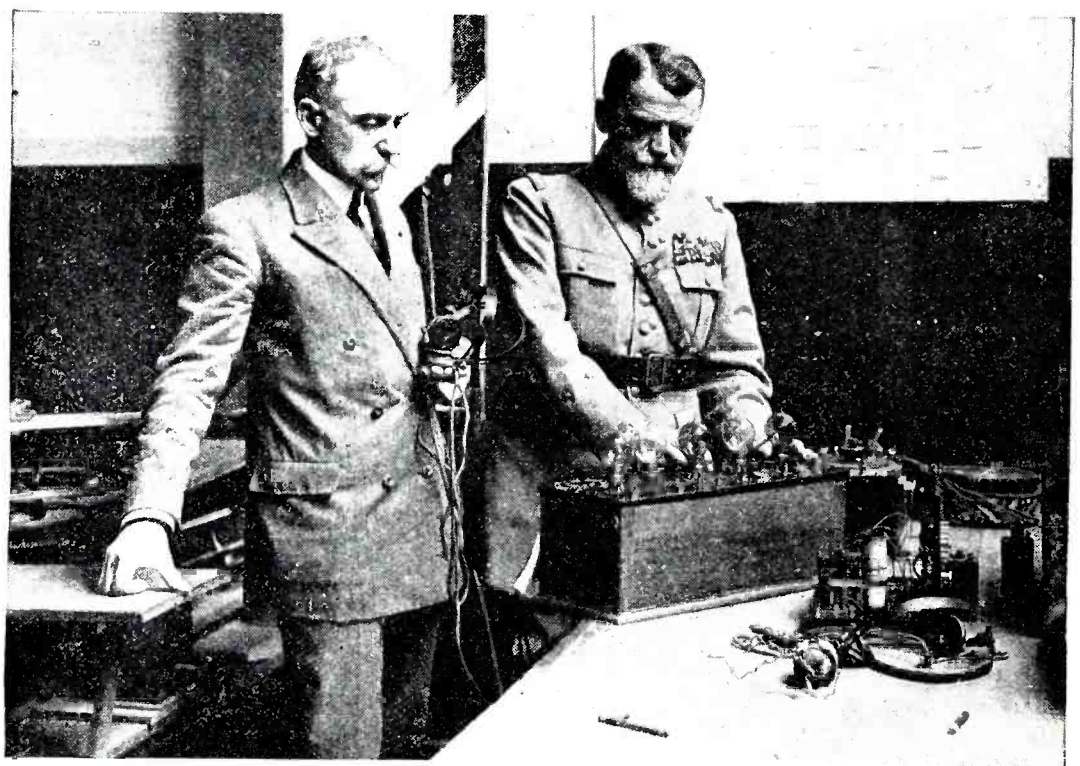
New Directional Antenna Described by Marconi

SENATOR MARCONI'S recent London lecture on his experiments with short-wave transmission was noted briefly in this Department last month.* The full text of this lecture, which is now at hand†, contains two other points of importance, not mentioned in the preliminary cable reports. One of these is the design of the new reflecting antenna perfected by Mr. C. S. Franklin of Senator Marconi's staff; the other is the failure of the familiar Austin formula to explain the results obtained.

In the majority of experiments that have been conducted with directional radio on the so-called beam system the reflector has been a set of vertical wires hung up in the form of a parabola with its plane horizontal and with the transmitting antenna at the focus of this parabola. This was the arrangement used in the 10-meter directional work of the United States Bureau of Standards and in the earlier,

* Marconi's Short-wave Tests," POPULAR RADIO for October, 1924, page 408.

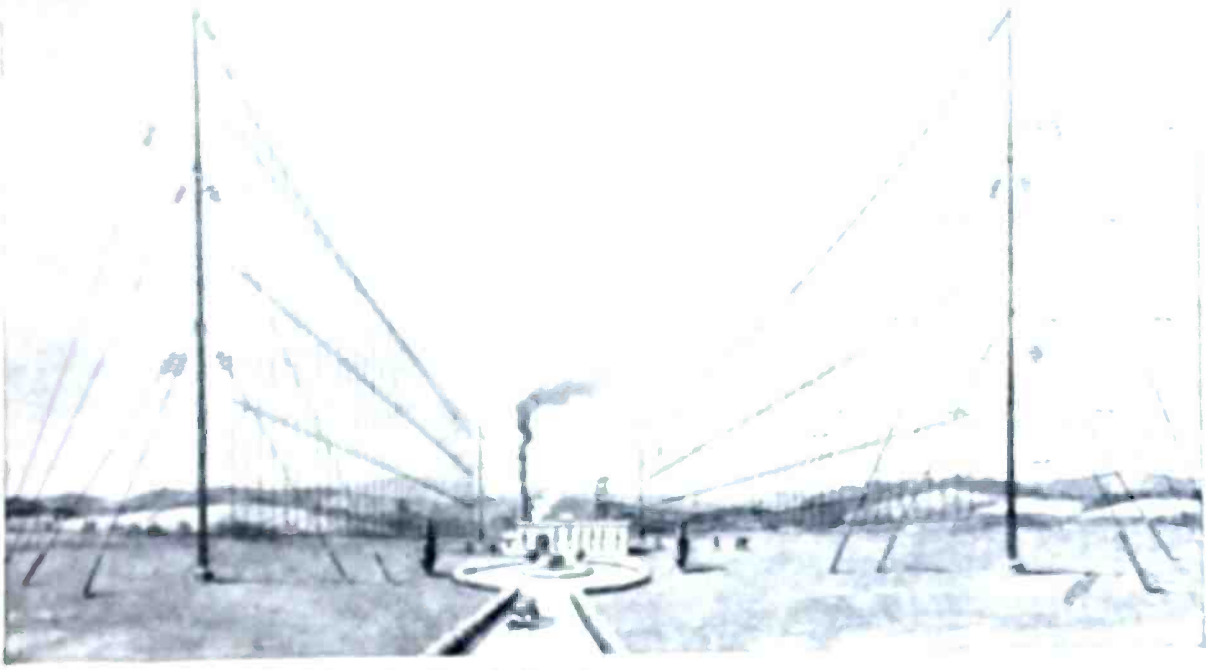
† "Results Obtained Over Very Long Distances by Short-wave Directional Wireless Telegraphy, More Generally Referred to as the Beam System," by Senator Guglielmo Marconi. *Journal of the Royal Society of Arts* (London), vol. 72, pages 607-621 (July 25, 1924).



From a photograph made for POPULAR RADIO

TWO FOREMOST RADIO EXPERTS OF FRANCE

At the right is General Gustave Ferrié, chief of the radio service of the French Army and already known to our readers as a contributor to POPULAR RADIO. *At the left is Commandant René Mesny, the man who perfected the apparatus and methods for radio telephony and telegraphy over waves only one and one-half meters long.*



WHAT THE NEW BEAM ANTENNA MAY [illegible]

[illegible]

and perhaps finally [illegible] the Marconi himself.*

In the later Marconi work, however, the parabolic reflector has been replaced by an arrangement of two vertical wire grids, the wires being arranged like the crossbars that hold the panes of glass in a small paned window frame. One of these grids serves as the transmitting antenna, the other one, located a little behind and parallel to it, serves as the reflecting mirror.

The signal energy is fed into the antenna grid at a number of points and through a special feeding system so designed that the phase of the oscillations in all the wires of the antenna gridwork is the same. The wave is transmitted directionally at right angles to the plane of the two wire grids and in the direction leading from the reflector grid to the antenna grid and then outward.

Few details are given concerning the operation of this novel antenna system, Mr. Marconi stating merely that the "directional effect of such an arrangement is a function of its dimensions relative to the wavelength employed." It is to be hoped that further characteristics will be published soon either by the Senator or by Mr. Franklin.

* Bureau of Standards Scientific Paper No. [illegible] 19[illegible]. See also the [illegible] in Popular Radio for June, 1924, page [illegible].

[illegible]

terms. It will probably [illegible] step in [illegible] the [illegible] ties of radio transmission.

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; De Forest Radio Tel. and Tel. Co.
Duplex variable condenser; Duplex Engine Governor Co., Inc.
Gem variable condenser; Eastern Specialty Co.
Elraco precision condenser; Elgin Radio Corp.
Variable condenser; Federal Telephone and Telegraph Co.
Continental vernier condenser; Gardiner and Hepburn Co., Inc.
"Low-loss" variable condenser; General Instrument Corp.
"No-loss" variable condenser; General Instrument Corp.
Variable condenser; General Radio Co.
Air condenser; Giltillan Bros., Inc.
Vernier variable condenser; Hammarlund Mfg. Co.
Sexton variable condenser; Hartford Instrument Co.
Radiant condenser; Heath Radio and Electric Mfg. Co.
Non-dielectric condenser; Heath Radio and Electric Mfg. Co.
"Low-loss" grounded rotor condenser; Haynes-Griffin Radio Service, Inc.

JACKS

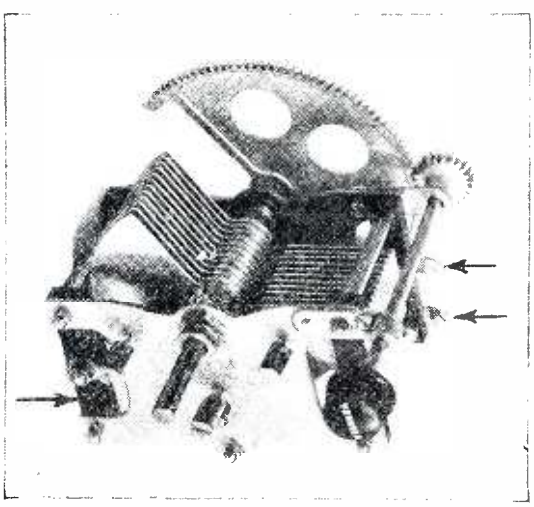
Jacks; Federal Telephone and Telegraph Co.
Jacks; Harris and Birdseye.

RHEOSTATS

De Forest rheostat; De Forest Radio Tel. and Tel. Co.
Filkostat; DX Instrument Co.
Tube control unit; Herbert Frost, Inc.
Rheostat; General Radio Co.
Rheostat; Howard Radio Co., Inc.
Rheostat; Henry Hyman & Co., Inc.
Rheostat; Framingham Co.

RADIO-FREQUENCY TRANSFORMERS

Telos variotransformer; Danziger-Jones, Inc.
Duratran transformer; Dubilier Condenser and Radio Corp.
Eiseman R. F. transformer; Eisemann Magneto Corp.
Radio-frequency transformer; Electrical Research Laboratories.
Radio-frequency transformer; Federal Telegraph and Telephone Co.
Radio-frequency transformer; General Radio Co.
Tuned air-core transformer; General Radio Winding Co.
Reflex coils; General Radio Winding Co.
H and H transformer; Hart and Hegeman Mfg. Co.
Intermediate-frequency transformer; Haynes-Griffin Radio Service, Inc.



Radion insulation and soldering lugs

A CONDENSER WITH GEARED VERNIER

Name of instrument: Vernier variable condenser.

Description: A condenser of the grounded rotor type with the insulating pieces spaced so that they are outside of the dense part of the electrostatic field. The plates are cut away in a novel manner to make the lower end of the capacity curve slope more gradually.

Usage: In any radio-frequency circuit for tuning.

Outstanding features: A low-loss vernier condenser that can be used with a 4-inch dial. Equipped with soldering lugs.

Maker: New York Coil Co.

A LOUDSPEAKER FROM YOUR PHONOGRAPH

Name of instrument: Phonograph attachment.

Description: A neatly made and assembled unit encased in an aluminum shell with an adjusting screw on the back for raising or lowering the magnets. The front cover is of molded bakelite and is fitted with a universal connection for attaching to the phonograph horn.

Usage: With a phonograph horn and a radio set as a loud speaking device.

Outstanding features: Good workmanship, volume, and clarity of reproduction.

Maker: Royal Electrical Laboratories.

Knurled knob for volume adjustment

LOOPS

Loop aerial, Hartman Electric Co.

SETS IN KIT FORM

Telos kit; Danziger-Jones, Inc.
Knockdown neutrodyne; Freed-Eisemann Radio Corp.
Parts for Cockaday circuits; S. Hammer Radio Co.
Resistance-coupled amplifier kit; Daven Radio Co.
Resistance-coupled amplifier kit; Electrad, Inc.

PHONOGRAPH ATTACHMENTS

De Forest attachment; De Forest Radio Tel. and Tel. Co.
N and K phonograph unit; Th. Goldschmidt Corp.
Phonograph attachment; Holtzer-Cabot Electric Co.

GRID LEAKS AND RESISTANCES

Resisto coupler; Daven Radio Co.
Precision resistors; Daven Radio Co.
Variable grid leak; Durham and Co.
Fil-ko-leak; DX Instrument Co.
Grid leaks; Electrad, Inc.
Variohm; Electrad, Inc.
Fixed grid leak; Chas. Freshman Co., Inc.
Lavite resistances, Harold Herbert, Inc.

TUBES

De Forest audions; De Forest Radio Tel. and Tel. Co.

PANELS

Celeron panels; Diamond State Fibre Co.
Fibroc bakelite panels, Fibroc Insulation Co.
Electrasote radio panels; M. M. Fleron and Son, Inc.
Formica panels; Formica Insulation Co
Hard rubber panels, B. F. Goodrich Rubber Co.

MICA FIXED CONDENSERS

Micadons; Dubilier Condenser and Radio Corp.

BATTERIES

Diamond "B" batteries; Diamond Electric Specialties Corp.
Exide "A" and "B" batteries; Electric Storage Battery Co.
Radio-primary battery; Thomas A. Edison, Inc.

CRYSTAL DETECTORS

Fixed crystal detector; Electrical Research Laboratories.
Variotector; Foote Mineral Co.
Giant crystals; Foote Mineral Co.
Crystal detector; Henry Hyman and Co., Inc.
Fixed reflex detector, Grewol Mfg. Co.

RECEIVING SETS

Eagle neutrodyne; Eagle Radio Co.
Echodyne duplex receiver, Economic Appliance Co.
Broadcast receiver; Eisemann Magneto Corp.
Faraway radio receiver, Faraway Radio Co.
Federal receivers; Federal Telephone and Telegraph Co.
Freed-Eisemann neutrodyne; Freed-Eisemann Radio Corp.
Focceleste portable receiver; General American Radio Corp.
Gilfillan neutrodyne; Gilfillan Bros., Inc.
Grebe broadcast receiver, A. H. Grebe & Co., Inc.
Synchrophase receiver; A. H. Grebe & Co., Inc.
A. C. H. receiver; A. C. Hayden Radio and Research Co.
Haynes receiver; Haynes-Griffin Radio Service, Inc.
Bestone V-60 receiver; Henry Hyman and Co., Inc.
Tesco crystal sets; Eastern Specialty Co.

POTENTIOMETERS

De Forest potentiometer; De Forest Radio Tel. and Tel. Co.
Frost tube control unit; Herbert H. Frost, Inc.
Potentiometer; General Radio Co.
Potentiometer; Howard Radio Co., Inc.

LOUDSPEAKERS

Dictograph loudspeaker; Dictograph Products Corp.
Fibertone horn and base; Fibre Products Co.
N and K imported loudspeaker; Th. Goldschmidt Corp.
J. Andrew White loudspeaker; Haynes-Griffin Radio Service, Inc.
Herald loudspeaker; Herald Electric Co., Inc.
Holtzer-Cabot loudspeaker; Holtzer-Cabot Electric Co.

Brass mounting without solder

A WELL-MOUNTED CRYSTAL

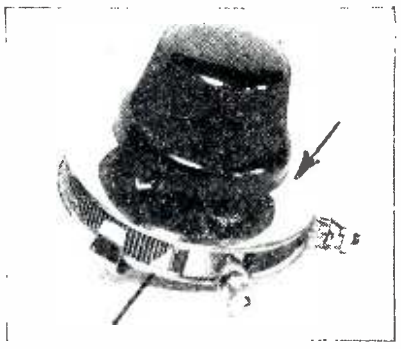
Name of instrument: Mounted crystal.

Description: A tested crystal that is mounted in a brass cup without any solder. The crystal is kept in good electrical contact with the cup by a screw adjustment at the back of the cup. This method of mounting eliminates the possibility of damage to the crystal during the usual soldering process.

Usage: In any receiving circuit where a sensitive crystal detector may be used.

Outstanding features: Uniformity of sensitivity. Degree of sensitivity.

Maker: Newman Stern Co.



Resistance wire held between metal plates

A COMPACT FILAMENT RHEOSTAT

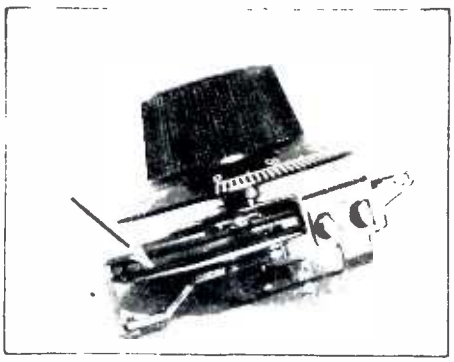
Name of instrument: Filament rheostat.

Description: This instrument is fastened securely together between two metal discs which clamp the windings firmly. The sliding arm and the end of the resistance wire are both brought out to binding posts. A neat knob and pointer shows the setting when fastened on the front of a panel. The whole rheostat takes up a minimum of space in back of the panel.

Usage: In a radio receiving set as a vacuum-tube filament control.

Outstanding features: Evenly spaced windings. Smooth operation. Small space requirements.

Maker: Central Radio Laboratories.



Smooth running contact

A FINELY MADE POTENTIOMETER

Name of instrument: Potentiometer.

Description: An extremely well made instrument in which the resistance winding is mounted between two flat metallic discs. The shaft is fitted with a good bearing and the pointer is kept in good contact with an effective pigtail connection. The slider is constructed so that it runs smoothly and makes good connection at all times.

Usage: In radio receiving apparatus for controlling grid potentials or plate potentials. It is usually connected across the "A" battery with the pointer or slider connected in series with the grid circuit or the plate circuit.

Outstanding features: Fine workmanship. Smooth operation. Silent operation.

Maker: Yaxley Manufacturing Co.

SWITCHES

Arkay cam switches; Essex Mfg. Co.
Anti-capacity switch; Federal Telephone and Telegraph Co.
4-way switch plug; Four-way Co.

AUDIO-FREQUENCY TRANSFORMERS

Amplifier unit; DeWitt-La-France Co., Inc.
Type C transformer; Dongan Electric Mfg. Co.
Push-pull transformers; Electrical Research Laboratories.
Audio-frequency transformer; Electrical Research Laboratories.
No. 65 transformer; Federal Telegraph and Telephone Co.
Republic audio-frequency transformer; Flint Radio Co.
Supertran transformer; Ford Mica Co.
Audio-frequency transformer; General Radio Co.

SOCKETS AND ADAPTERS

De Forest sockets; De Forest Radio Tel. and Tel. Co.
Erla sockets; Electrical Research Laboratories.
V. T. socket; Federal Telephone and Telegraph Co.
V. T. socket; General Radio Co.
V. T. socket; Gilfillan Bros., Inc.
V. T. socket; Heath Radio & Electric Mfg. Co.

TUNING INDUCTANCE UNITS

Eastern coupler; Eastern Coil Corp.
Cockaday coils; Eastern Coil Corp.
Pall-mall variocoupler; Essex Mfg. Co.
Ferbend wave trap; Ferbend Electric Co.
Masterpiece coil and condenser; Chas. Freshman Co., Inc.
General Radio tuning inductances; General Radio Co.
"Gen-Win" master tuning coils; General Radio Winding Co.
Variocoupler; General Radio Winding Co.
Variocoupler; Gilfillan Bros., Inc.
Variometer; Gilfillan Bros., Inc.
Short wave tuner; L. W. Goodman.
Grebe clarifier; A. H. Grebe & Co., Inc.
Variocoupler; Hartman Electric Co.
Bank-wound variocoupler; Haynes-Griffin Radio Service, Inc.
Vernituner; Horne Electric and Mfg. Co.

BATTERY CHARGERS AND RECTIFIERS

Fore battery charger; Fore Electrical Mfg. Co.
F. F. battery charger; France Mfg. Co.

PHONE PLUGS

4-way switch plug; Four-way Co.
Comsco bull-dog grip plug; General Instrument Co.
Plug; Harris and Birdseye.

DIALS

E-Z-toon radio dials; E-Z Radio Co.
A. C. H. sharp tune dials; A. C. Hayden Radio and Research Co.
Heath Bakelite dial; Heath Radio & Electric Co.

RADIO CABINETS

Vulcanwood (cabinet material); Diamond State Fibre Co.
Hines Radio Desk; Hines Radio Desk Co.

HEADSETS

Dictograph headset; Dictograph Products Corp.
Federal headset; Federal Telephone and Telegraph Co.
Frost phones; Herbert H. Frost, Inc.
N and K phones; Th. Goldschmidt Corp.
No. 2 universal headphones; Holtzer-Cabot Electric Co.
No. 4 national headphones; Holtzer-Cabot Electric Co.

A GROUNDED ROTOR VARIABLE CONDENSER

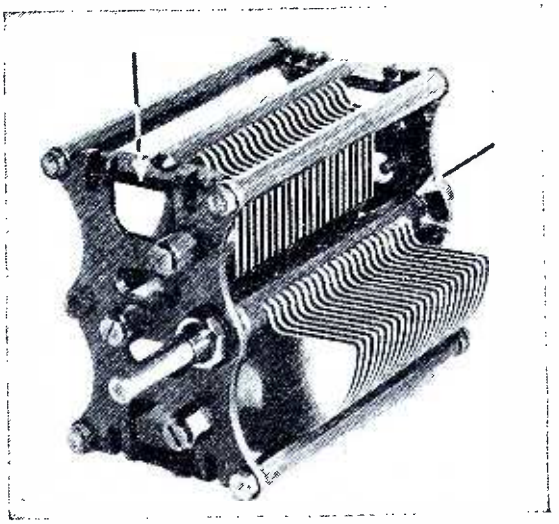
Name of instrument: Variable condenser.

Description: Grounded rotor type. All parts are of brass except the shaft, which is of steel, and the plates, which are of hard aluminum. Radion insulation is used in thin strips. The plates are set into the slotted brass supporting bars and then the bars are pinched so that a good electrical connection is made to each plate. The connection between the shaft and the end plates is made by a flexible pigtail connection. The workmanship is extremely good.

Usage: In any radio-frequency circuit where a low-loss condenser can be used for tuning.

Outstanding features: Low minimum capacity. Very low dielectric losses. Smooth operation. Rigid construction.

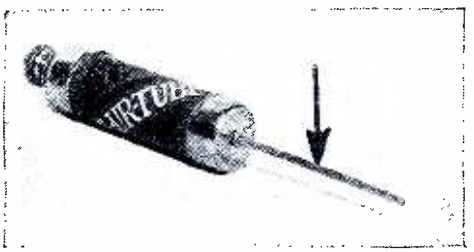
Maker: Amsco Products, Inc.



Radion insulation and pigtail connection

MISCELLANEOUS ACCESSORIES

Dixie engraved binding posts; Dixie Supply Co.
High resistance voltmeter: Dongan Electric Co.
Ducon lamp socket antenna; Dubilier Condenser and Radio Corp.
Filko lightning arrestor; DX Instrument Co.
Eby binding posts; H. H. Eby Mfg. Co.
Indooraerial; Electrad, Inc.
Lead-in device; Electrad, Inc.
Lightning arrestor; Electrad, Inc.
Keystone lightning arrestor; Electric Service Supplies Co.
Dynamotor; Electric Specialty Co.
Generators; Electric Specialty Co.
McNeary scalometer; Emblem Mfg. Co.
Binding post name plates: Etching Co. of America.
Fahnestock clips; Fahnestock Electric Co.
Fahnestock ground clamp; Fahnestock Electric Co.
Fahnestock antenna connector; Fahnestock Electric Co.
No. 1 hydrometer set; F. L. Freas Glass Works.
Clearview hydrometer set; F. L. Freas Glass Works.
Radio "B" hydrometer set; F. L. Freas Glass Works.
Radio aerial mast fittings; Freidag Mfg. Co.
Wavemeter; General Radio Co.
Laboratory instruments; General Radio Co.
Goldenrod aerial wire; Goldenrod Aerial Co.
Handy time-saver disc; Han-disc Co.
Screw gauge; Han-disc Co.
A. C. H. phone connectors; A. C. Hayden Radio and Research Co.
Sensory lightning arrestor; Heineman Electric Co.
Steel aerial mast; S. W. Hull & Co.
Nokorode soldering kit; M. W. Dunton Co.
Nokorode soldering paste; M. W. Dunton Co.



Wire to be clamped on binding post

PREVENTS TUBE BURN-OUTS

Name of instrument: Tube protecting device.

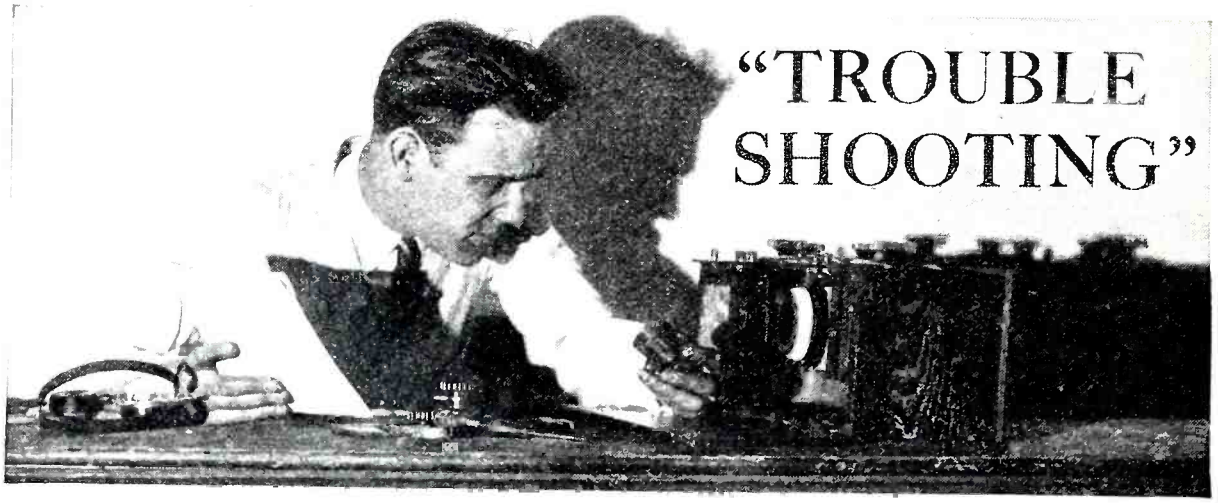
Description: A protective resistance element in a small tubular mounting with a binding post on one end and a wire at the other end. The wire may be bent and fastened on the "B" battery post on the set and the binding post on the device may be fastened to the positive terminal of the "B" battery. If the filament circuits of the tubes get short-circuited with the plate circuits, the device prevents the filaments from being burned out.

Usage: With any vacuum-tube receiver as a protection against short-circuits.

Outstanding features: A device that can be added to any set without having to rearrange the wiring.

Maker: Terlee Electric and Mfg. Co.

¶ 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 H.



"TROUBLE SHOOTING"

CONDUCTED BY S. GORDON TAYLOR

EVERY radio receiver requires a careful balancing of all of its parts if the best results are to be obtained. Two receivers made from exactly the same design may give widely different results, owing to variations in the parts used, the skill of the experimenters and the locations of the receiver. This department is conducted for the special benefit of readers who have built the radio receivers described in POPULAR RADIO *and who want to profit from the experience of others in operating them—to learn the little kinks that get the maximum results.*

How to Increase the Selectivity of the Tuned-radio-frequency Reflex Receiver

(*This set was described in* POPULAR RADIO *for August*, 1924)

SOME difficulty has been found by readers in laying out the correct angle for setting the secondary of the special fixed-coupler used in connection with the tuned-radio-frequency reflex receiver. In the description (in POPULAR RADIO for August, 1924) this angle is given as 65 degrees, but it is not an easy task to get the correct angle without the use of instruments.

A simple solution of this problem is given in Figure 1. A rectangle A, B, C, D is first drawn on a piece of paper with the long sides 4¼ inches and the short sides 2 inches. A line is then drawn from a corner of the rectangle to the corner diagonally opposite, as the line AC. The angle formed by the lines AC and DC will be found to be 65 degrees. Now bend the brass support for the secondary coil of the coupler until it matches the angle just drawn on paper.

May be Improved in Two Ways

In some locations where this receiver is in use close to two or more broadcasting stations and more than usual selectivity is needed, there are two ways to obtain the desired results. First, the angle of the secondary coil of the coupler may be increased in its relation to the primary so that the secondary is more nearly at a right angle to the primary. This is accomplished, of course, by straightening out the small metal angle slightly so that the angle will be greater than 65 degrees.

However, this change is usually not necessary. Approximately the same results can be obtained by setting the primary coil switch lever on a lower tap, thus using fewer turns of the primary winding. When either of these methods is followed a slight reduction in volume results, but this is a sacrifice that must be made to obtain greater selectivity in any non-regenerative receiver. It is because of this slightly reduced volume that it is not desirable to change the angle of the coupler because in that case the volume is sacrificed whether or not great selectivity is needed at all times.

Coupler Coils Should be Set Carefully

It is imperative to have the coupler coils at an exact right angle to the radio-frequency transformer primary coil. Otherwise there will be an undesirable interaction between the two instruments and it will be more difficult to prevent feed-back or, in other words, it will be difficult to find the proper setting of the three-plate neutralizing condenser.

Coil Connections Can be Reversed

Some question has come up as to whether it makes any difference which end of the winding of the honeycomb coil is connected to the primary of the audio-frequency transformer, and which end to the crystal detector.

The leads to the honeycomb coil may be reversed without any noticeable change in efficiency.

Try Different Capacities Across the Primary

Where other audio-frequency transformers than those mentioned in the description of this receiver are used, it may be found advisable to try condensers of different capacities across the secondary of the first audio-transformer and the primary of the second audio-frequency transformer. And in addition, with certain transformers, it sometimes helps to place a fixed condenser across the primary of the first transformer. The capacity of this condenser may best be determined by experiment, but is usually about .0005 to .001 mfd.

Tips on the Four-circuit Receiver

Watch Out for Defective Tubes

It will be well to repeat a warning against the tricks that a poor or defective vacuum-tube will play in this or any other circuit. Perhaps nothing will better emphasize this than a quotation from a letter recently received from a builder of the improved four-circuit receiver in Buffalo, N. Y.

When his receiver was first built he found that he could only receive local stations and could not succeed in obtaining regeneration at all. He went on to say:

"In the weeks that followed I tried everything I could think of, without much success. I hooked up the circuit backwards, frontwards and upside down, but with all my experiments I obtained only weak signals. I had given up hope of ever getting the set to 'perk' and dismantled it entirely. However, my old stubbornness overcame me and I decided to make that circuit work. I had no new evidence that I could accomplish the task aside from the fact that I had an unshaken faith that others had turned the trick.

"Back into the circuit went the apparatus which was hooked-up exactly as it had been several times before. As I turned on my rheostats I happened to be looking directly at the detector tube (UV-200) but noted that it gave forth a rather sick-looking brilliance. When I plugged in the receivers results were the same as before. I then went to the nearest radio store and bought a new detector tube and it took about two seconds to find that this was my trouble. My detector tube had 'gone west' and I had never suspected it. With the new tube I succeeded in tuning in nearly all of the stations from 337 meters upward, in spite of the fact that WGR was going full blast and is located only a mile from us. It was the end of a perfect day and I gave vent to my enthusiasm by taking my old tube out in the back yard and 'socking' it against a stone wall.

"This discovery was the means of saving me from condemning the best circuit I have had the good fortune to come across."

In buying new tubes it is by all means advisable to have the dealer test them in a receiving set before making the purchase. Sometimes a tube will light up when connected to a battery but will not work in a receiver in spite of the lighted filament. This is sometimes due to a short circuit between grid and filament within the tube and sometimes due to a falling off of electron emission. A detector tube should always be tested in a regenerative receiver to make sure that it will oscillate. A little care of this kind in purchasing tubes will often save much time, worry and expense.

Filament Terminals Can be Reversed

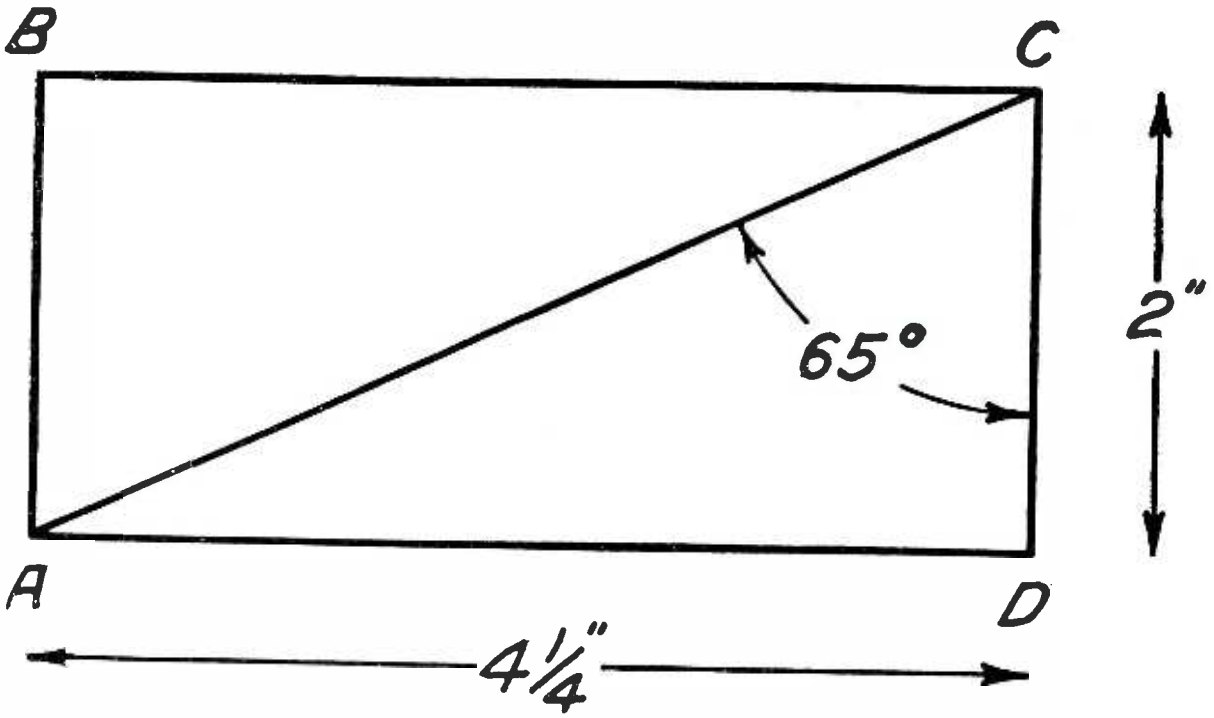
Some builders of the improved four-circuit receiver have been confused by the fact that some of the leads from the negative "A" battery circuit were shown on the wiring blueprints as being connected to the filament connections marked "+" on some of the sockets. Actually the plus and minus signs stamped on sockets may be entirely disregarded, as results will be the same regardless of which of the filament connections on a socket are connected to the negative side of the "A" battery circuit and which to the positive side. This is becoming more generally recognized and many manufacturers are no longer marking sockets with the positive and negative signs but instead are simply marking both filament binding posts "F."

Keep Battery Wires Away from Grid Condenser

In several improved four-circuit receivers constructed by readers of POPULAR RADIO it has been found that inability to hear DX stations was due to inefficiency resulting from running "A" battery and negative detector "B" battery leads close to and parallel with the grid condenser. These three wires, running from the binding post sub-panel at the rear of the set to the potentiometer, should be kept clear of the grid condenser by at least an inch, and preferably two inches. Otherwise the capacity between these leads and the plates inside of the grid condenser will interfere with the proper functioning of the detector.

The Condenser May be Too Large

If there is a noticeable hum or whistle when the loudspeaker is plugged into the last jack of the improved four-circuit receiver it is usually an indication that the value of the condenser across the secondary of the first audio-frequency transformer is too great. In the description in the Janaury issue, a .0005 mfd. mica fixed condenser was specified for use



BEND THE BRACKET TO MATCH ANGLE A-C-D

FIGURE 1: *The coupler coil of the tuned-radio-frequency receiver should be fastened with its axis at an angle of sixty-five degrees to the axis of the primary coil. If it is necessary to increase the selectivity, bend the bracket so that it is a little more open than the angle A-C-D.*

here. In some cases it has been found, however, that a lower capacity, such as .0001 or .00025, will give better results and will eliminate the whistle.

In extreme cases (and this applies particularly where a high ratio, such as a 10 to 1 transformer has been used in the first stage) a variable grid-leak such as the Bradleyleak or the Tunit should be connected across the two grid connections of the "Input" push-pull transformer and should then be adjusted until the hum or whistle disappears entirely.

Hints on the Multi-wave Tuner

(*This set was described in* POPULAR RADIO *for September, 1924*)

If the tickler coil is not connected in the circuit in the right direction, results will not come up to expectations. However, it is easy to determine the correct connections. With the receiver functioning properly, regeneration should increase as the tickler coil is moved toward the secondary and decrease as it is moved away. If it does not, reverse the connections.

When listening to a powerful local station it is sometimes impossible to make the receiver break into oscillation by bringing the tickler coil close to the secondary. This fact leads some users of this type of receiver to believe that the tickler coil being used is not large enough to provide proper regeneration. Frequently such is not the case, however, because it will be found that plenty of regeneration will be noticeable on the weaker signals from more distant stations. On the other hand, if it is impossible to make the receiver "spill over" into an oscillating condition even on weak signals, it is safe to assume that the tickler coil being used is not large enough. Or if regeneration is obtainable on the lower wavelengths (the lower part of the secondary dial) but the set will not oscillate when stations are tuned in on the upper part of the secondary dial, this indicates that the tickler is too small.

Coils for Various Wavelengths

Following is a list of coil combinations to cover all wavelengths between 200 and 25,000 meters. The construction of single-layer coils to cover wavelengths below 200 meters was described in the September issue, page 287.

Wavelengths	Primary	Secondary	Tickler	Primary Condenser
150-350	35	25	35	Series
300-710	75	50	35	Series
635-1,500	150	100	75	Series
845-1,970	200	150	100	Series
1,420-2,850	300	250	150	Series
2,550-4,250	200	300	150	Parallel
4,200-6,300	400	500	250	Parallel
6,250-14,500	1,250	750	500	Series
13,600-21,000	1,000	1,250	750	Parallel
16,000-25,000	1,250	1,500	1,000	Parallel

CONDUCTED BY KENDALL BANNING

WHAT *little kink have* YOU *discovered for increasing the efficiency of your set? What helpful bits of radio information have you picked up that will be of use to the other fellow?* POPULAR RADIO *will pay one cent a word for items for this department, and a monthly prize of* $10.00 *in addition for the best contribution. Send your items to Listening In Editor,* POPULAR RADIO, 627 *West* 43*rd Street, New York City.*

How to Stop Local Interference from Machinery

"THERE are some people here," reports W. R. Duncan of Bentonville, Arkansas, "who cause interference with instruments that throw off sparks loud enough to kill all reception. These sparks are caused by running a buzzer and other instruments."

This nuisance, unfortunately, is not confined to Bentonville. Broadcast listeners elsewhere are complaining—and inquiring what legal steps might be taken to abate it. Here is an informal legal opinion of a New York lawyer who is himself a radio fan and who is specializing in radio law:

Radio fans are reporting that radio outlaws on the highways of the ether are interfering with broadcasting reception here and there.

I agree that something should be done. Our programs around New York are punctured, as it were, intermittently by spark transmitters or other transmitters of the telegraphic variety, especially those of the United States Navy. It is not pleasant when it occurs, but it is not a nuisance. The American 100-percent amateur senders are very gentlemanly in the use of their transmitting instruments, complying with the laws and rules for operating the same and using their instruments so as not to cause interference. In radio transmission, each sender should be a gentleman. When a man is so unlike a gentleman as to unduly infringe the rights of others the law steps in to assist in the enforcement of such rights.

While the several states do not have laws expressly prohibiting the unbridled operation of radio transmitters, yet it is a fundamental principle that where rights are infringed the law will find a remedy. For instance, the interfering operation of a transmitter may constitute a nuisance, like certain disagreeable noises of a more or less continuous nature, wilfully and maliciously caused. A nuisance can be abated usually by suitable action in the proper tribunal or court of the state in which the nuisance occurs.

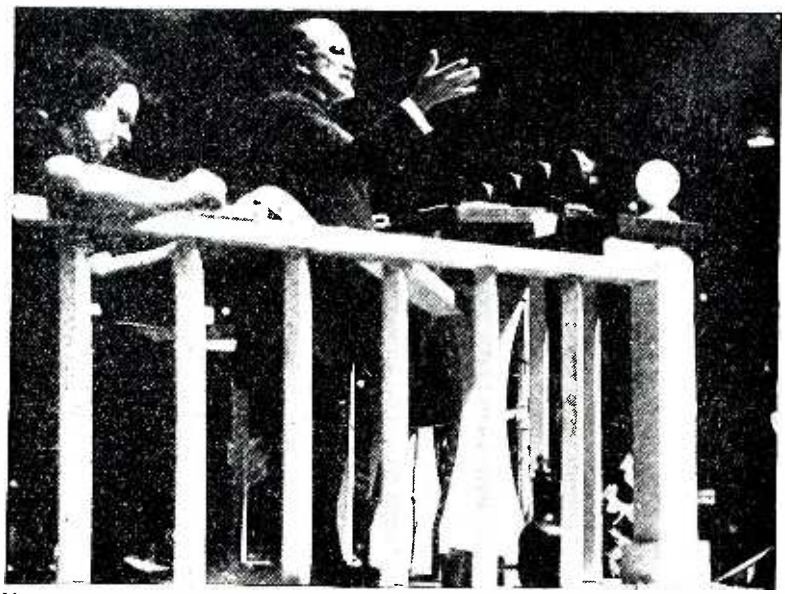
The Federal Government, however, primarily controls and regulates radio throughout the several states. The act of August 13, 1912, prohibits the use or operation of "*any apparatus for radio communication*" as a means of commercial intercourse among the several states, or for the transmission of signals, *the effect of which extends beyond the state* in which the signals are made, or *where interference* would be caused thereby *with the receipt of messages or signals from beyond the state*, except under and in accordance with a license granted by the Secretary of Commerce.

Any person that shall use or operate any apparatus for radio communication without a license shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be punished by a fine not exceeding $500.00, and the apparatus or device unlawfully used may be forfeited to the United States.

Section 5 of the same law also provides that every license shall prescribe that the operator shall not "wilfully or maliciously" interfere with any other radio communication. The penalty, if one does, is one year in jail, or a fine of $500.00, or both.

The licenses granted to amateurs provide for the sending of signals on wavelengths not exceeding 200 meters, and with a transformer input not exceeding one kilowatt. The rules and regulations and provisions in the licenses are for the purpose of preventing interference. Persons who break these rules and regulations are subject to fine and are liable to have their licenses revoked.

Since the handling of misdemeanors is a



Underwood & Underwood

HOW NEW YORK LISTENED IN ON THE DEMOCRATIC CONVENTION

The four microphones in front of the speaker in Madison Square Garden were connected to broadcasting stations throughout the country by means of wire lines and short-wave retransmission. Loudspeakers were set up in public parks, so that everyone could listen in on the convention proceedings. On the facing page is shown a truck fitted with a loop receiver and a public address system which is used during the broadcasting of important events.

matter for the local district attorney of the United States, it may help if he is put on the job. With both the radio inspector and the district attorney on the job, I am sure that unlawful interference will soon stop.

—CHARLES H. KESLER

Bobbed Radio Waves Now in Style

A VAST amount of research work is being done on the shorter radio wavelengths. The amateurs have just recently been permitted to operate on several bands of waves far below one hundred meters and everyone knows of the experimental broadcasting which is being carried out on these shorter waves. Mastering the use of the shorter waves is not going to be quite as easy as it would seem, however. Here is how C. A. Briggs of Washington, D. C., sizes up the situation:

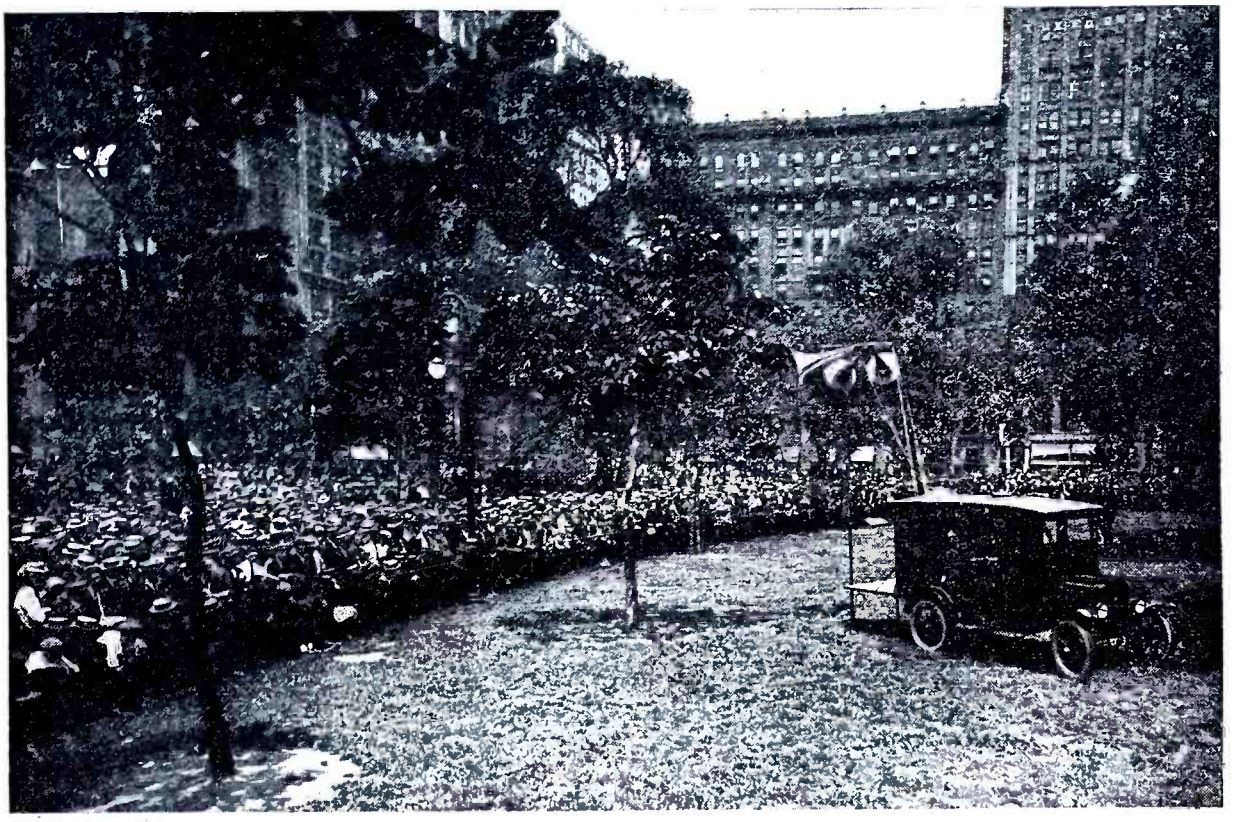
Short radio waves have been found to carry great distances both at night and in the daytime, and in the summer and in winter.

The navy, in co-operation with the amateur, is doing pioneer work on these short waves. The amateur under the old law, as yet unchanged but now obsolete, were given from 200 meters down. Under regulations made placing restrictions on them they are now confined to certain bands.

If one of the electric lights in your house suddenly lights up without being turned on, and then, when you turn it on, goes out, burned out, don't be surprised. You have appropriated some energy that doesn't belong to you. The amateur next door is adjusting his short-wave transmitter, and the natural tuning of your house wires has whisked away from him the energy which originally was destined for Australia or other remote place. These short waves give some interesting exhibitions of the transmission of power. However, they act like mischievous children, and often escape and do more things than one is able to find out about. They are liable to do gymnastics on a neighbor's wire clothes line instead of reaching out across five thousand miles of land and sea. And again, where they appear to be weak and feeble at the transmitter they may be striking with powerful impact at a distant point. They obey with absolute precision the most rigorous mathematical laws, yet they appear to be the most temperamental of things. Perhaps temperamental displays in people are, after all, but the responses of a controlled nature.

Radio Reception in the Oregon Caves

READERS who have experimented with radio reception in mines, caves, tunnels and other underground chambers which are not ordinarily con-



Morris Rosenfeld

sidered favorable for reception, are invited to send an account of their experiences to POPULAR RADIO. One of the most interesting of such experiments was recently made in Oregon; a report of the experiment follows:

On Sunday evening, May the 4th, a group of radio experts experimented with tuning in at the Oregon Caves, situated fifty-one miles from Grants Pass and on the highway from Crescent City to Grants Pass. In the innermost recesses of these caves is a large room called the Ghost Chamber. This room is 40 feet high, 50 feet wide and 520 feet long. At the base of this chamber the altitude from the sea level is 4,055 feet. The radio set used was the most sensitive 8-tube super-heterodyne available, using the modulation system. The caves at this point are 1,600 feet straight down from the surface of the earth and 3,300 feet back from the entrance. The caves are situated in a solid ledge of limestone which is at this time of the year saturated with water.

The first experiments were tried with an aerial but no results were secured as there was no opportunity for proper grounding within the caves. At 7:25 P.M. a Mu-rad loop aerial was connected; within three minutes, at 7:28, KGW at Portland was picked up; the ball score was heard and music by an orchestra. Signals were weak on the speaker with good volume on the headphones. At 8:11 P.M. station CFCN of Calgary, Canada, was picked up; it signed off at 8:17. On the loudspeaker there was better volume from Calgary than from Portland. At 8:37 we picked up an orchestra which proved to be at KPO, San Francisco; was very weak on the loudspeaker. At 9:22 we picked up KGG at Portland, Oregon, playing Victor records; this came in with more volume than anything previously received. At 9:25 we picked up a station with a woman announcing; judging by the position on the dials we concluded that it was KLX at Oakland, California. At 9:35 we disconnected the set.

No static could be detected within the caves but fading was quite noticeable. The experiment was witnessed by the entire party of twenty-eight people, composed of the senior class of the high school of Yreka, California, and Mr. W. J. Virgin of Medford, Oregon. The party, under the leadership of Principal E. C. Browne of Yreka High School, made an extensive exploration of the caves and the radio experts, Mr. Brice Rohrer, Edson Foulke, Jr., and Mr. Virgin succeeded in tuning in for the first time under these apparently impossible conditions.

Considering the depth of the caves at the point of experimentation, the results undoubtedly stand out as a wonderful accomplishment.

The trail into the part of the caves is very irregular, turning at sharp angles and varying in altitude many times before the Ghost Chamber is reached. Water is dripping down in the caves constantly and iron ladders are placed at different points in the trail. These conditions plus the nature of limestone would tend to make reception very difficult.

—E. C. BROWNE

CONDUCTED BY DAVID LAY

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

A "Zone System" License for Receiving Sets

THE new wireless regulations in Australia provide for a license fee for receiving sets The fee is graduated according to the distance of the set from the broadcasting station. The first zone includes all territory within 250 miles; stations in the second zone are those between 250 and 400 miles away from the station; the third zone includes the remainder of the country. Heavy license fees are exacted from owners of receiving sets operated in the lobbies of hotels and other public places. The new regulations permit paid advertising to be sent from the broadcasting stations; a peculiar feature of this regulation is that no advertisement may be refused except with the approval of the postmaster-general.

* * *

Polished Antenna Wire Necessary on Short Waves

AMATEURS who have attempted to operate their transmitters on the new low wave bands recently opened to their use by the government have found that the black oxide coating which appears on copper wire soon after an antenna has been erected has an exceptionally bad effect at these high frequencies. Many amateurs have found that the use of enamelled wire for antennas eliminates this source of trouble.

* * *

How Radio Is Affecting Power Companies

POWER companies are showing a growing interest in eliminating the interference to radio reception caused by defects in their lines. Records show that radio is responsible for a 20 percent increase in lighting kilowatt-hour sales. Some companies hesitate to admit that defects in their circuits can be indicated by interference complaints, but the more progressive power companies consider these complaints as valuable sources of information.

Radio Control of Military Airplanes

ACCORDING to General Herschauer, who commanded the French aviation forces during the recent war, the extensive experiments carried out on this important application of radio have been extremely successful. One man seated at a switchboard can direct the flight of the planes with such accuracy, says the general, that a whole fleet of them can be sent for long flights to bomb distant cities. No information is available, however, as to just what extent the French radio-controlled airplanes are immune to interfering radio waves sent out from enemy stations.

* * *

Paying in Advance for Radio Programs

THE regulations regarding radio receiving sets are strict in Germany. Set owners must secure licenses from local postmen and pay in advance for broadcast programs. Houses may be searched without warrants if owners are suspected of breaking the rules. Detector and audio receivers may only be used on wavelengths between 250 and 700 meters. Radiating and oscillating sets are forbidden. As the Germans put it, "receivers fitted with audion must be so constructed that they do not swing even if the tension is increased."

* * *

"Hello! Is This London?"

AMERICAN telephone interests are now experimenting with a British concern in order to determine the possibilities of establishing a regular radio-telephone service across the Atlantic. Transmission from America to England has already been proven possible and, upon the completion of a new and powerful station in England, tests will be undertaken to find out if service in the other direction will be as feasible. It is reported that the complete service will be in operation within a year unless unexpected difficulties are met with.

Ship Calls for Ambulances by Radio

OFFICIALS of the White Star line were mystified recently by a radio message from the *Arabic* requesting that a string of ambulances meet the vessel on her arrival at the pier. The request was carried out and when the liner docked, sixteen of the passengers were taken to hospitals. Over seventy-five of the number on board had been more or less severely injured when the ship encountered a terrific hurricane.

* * *

Broadcaster Finds a Long-lost Brother

LIEUT. W. NEPHEW KING appeared on the morning program at WEAF a short time ago; at the conclusion of his address he received a call at the studio from a brother he had believed dead for more than twenty years.

* * *

Loudspeakers Take the Stump

JOHN W. DAVIS has been using in his campaign a special Pullman car fitted with a loud-speaking apparatus on the rear platform so that the crowds that gathered around the car had no difficulty in hearing every word. A special feature of the installation is a plug provided so that local broadcasting stations have been able to connect up their circuits direct to the car and broadcast the political speeches.

* * *

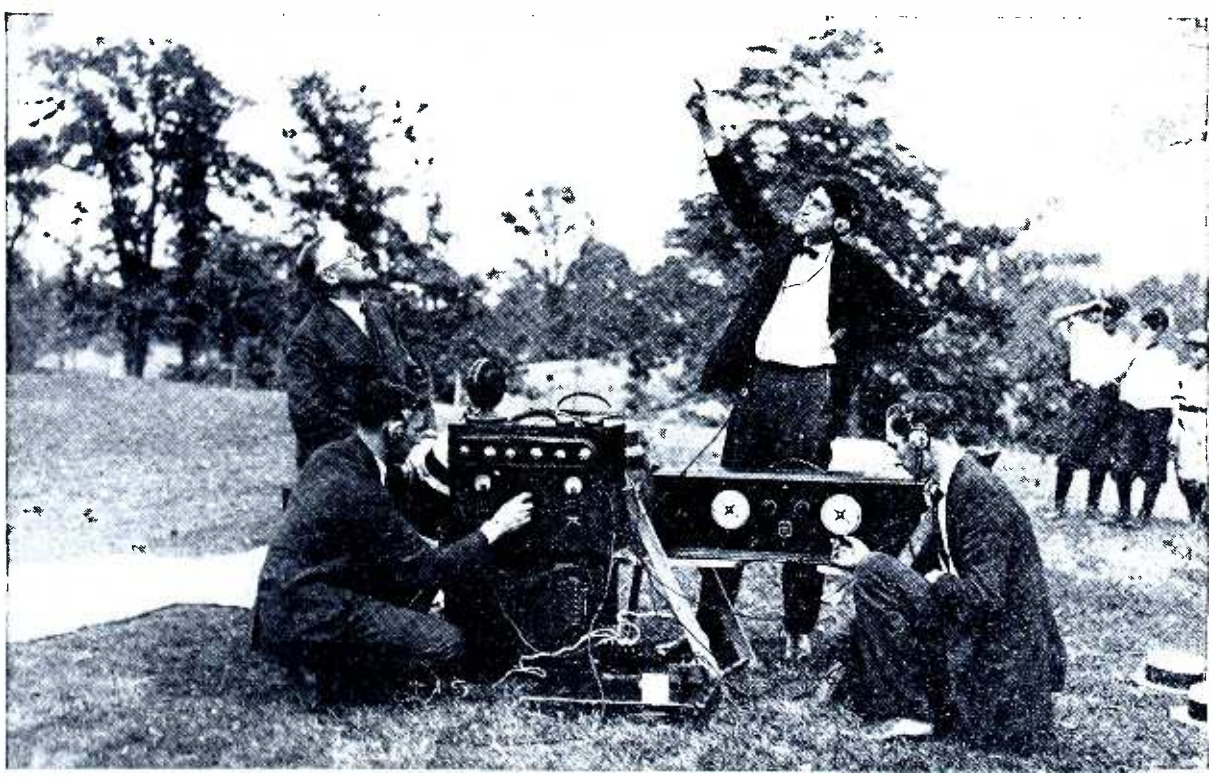
Radio Distributes News During a Strike

DURING the recent railway strike in Cuba the newspapers of Havana found themselves unable to reach their subscribers in the remoter parts of the island. Radio was pressed into service. News bulletins were read over the Havana broadcasting station, PWX, and were picked up and posted in all parts of the country.

* * *

Broadcasting that Goes Under a Bay

STATION KGO, in Oakland, California, has recently installed a broadcasting studio across the bay in San Francisco. The microphone impulses, picked up in the San Francisco studio, are transmitted nearly ten miles in a cable laid under the water of San Francisco Bay, before they reach the broadcasting station itself.



Kadel & Herbert

BROADCASTING FROM AN AIRPLANE RECEIVED LOUDER THAN FROM A POWERFUL LAND STATION

When station WJZ in New York picked up the voice of an aviator who was circling high over Central Park and then retransmitted it on 455 meters, many listeners found that they could hear the aviator direct louder than through WJZ. The shielding of the steel buildings in the city probably caused this curious effect.

Teaching Radio Code by Phonograph

RADIO instructors and experts at the Army Signal School at Camp Alfred Vail, New Jersey, are experimenting successfully with a method of instructing prospective radio operators by means of phonographic records for sending and receiving code. Phonographic records have been in use for years to teach receiving, but this is the first time that a recording phonograph has been used to make a record of the student's messages as he sends them. The records are run through the reproducer several times in order to familiarize the new man with the defects in his key work.

* * *

Compulsory Radio Advocated for Mines

BRITISH radio engineers and mining experts are reported to be at work on a small radio receiver for miners. It will be light and cheap enough so that each miner may be compelled to take one with him when he goes underground. Then in case of a disaster of any kind the miners can be told, from the surface, what to do and where to go in order to facilitate their rescue.

* * *

Britain's Most Powerful Station

THE new broadcasting station of the British Broadcasting Company at Chelmsford, England, is now on the air with regular programs. The wavelength is 1,600 meters and the call letters are 5XX. The power used is the largest of any broadcasting station in England and probably in the world; it is 25 kilowatts. At present the programs are transmitted from 11.30 A.M. to 12.30 P.M.; from 4.30 to 5.30 P.M.; and from 7.30 to 8.30 P.M. These are British daylight saving time.

* * *

Lead Rod for Catwhisker

IN an interesting series of articles now being published in the *Wireless World* (London) on crystal reception, Mr. James Strachan mentions a curious type of catwhisker consisting of a rod of metallic lead a quarter-inch or so in diameter and sharpened to a point where it presses against the crystal. The idea is to eliminate the disturbance of the adjustment by vibration of the catwhisker.

* * *

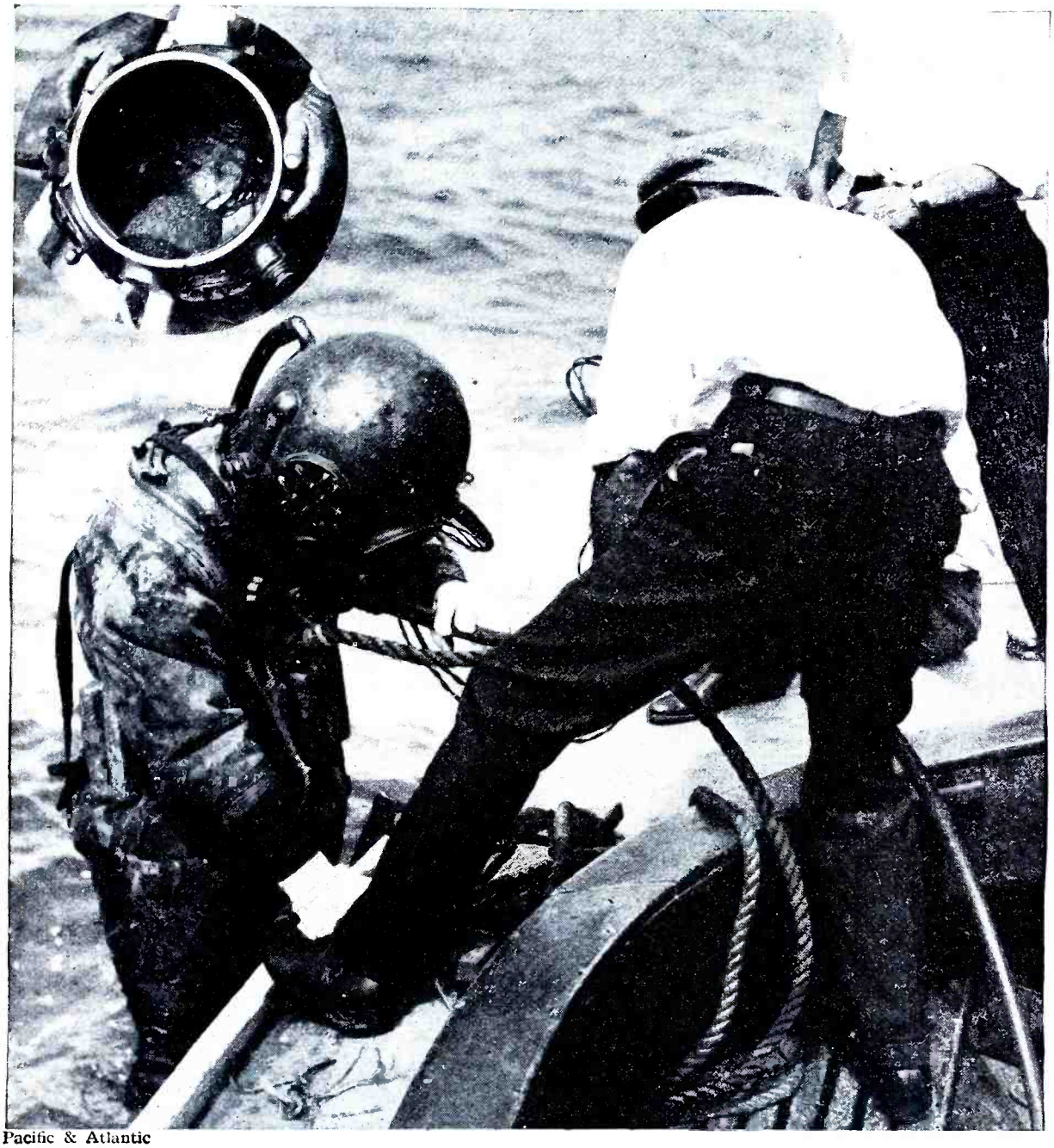
New Measurement of Maximum Size of Universe

AT the recent meeting of the British Association for the Advancement of Science, at Toronto, Canada, Dr. Ludwik Silberstein, of Rochester, New York, announced his recent calculations on the maximum size of the universe to which the earth and all the visible stars belong. The calculation is based on measurements of the light rays from distant stars and on the conclusions of the Einstein theory of relativity. It comes out that the greatest possible distance in the universe is about 180,000,000,000 light years or some 1,000,000,000,000,000,000,000,000 miles. Light and other ether waves do not move, Dr. Silberstein believes, in straight lines; instead they move in very long curves. A light ray, if not absorbed by anything, will return ultimately to its starting point, just as a man who sails straight around the earth will come back, in the end, to the place where he started. If a radio wave went out from the earth and was not absorbed or deflected in passing through space it would come back to the earth again in about 360,000,000,000 years.

Thos. Coke Knight

RADIO HELPS THE SHORTHAND STUDENT

Lectures and speeches broadcast by radio make good material on which to polish up the "pothooks." Charles L. Swen, the world's champion shorthand writer, kept a notebook handy to take down the lectures that were sandwiched in between the musical numbers while he was training for competition.



Pacific & Atlantic

BROADCASTING FROM THE BOTTOM OF THE SEA

In an attempt to find out whether radio fans would be interested in a description of the bottom of the sea, as told by an eyewitness, station WIP equipped a diver's helmet with a microphone (as shown in the upper left-hand corner of the illustration) and sent the diver down to the bottom a short distance off-shore with instructions to describe what he could see in the way of fish, marine vegetation and old wrecks. Here is one instance, at least, where the program director had no means of checking the accuracy of the speech being broadcast from his station!

Claims Radio Influences Jurors

A NEW and confusing element threatens to be injected into our law courts in the form of broadcast discussions of celebrated cases that may be listened in upon by jurors who might be unduly influenced in their decisions. This unique but plausible claim was recently made by Frank J. Hogan, chief counsel for Edward L. Doheny in the oil investigation, who requested that the indictments against his client be quashed. Mr. Hogan claimed that a speech broadcast from station WRC by Senator Walsh, who was in charge of the investigation, had influenced the Grand Jury which was in session at the time, and he called attention not only to the fact that the jurors likely had their own receiving sets, but that there were at least twenty public receiving stations where members of the jury could have heard the address.

"Vacation Radio" Must be Registered in France

If you live in France and if you want to take a radio receiver with you on your vacation, you must first go to the office of the governmental radio authorities and register your set, the location at which you expect to use it, how long you will be gone and all the rest of your plans for a radio vacation.

* * *

Lost Flamingo Located by Radio

One of the most curious services ever rendered by a broadcasting station fell recently to the lot of 2LO in Manchester. A flamingo escaped from the zoo, a description of the bird was broadcast and it was located presently and returned to its cage.

* * *

Radio Expedites Distribution of Weather News

The weather information given to the public in France by the office of Meteorology (the French equivalent of our Weather Bureau), is broadcast altogether by radio. This has resulted, says M. Bureau of that office, in a much quicker and cheaper distribution of the information. The distribution of a weather forecast formerly required the co-operation of six separate telegraph offices, as well as a host of messengers. Now the entire procedure is carried out by a single broadcasting station connected directly with the forecaster's office.

Notes of 'Cello Coax Nightingale to Sing

When the song of the nightingale was broadcast recently by the British Broadcasting Company the microphone was set up in a suburban garden where the birds were known to be plentiful. A 'cellist then played to the birds until they were induced to imitate the sound and burst into song.

* * *

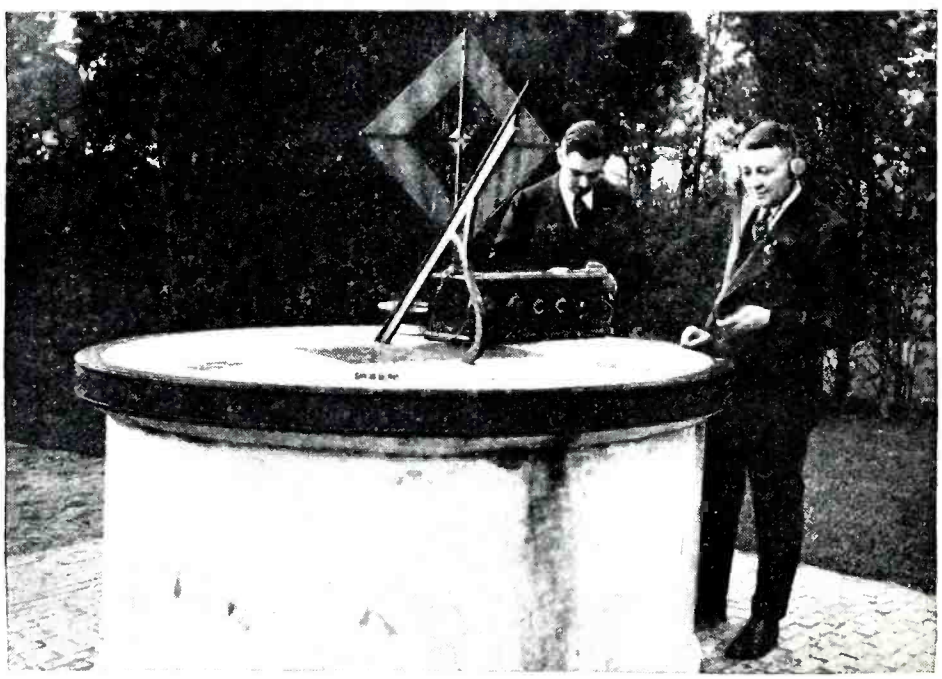
Interference Between Long-wave Stations Serious in Europe

The tendency of the first European broadcasters to select waves in the neighborhood of 2,000 meters has now become a serious matter because of the number of such stations now on the air and the interference that they cause to each other's programs. Radio-Paris works on 1,760 meters, Prague and Rome are on 1,800 meters, Madrid is between these two figures. Now comes the new 25-kilowatt British station, soon to be on the air at Chelmford and which will work at 1,700 meters.

* * *

Radio Via the North Pole

An amateur in Holland who has succeeded several times in hearing the radio telegraph station at Hawaii reports that the direction of his receiving loop when this station is received indicates that the Hawaiian waves are arriving from almost due north. It is apparent, therefore, that the north magnetic pole or other "radio obstacles" so commonly assumed to occupy the Arctic regions do not really prevent the passage of radio waves across the pole.



Kadel & Herbert

RADIO TIME SIGNALS CHECK THE SUN DIAL

Captain "Jack" Irwin, on his way to California from New York, stopped off long enough at Garden City to check the sun dial by means of time signals received on the radio receiver he is taking along on his trip.

WITH THE INVENTORS

CONDUCTED BY THOMAS ELWAY

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

Metal-coated Mica for Condensers

No. 1,479,315, FIGURE 1. *Invented by G. W. Pickard of Newton Center, Massachusetts, and assigned to the Wireless Specialty Apparatus Company.*

With the object of producing a condenser having the least possible distance between plates as well as low losses by leakage or in the dielectric, a thin adherent coating of metal is produced on the surfaces of plates of mica or of other dielectrics. The metal coatings may be formed by electro-plating methods, by cathode deposition (after the manner used in making master-moulds from phonograph records) or in other ways. In poorly designed condensers in which the dielectric is not properly compressed between the plates, a loss occurs due to the actual mechanical motion of the plates caused by the alternate charging and discharging and the consequent alternate attraction and repulsion of the plates.

A Receiver that Uses a Ground Only, Without Antenna

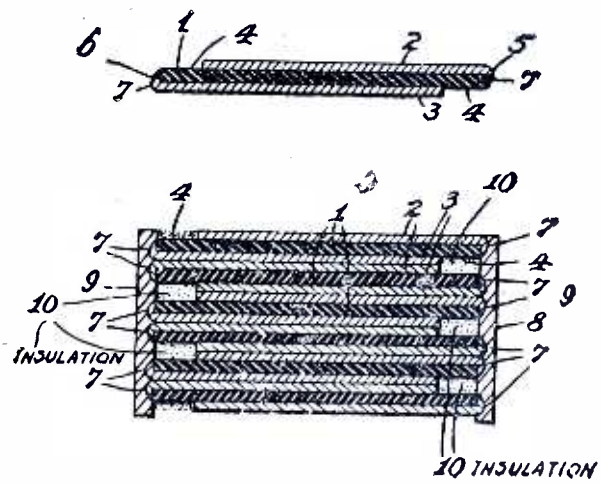
No. 1,479,475, FIGURE 2. *Invented by Ogden Minton of Greenwich, Connecticut.*

The two input terminals of a vacuum-tube receiver of any standard type are connected to a ground, one terminal through each winding of a standard short-wave variometer, one of these windings being shunted by a variable condenser. Rough tuning is accomplished by varying the coupling between the variometer coils, the condenser being used for the final, more precise, tuning. The apparatus can be made to operate successfully without this condenser. The patentee claims that the device is "the first successful receiving apparatus using neither an aerial, nor a loop, and having only one connection to the ground."

Multiple Loop System for Simplified Tuning

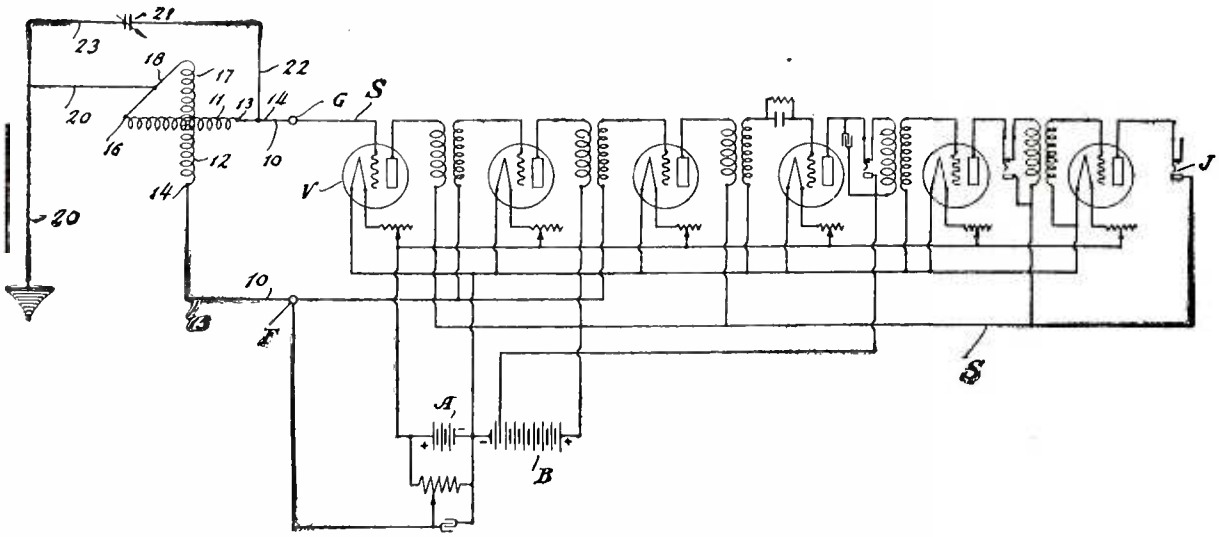
No. 1,479,638, FIGURE 3. *Invented by V. K. Zworykin of Kansas City, Missouri.*

This invention contemplates the use of three or more loops, each one tuned, and all connected in multiple to the receiver proper. One way of making the connections is shown in Figure 3, but other ways are possible. The inventor claims that useful regeneration (in addition to the ordinary effect of regenerative circuits) occurs because of the mutual inductive effect of the loops. Tuning of the loops is said to be possible without decreasing the energy pick-up or interfering with the directional effect of the loops.



PICKARD'S CONDENSER MADE OF METAL-PLATED SHEETS

FIGURE 1: *The upper figure shows a single plate of mica (or other dielectric) with the metal coatings on the two sides. Note that the opposite edges on either side of the mica are left uncoated. The lower figure shows how such plates are built up to obtain larger capacity.*



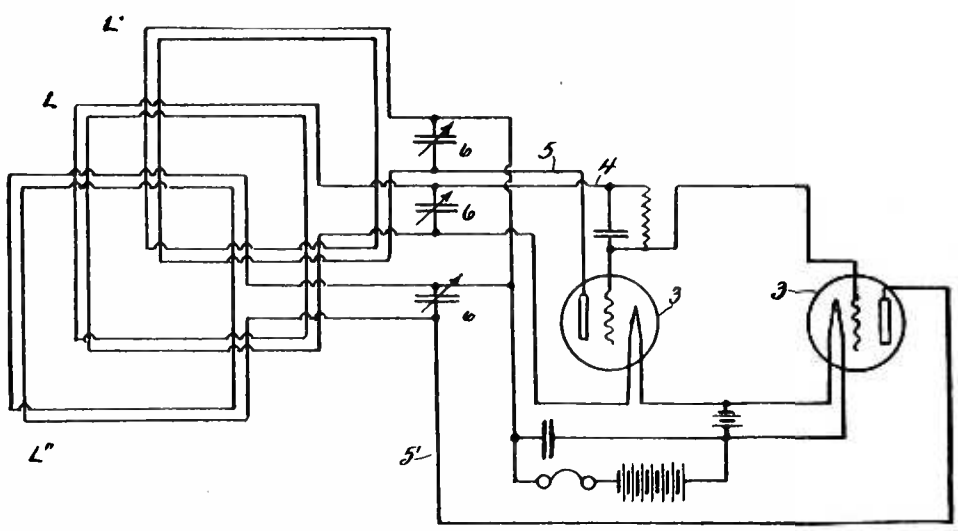
HOOK-UP FOR THE ONE-GROUND RECEIVER

FIGURE 2: *The two coils of the variometer, 11 and 12, may be rotated to vary the coupling. When a standard short-wave variometer is used for these coils, the condenser, 21, is a standard 43-plate variable condenser. Other coils and condensers may be used, as may other hook-ups for detection and amplification.*

Link Circuit to Block Low-frequency Interference

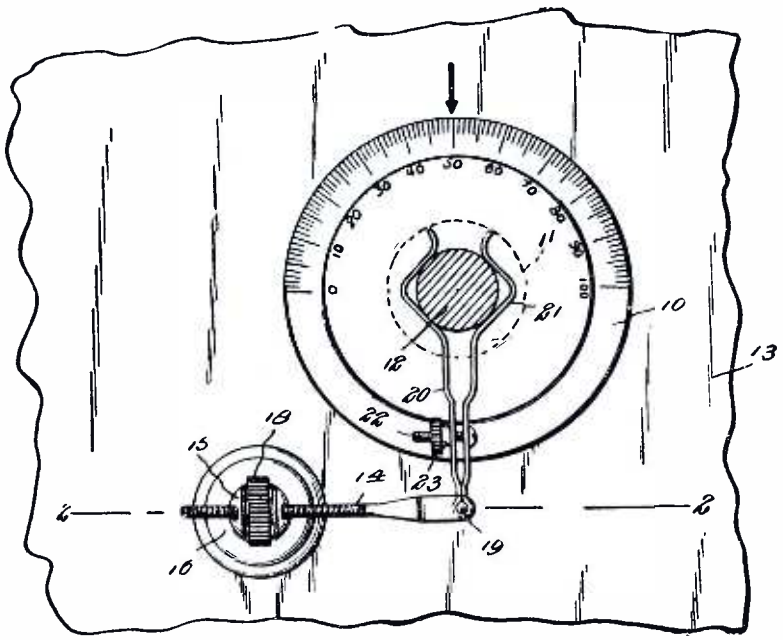
No. 1,480,891. *Invented by Howard J. Becker of Schenectady, New York, and assigned to the General Electric Company.*

In many circuits that employ vacuum-tube detectors or amplifiers, low-frequency disturbances arising from internal irregularities in the operation of the tubes themselves may be introduced and will then be amplified by tubes farther along in the cascade. The inventor avoids the retention of these low-frequency disturbances by employing a link circuit tuned to the wanted frequency. The output of the radio-frequency amplifier is arranged non-inductively to the input of the detector; the link circuit being introduced between them and inductively coupled to both. This link circuit may consist, conveniently, of a capacity and an inductance.



ARRANGEMENT FOR REGENERATION BETWEEN LOOPS

FIGURE 3: *The connections of the multiple loops to the receiver may be varied, if desired. The mutual induction of the loops is supposed to assist regeneration.*



DIAL VERNIER THAT MAY BE MADE AT HOME

FIGURE 4: *The spring clip, 20, holds the knob on the dial loosely enough so that the knob can be turned inside it. Fine adjustment may be made with great precision by means of the screw, 14, turned by the knurled nut, 18.*

Vernier Control for Dials

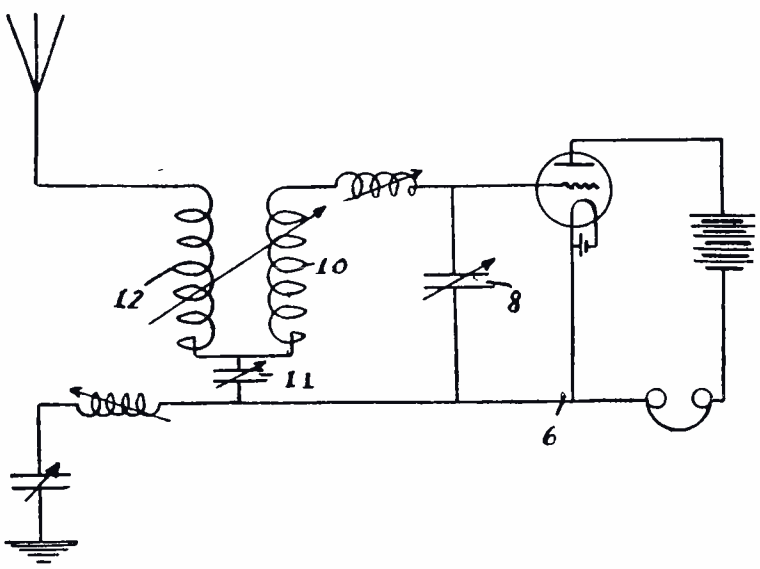
No. 1,481,669, FIGURE 4. *Invented by William M. Justice of Baltimore, Maryland.*

A spring clip attached by friction to the knob on the dial may be moved backward or forward with great precision by means of a screw that is fastened to it. The arrangement will be made clear by a glance at Figure 4.

Preventing Interference from Strong Signals

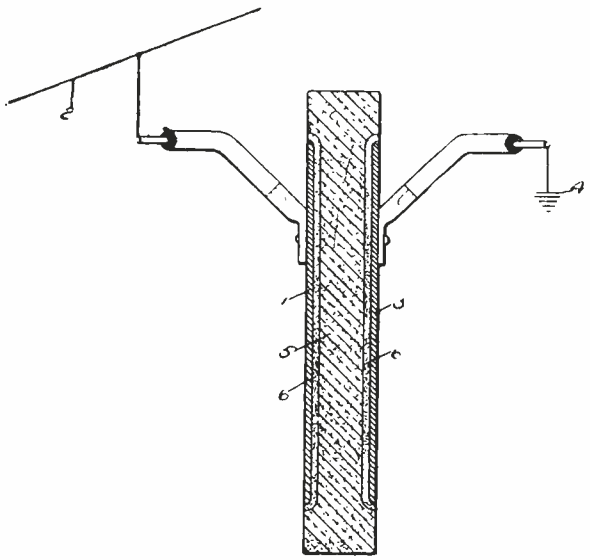
No. 1,481,945, FIGURE 5. *Invented by Julius Weinberger of New York, New York, and assigned to the Radio Corporation of America.*

Two inductances are connected in parallel to a single condenser and are also coupled inductively, this coupling being variable. The condenser is also variable and, by properly adjusting the coupling and the capacity of the condenser, it is possible to oppose the direct signal through the condenser and one inductance to the opposed signal originated in the other inductance by the coupling. The hook-up is said to be of especial utility in tuning out the strong signals of a nearby station in order to hear the weaker signals of a more distant one.



HOW TO BALANCE OUT STRONG INTERFERENCE

FIGURE 5: *The direct signals through the inductance, 12, are cancelled, when they come to the condenser, 11, by the opposing impulses that they have generated by inductive coupling in the second inductance, 10. Exact balance is secured by varying the coupling between 12 and 10, as well as the capacity of the condenser.*



THE LEAD PEROXIDE LIGHTNING ARRESTER

FIGURE 6: *The metal plates, 1 and 3, are connected to the line and to the ground. These are surrounded by the films of lead peroxide, 6 and 6. This is conducting when cold; non-conducting after it has been heated. 5 is a non-conducting filler such as asbestos or spun glass, through the pores of which the arc passes when the arrester acts.*

A Lightning Arrester That Readjusts Itself

No. 1,483,538, No. 1,483,539 AND No. 1,483,540, FIGURE 6. *Invented by C. T. Allcutt of Pittsburgh, Pennsylvania. Also No.* 1,483,548. *Invented by F. A. Lind of Turtle Creek, Pennsylvania. All assigned to the Westinghouse Electric and Manufacturing Company.*

It is a fault of many types of lightning arresters and other devices for discharging overload surges to the ground, that when an arc has once been established across them the arc is likely to continue although the voltage has dropped to a safe value. The four patents referred to describe a method of avoiding this by the utilization of a property of lead peroxide. This compound is a relatively good conductor when cold. So soon, however, as it is heated it undergoes a chemical change that makes it a non-conductor. Accordingly, if the terminals of a spark gap for a lightning arrester are coated with lead peroxide and if an arc forms (because of an overload) between these terminals, the spots on the lead peroxide layer where the arc plays become heated and therefore non-conducting. This breaks the arc. If the overload continues a new arc will form on some other spot of the lead peroxide surface. This arc, in its turn, will be broken by the increased resistance of the lead peroxide as soon as it gets hot. Thus the arc passes only so long as the overload persists. Figure 6 is from patent Number 1,483,539.

Impulses Applied to Masts Prevent Antenna Losses

No. 1,483,860. *Invented by Otto von Brink of Berlin, Germany.*

In the antenna systems of large stations the charges induced in the tall metal masts by the alternations of charge in the antenna wires may be the cause of serious losses of energy. It is for this reason that the masts are commonly insulated from the ground, even at the penalty of difficult and costly construction. This inventor proposes to minimize still further the inductive losses in the masts by communicating to them through a special circuit electromotive forces just competent to neutralize the inductive effects of the antenna. It is said that the amount of energy radiated is increased.

A Group of Patents on the Hammond Control System

Nos. 1,484,605; 1,486,885; 1,486,886; 1,486,887; 1,489,031 AND 1,496,311. *Invented by John Hays Hammond, Jr., of Gloucester, Massachusetts.*

These patents are part of a group, filed between August 24, 1912 and October 17, 1917, covering Mr. Hammond's system, now well-known, for the radio control of torpedoes or other machinery by means of multiple modulation.

Catwhisker Made of Rolled Metal Sheet

No. 1,485,524, FIGURE 7. *Invented by H. H. Pickron of Rock Island, Illinois.*

A strip of metal, rolled up and then drawn out into a fairly stiff spiral, is said to make a catwhisker that not only stays in adjustment much better than the more usual and more flexible forms but possesses a larger area of good contact and does not require, therefore, so much searching of the crystal surface.

Telephones Make Ground Through Body of Listener

No. 1,486,049. *Invented by G. B. Spring of Milford, New Hampshire.*

A telephone headset, otherwise of usual character, carries a metal plate that makes contact with the ears of the wearer. This may be so connected to the circuit that the body of the listener becomes either the antenna or the ground for the set.

THE SPIRAL CATWHISKER

FIGURE 7: *This rolled-up strip of metal may be used as a catwhisker and is said to have many advantages.*

CONDUCTED BY ALBERT G. CRAIG

Cover Your Coils While Soldering

PLACE a piece of paper over the windings of coils when you are soldering a connection which lies directly over or near the coils. This will prevent solder or soldering paste from spattering on the windings. Many good circuits and sets are discarded just because the coils are damaged in the process of soldering.

Cover up the coils while you are doing this job!

Keep Contacts on Vacuum Tubes Clean

BE sure that the contacts on the bottom of the vacuum tubes you use are kept clean and bright. If they are blackened or dirty, the connection through to the rest of the circuit will be poor and you may get varying signals or none at all. Clean the contacts with a bit of sandpaper or with a small file.

Mounting Condensers Which Have Metal End Plates

IN laying out the radio-frequency parts of a circuit, such as condensers and coils, there are a number of precautions that should be taken to prevent losses in the fields, both electromagnetic and electrostatic.

Condensers which have grounded rotors, and the accompanying metal end plates, should not be mounted in such a position that there will be any eddy-current losses induced in the plates. This means that the condensers should not be mounted directly in the electromagnetic fields of the coils nor should they be mounted so that the plane of the plates lies at right angles to the direction followed by the lines of force themselves.

It should be remembered that any energy expended from the energy of the field itself, detracts from the total amount of energy that will be induced in the secondary of the coils themselves. Placing condensers in the wrong position has the effect of adding a resistance to the electrical circuit which decreases the vital energy which causes the set to operate.

Remember this when you design a set and keep the metal end plates away from the strong portions of the inductive field: a distance of two inches is usually safe.

Guard Against Jarring of Magnets in Headphones and Loudspeakers

NEVER drop the headphones on the floor, and never place the loudspeaker in such a position that it may be knocked off onto the floor.

Sudden shocks will affect the magnets so that they will lose their magnetism and the reception will be weakened.

Keep the phones hanging on a hook, and place the "speaker" in a safe place.

Hints for Builders of Sets

If you are a beginner at constructing your own radio receivers, you should certainly follow closely the instructions that you are given, to make the set function with the same success as the set described.

If, however, you are an experienced radio man and understand the problems that are encountered in designing and construction work, you may be able to incorporate some changes and departures of your own into the set you are building. You may even be able to improve on the set so that it will more completely suit your own particular needs.

But don't try to do it if you have not had a lot of experience, and if you are not sure that you know exactly what you are doing when you make any changes.

Solder Well All Joints in the Antenna Wires

The antenna which is erected for broadcast reception is usually put up in a single piece. It usually consists of a 100-foot horizontal wire with a lead-in, varying in length from 20 feet long to 100 feet long, running down to the set.

Sometimes the antenna cannot be made in one piece as in the case of the two-wire antenna. If this is the case be sure to solder all joints well so that there will be no poor connections.

Antenna Connections Inside the Set

Be sure that you keep the wiring of the antenna circuit isolated from the grid circuit (the secondary circuit, in general) when you lay out the next set you intend building. If you leave them in close proximity to each other you will never be able to obtain loose enough coupling to be able to tune sharply enough.

Especially, keep the antenna lead to the coil as short as possible, and as far as possible from all the other wiring.

Soldering Lugs *versus* Binding Posts

The wise manufacturer is gradually discarding binding posts for making connections to the instruments. A much more positive connection and a more permanent one is made by means of a soldering lug. Some manufacturers include both on the parts they build and sell, but the trend is towards the soldering lug.

Sockets, rheostats, condensers, variometers, couplers, transformers, and coils, only do their work properly when they are properly and fully connected. A soldered joint gives a better and more lasting connection than a binding post because it does not vibrate loose; because it produces a joint of higher conductivity; and at the same time it costs slightly less, so that the manufacturer can put more quality into the other details.

Be sure that the instruments you purchase have a proper means for connections.

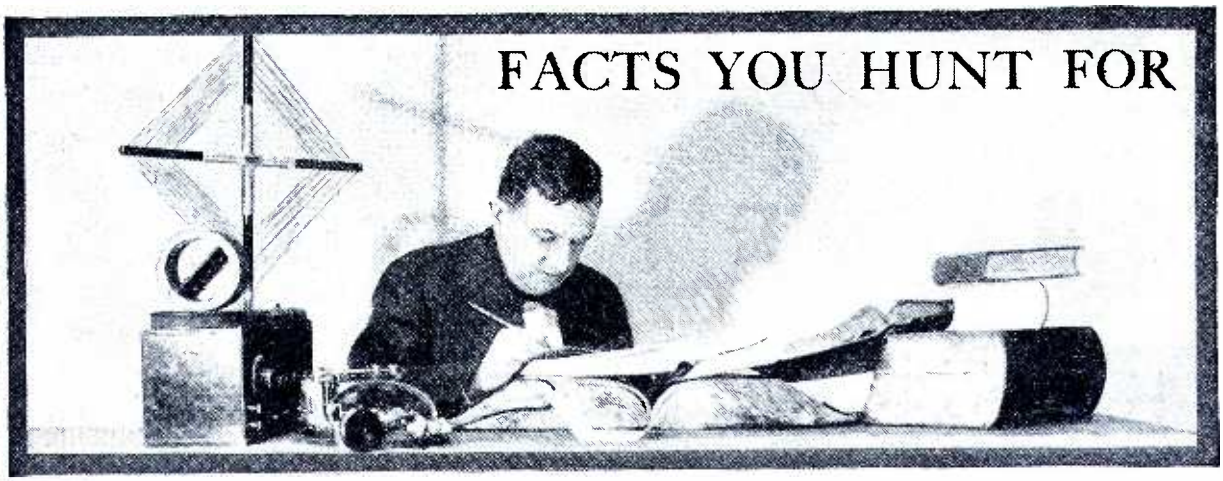
Hunting for Loose Connections In Your Set

When looking to find a loose connection in a set, first turn on all the tubes. Then rap the panel (with the cabinet off the set) and if you hear a clicking or harsh scratching noise, you will know it is in one of the wires leading to some instrument situated on the panel.

It is a good plan to test out every wire in the set by shaking it with an insulated rod such as a fountain pen or a wooden pencil. Never use a metal screw-driver or any kind of metal rod. You may short-circuit some of the circuits if you do.

Just listen in while testing out every wire with the rod and you will hear a series of scratching sounds or clicks when you shake the wire that is not firmly connected.

A loose ground connection may also cause noisy reception.



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.

Is it possible for a telegraph instrument to pick up radio waves and to talk to you, as was reported in the newspapers?

IF an audio-frequency current is fed into a telegraph line the telegraph instruments will frequently convert it into sound just as a telephone does. A loose iron core in one of the electro-magnets or an armature clamped down on the pole piece just tight enough but not too tight, will make a vibrating unit that behaves exactly as a telephone diaphragm would do. But the current must be rectified. Radio waves that have not passed through a detector will not do it.

Can an old-fashioned liquid battery such as was once used on doorbells be used as an A battery for radio?

YES, provided it is of a type that will give constant current while in use. The copper sulphate cell, having metal elements of copper and of zinc, will do very well. Its voltage is about 1.1 volt per cell. The sal-ammoniac cells are less satisfactory, as their voltage runs down rapidly.

Is it true that shooting stars can be heard in a radio receiver?

THERE used to be a theory to this effect, but it has not been much heard of recently. Shooting stars are really small particles of iron or stone that enter our atmosphere from outer space and burn up by friction with the air. The idea was that they would produce electric charges in doing this and that these charges might be responsible for the "hissing" variety of static. No one seems ever to have listened for static and watched for shooting stars at the same time, but with the development of newer theories of static the shooting star idea seems to have died a natural death.

Why is it that the text-books of electricity give water as an insulator and yet the current will pass through water easily, as is evident by the serious leakages caused by a wet panel in a radio set?

THE confusion is due to forgetting the question of the *purity* of the water. Pure water is a very good insulator. It is possible, indeed, that if we ever succeed in making absolutely pure water, not containing even a trace of any impurity, we will find it to be an almost perfect insulator. But ordinary water is far from pure. It contains, for example, some common salt dissolved in it. It is the impurities that carry the current.

How much electricity is necessary in order to cause death?

IT depends on circumstances. The effect of heavy electric currents on the human body is very little understood. It is supposed that they act in some way on the nerves, paralyzing the action of these organs and thus stopping the impulses that keep the heart and the lungs going. If this is true it is easy to see that the condition of the body, the point of application of the current and many similar circumstances may alter the effects of the current on the body. Cases are on record of persons being killed by contact with potentials below 100 volts, although such voltages are usually quite safe. On the other hand, 60,000 volts have failed to kill on momentary contact.

What is a current-squared meter?

THIS is merely a sensitive milliameter, the scale of which is calibrated to read the square of the current instead of the current itself. Some of the formulas used in radio calculations require that the current in milliamperes be squared before substitution in the formula. The current-squared meter does this automatically.

What is a tantalum rectifier?

IT is an electrolytic rectifier which makes use of plates of the rare metal tantalum instead of the aluminum plates that are ordinarily used. The solutions, construction and other features are also different, being suited to the employment of the tantalum. As in all electrolytic rectifiers, the principle is that some property of the surface of one electrode, usually the formation of a surface film on it, prevents the flow of the current in one direction while allowing it to flow in the other direction.

What is the cause of the skin effect by which most of the current in a wire flows on its outside surface?

THE detailed theory of this effect is too complicated for description here. Briefly, what happens is this. With each change of direction of an alternating current an electromagnetic wave is set up about the wire. This takes energy and time. It also reacts on the current in the wire. With rapidly alternating currents, like radio-frequency ones, the net result of the reaction between field and current is to cancel the current in the center part of the wire.

What is the so-called silicon iron that is sometimes used for iron cores of transformers and other magnetic parts?

IT is an alloy of iron with a little of the chemical element named silicon. The silicon alters the properties of the iron somewhat, especially its magnetic properties. For certain purposes this silicon iron is better than ordinary cast iron or wrought iron.

What is the difference between conductive coupling and resistance coupling?

THERE is no difference. These are different names for the same thing. Conductive coupling means that two circuits are coupled through a conductor. Of course a resistance is a conductor, though perhaps a poor one.

Why are the plates of variable condensers made of aluminum or of some similar soft metal when plates of thin steel would be so much more rigid?

STEEL plates would be magnetic. The charges of electricity flowing continually in and out of the plates, would set up eddy currents in them and these eddy currents, in turn, would set up magnetic fields. This would mean a loss of electric energy. Only the non-magnetic metals, like copper or brass or aluminum, can be used for condensers to be employed with high-frequency currents.

What is the meaning of figures written with powers of 10, like, for example, the diameter of the hydrogen atom being given as 1.1 x 10^{-8} centimeter?

THIS is a notation used by mathematicians and physicists to avoid writing down long strings of zeros. The figure first given is understood as being multiplied by the specified power of ten. Minus powers indicate division, as is usual in mathematical notation. This will be clear from the following examples:

5.5×10^{1} equals 5.5 multiplied by ten.
5.5×10^{2} equals 5.5 multiplied by the square of ten, or 100.
5.5×10^{3} equals 5.5 multiplied by the cube of ten, or 1,000.
5.5×10^{4} equals 5.5 multiplied by the fourth power of ten, or 10,000; and so on.

Similarly with the minus powers:

5.5×10^{-1} equals 5.5 multiplied by 1/10, or, what is the same thing, 5.5 divided by ten.
5.5×10^{-2} equals 5.5 divided by the square of ten, or 100; and so on.

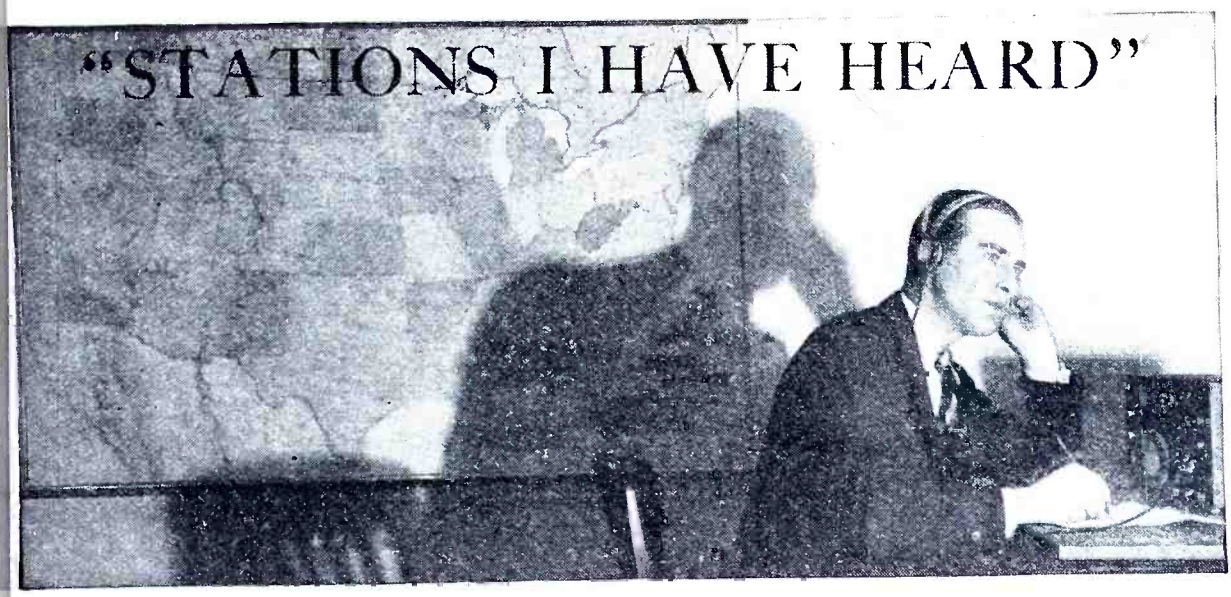
The figure given for the diameter of the hydrogen atom, 1.1×10^{-8} centimeter, means 1.1 centimeter divided by the eighth power of ten, or 100,000,000. In the usual decimal notation this equals .000,000,011 centimeter.

Where does the name microfarad come from?

THE scientific unit of electric capacity is called the farad. It was named after Michael Faraday, the great experimenter who worked out the laws of electromagnetic induction. The microfarad is one millionth of a farad, the farad being far too large a unit for practical use.

What is the present theory of the cause of magnetism in iron and in similar metals?

IT is supposed to be due to the revolution of the electrons inside the atoms. Any moving electric charge produces a magnetic field. Accordingly any electron that revolves in an orbit, as all the electrons in atoms are supposed to do, must create a magnetic field around its orbit. It is believed that in the majority of atoms the electron orbits are so arranged that the magnetic effects of their orbits cancel each other. The atom as a whole is not magnetic. But in the atoms of iron, cobalt and nickel the arrangement of the orbits is believed to be such that the magnetic fields do not cancel. Therefore, these elements are magnetic.



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.

ON A ONE-TUBE SET

AMONG those who are getting unusual results from the UV-200 detector tube is Robert M. Hillis of 1462 Belle Avenue, Lakewood, Ohio. He states that he has received a total of eighty-six stations in seven weeks with the one tube in a Colpitts circuit, which, like all single circuits, is among "the beautiful and damned," because of its distance getting qualities and its propensities for radiating and heterodyning in neighboring receiving sets.

He hears WJAR and WEAN of Providence, R. I., on one side of the country, and KGO of Oakland, Cal., on the other. He has also logged KFDY of Brookings, S. D., KLZ, Denver, Colo., WCAR, San Antonio, Tex., WBZ, Springfield, Mass., CFAC, Calgary, Canada, and PWX, Havana, Cuba.

* * *

WHAT A CIGAR BOX DID

"WHEN I read about Sinclair's Spring Hike Kit in the May issue of POPULAR RADIO, I learned something, and I must tell you about it," writes F. B. Monroe of Yonkers, N. Y. "I had a good cigar box, just the size, and by hooking up a WD-12 one evening, I got better results than I ever did with my two-tube outfit.

"I heard KDKA of Pittsburgh loud and clear, and the nearer stations were surprisingly loud."

* * *

73 DX STATIONS ON ONE TUBE

WITH only a dry-battery tube and the Haynes circuit, Carl L. McLain of Arcanum, Ohio, logged a long list of stations from California to Texas and Cuba. He is using an outdoor antenna 100 feet long, only 20 feet above the ground at the highest point and his set is grounded to a 5-foot pipe driven in good moist soil.

AND ON THE ELEVENTH DAY HE RESTED

"DEAR SIR," begins D. W. Ellison of Calgary, Alberta, Canada, "Ten days ago I finished building the Haynes circuit described in the September number of POPULAR RADIO, and I wish to submit my log of 45 stations which are on an average of 1,248 miles away.

"Every one of these stations was picked up with one tube with the exception of Havana, Cuba, which required two tubes.

"Up to the time of building this set I was a firm backer of the single circuit, but under no circumstances would I consider anything but a Haynes circuit now. Its ability to bring local stations in on a loudspeaker without antenna or ground is astounding. After following the Haynes and Cockaday circuits as described in your magazine, I have come to the conclusion that if either of these two gentlemen have anything to do in connection with a set, that set will do all you claim for it and prove to be a humdinger."

His log includes PWX, Havana, Cuba, 3,750 miles away; WJZ, New York City, 2,075; WDAS, Worcester, Mass., 2,125; WGY, Schenectady, N. Y., 2,000; KDKA, Pittburgh, 1,925; WSB, Atlanta, Ga., 1,975; WEAO, Columbus, O., 1,750, and WHAS, Louisville, Ky., 1,700.

* * *

A CRYSTAL DID IT

TONY STRAKA hears fifteen stations on his crystal set in Fairchance, Pa., according to his record.

"I heard KFI one time, but don't know its location," he writes.

The station is in Los Angeles, Cal., and so the list is cut to fourteen. But those fourteen include Chicago, so his set is still in a class with the best crystal receivers.

WHERE "SQUEALS" ARE FEW

In Columbus, Ohio, where squeals from single-circuit sets are few and are not always classed as nuisances, Edward Harmon of 268 East Cherry Street, hears thirty-seven stations with one dry-cell tube.

"Last night I listened to PWX of Havana, Cuba, without any interference at all," he writes. "I have also listened to WEAN of Providence, R. I., a hundred-watt station, while a station three blocks away was using five hundred watts. By substituting a worn-out dry cell of one and a half volts for the 'B' battery, I can still hear local stations."

On his log are WEAF, New York City; WCAP, Washington, D. C.; WGR, Buffalo, N. Y.; WSY, Birmingham, Ala., and WWJ, Detroit, Mich.

* * *

45 STATIONS ON ONE TUBE

Using the one-tube Man-Day set which was described in the November issue of Popular Radio, Robert Schuemann of 3137 Fairfax Road, Cleveland, O., has received 45 stations in 21 different states, covering a total of 25,000 miles.

* * *

COCKADAY CIRCUIT REJUVENATES OLD NAVY SET

"Home-made radio sets, like ships, are never finished," writes Edward A. Hodge of New York City. "Probably some of your readers may be interested in what can be done with an old navy CW 926 amplifier plus a Cockaday hook-up and a little nickel plate." We believe our readers will agree that Mr. Hodge's set presents a very attractive and workmanlike appearance. In rebuilding the set, he found that every wire that was not short-circuited proved to be crystallized and the unit as an amplifier was no good. The set now works as well as its appearance would indicate. Twenty-four stations were logged during the first two nights of operation. The list includes WOAW, Omaha, Neb.; KHJ, Los Angeles, Cal., and WMC, Memphis, Tenn.

WHAT A "SUPER" DOES

The Super-heterodyne receiver described in Popular Radio picks up ninety stations in Wilkinsburg, Pa., according to Ivins L. Wilbert, who lives at 607 Hay Street. He combined the Haynes DX Tuner and the oscillator in one cabinet thirty inches long. He receives all the larger stations within a thousand miles, without any kind of antenna.

* * *

"LOCALS" DO NOT BOTHER

Ten distant stations are "pulled through" the local stations by Alfred Fischer of 1111 Cypress Avenue, Evergreen, N. Y. He uses a Cockaday four-circuit tuner and two stages of audio-frequency amplification. His antenna is 180 feet long. The length is too great for most receiving sets, but is a help with the four-circuit type.

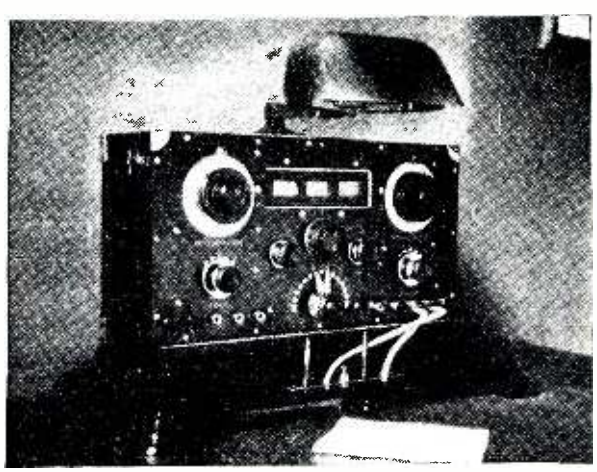
The ten stations he hears well on a loud-speaker while local stations are broadcasting are WDAR, WIP and WOO, Philadelphia, Pa.; WJAZ and WDAP, Chicago, Ill.; KDKA, Pittsburgh, Pa.; WGAR, Fort Smith, Ark.; WFAA, Dallas, Tex.; KFJZ, Fort Worth, Tex., and 9BM, Montreal, Canada.

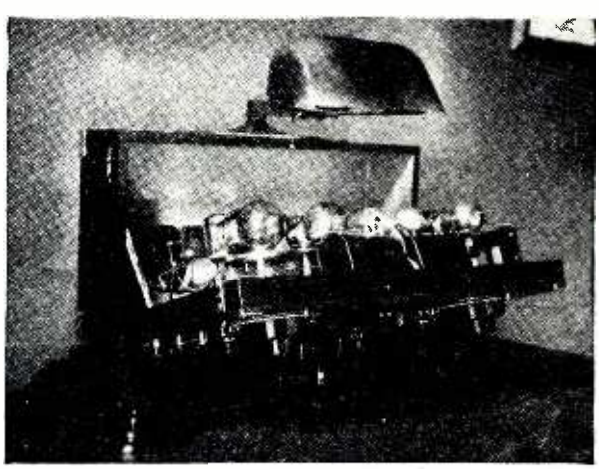
* * *

HAS PICKED UP ALMOST EVERY STATION IN THE CALL BOOK

With a three-tube regenerative, a Cockaday four circuit using five tubes in a push-pull amplifier and a seven-tube superheterodyne all arranged so that he can use any one of the sets on three different antennas, Mr. F. F. Howe of Milwaukee, Wis., is in a position to make some very interesting comparisons of antenna and set efficiency.

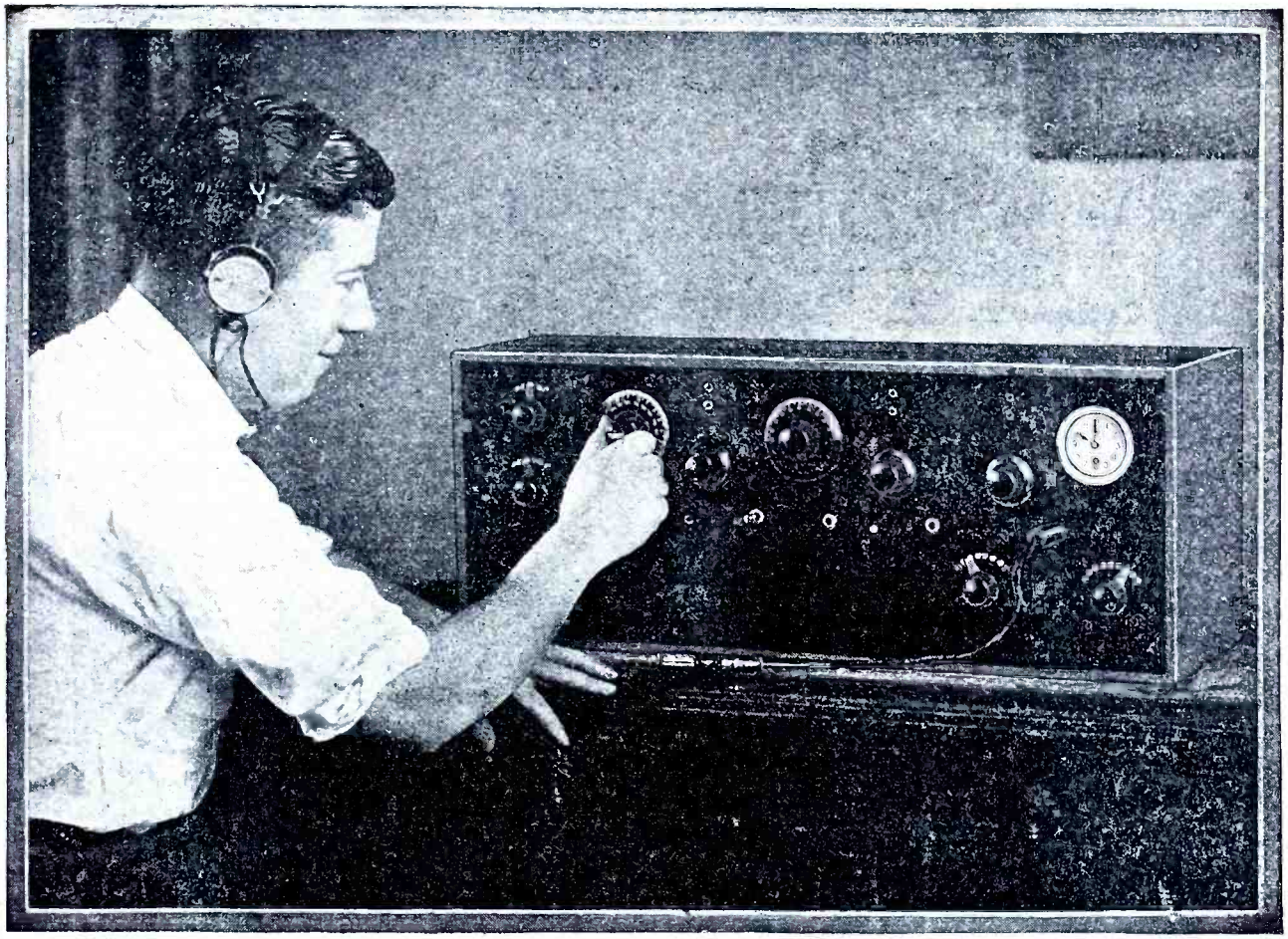
According to Mr. Howe, the outdoor antenna brings in more DX stations when conditions are right, than either the indoor antenna hung in the attic or the loop. He claims that the loop is a last resort to turn to if an outdoor antenna is impossible to construct. Using headphones, he says he has received at one time or another almost every broadcasting station listed in the call book.





A FOUR-CIRCUIT TUNER *DE LUXE*

Judging from the photograph that Mr. Hodge included with his letter, his Cockaday four-circuit set would be hard to beat for neatness and "professional appearance," as he phrases it. Note the desk lamp mounted on the top of the cabinet and the convenient, swing-out panel.



Note the clock in the panel of Mr. Kent's set. With it he checks Government time signals and broadcasting schedules. Note the beauty of the Celoron panel.

What Kent says about panels

Albert Kent builds his own sets. He uses instruments of the highest quality. He has learned that they must be properly insulated to give the best results. He has found that it does not pay to mount his parts on just any old radio panel.

In a letter written to us a few days ago, Mr. Kent said:

"Having completed over thirty radio receivers of various styles, I thought you would like to know of the truly wonderful results obtained with the use of Celoron panels.

"By the process of elimination, I found that Celoron was the only satisfactory panel, mainly because of its extremely low loss of high frequency currents. This characterisic was an absolute necessity to bring in the distant stations loudly and clearly with such a simple hook-up. I find working with Celoron a pleasant task and every completed receiver makes a strikingly beautiful appearance. The first one, after three years' hard use, has not warped yet and still looks like new.

"I wish I could tell every experimenter to begin building his set in the right way by using the best obtainable panel—and that is Celoron."

Send for free booklet

For set builders we have a special free booklet, "Getting the Right Hook-Up with Celoron." It contains valuable hints and suggestions for building and operating a set. Send for your copy today. Write to Department 4 A, Diamond State Fibre Company, Bridgeport, Pa.

CELORON
A BAKELITE PANEL

Diamond State Fibre Company

Bridgeport, Pa., and Chicago, Ill.

Branches in Principal Cities **Toronto, Canada—London, England**

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

WHERE "SQUEALS" ARE FEW

In Columbus, Ohio, where squeals from single-circuit sets are few and are not always classed as nuisances, Edward Harmon of 268 East Cherry Street, hears thirty-seven stations with one dry-cell tube.

"Last night I listened to PWX of Havana, Cuba, without any interference at all," he writes. "I have also listened to WEAN of Providence, R. I., a hundred-watt station, while a station three blocks away was using five hundred watts. By substituting a worn-out dry cell of one and a half volts for the 'B' battery, I can still hear local stations."

On his log are WEAF, New York City; WCAP, Washington, D. C.; WGR, Buffalo, N. Y.; WSY, Birmingham, Ala., and WWJ, Detroit, Mich.

* * *

45 STATIONS ON ONE TUBE

Using the one-tube Man-Day set which was described in the November issue of Popular Radio, Robert Schuemann of 3137 Fairfax Road, Cleveland, O., has received 45 stations in 21 different states, covering a total of 25,000 miles.

* * *

COCKADAY CIRCUIT REJUVENATES OLD NAVY SET

"Home-made radio sets, like ships, are never finished," writes Edward A. Hodge of New York City. "Probably some of your readers may be interested in what can be done with an old navy CW 926 amplifier plus a Cockaday hook-up and a little nickel plate." We believe our readers will agree that Mr. Hodge's set presents a very attractive and workmanlike appearance. In rebuilding the set, he found that every wire that was not short-circuited proved to be crystallized and the unit as an amplifier was no good. The set now works as well as its appearance would indicate. Twenty-four stations were logged during the first two nights of operation. The list includes WOAW, Omaha, Neb.; KHJ, Los Angeles, Cal., and WMC, Memphis, Tenn.

WHAT A "SUPER" DOES

The Super-heterodyne receiver described in Popular Radio picks up ninety stations in Wilkinsburg, Pa., according to Ivins L. Wilbert, who lives at 607 Hay Street. He combined the Haynes DX Tuner and the oscillator in one cabinet thirty inches long. He receives all the larger stations within a thousand miles, without any kind of antenna.

* * *

"LOCALS" DO NOT BOTHER

Ten distant stations are "pulled through" the local stations by Alfred Fischer of 1111 Cypress Avenue, Evergreen, N. Y. He uses a Cockaday four-circuit tuner and two stages of audio-frequency amplification. His antenna is 180 feet long. The length is too great for most receiving sets, but is a help with the four-circuit type.

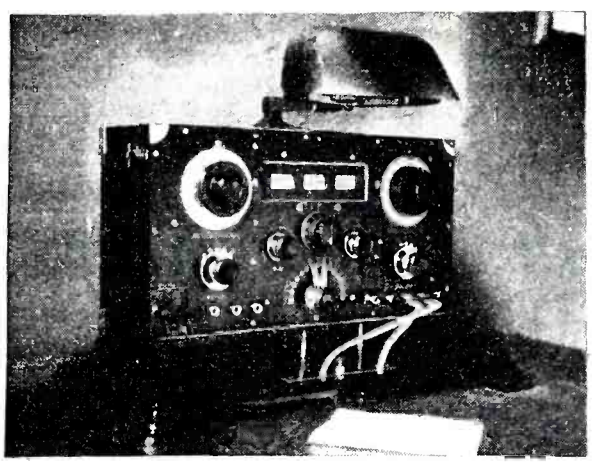
The ten stations he hears well on a loud-speaker while local stations are broadcasting are WDAR, WIP and WOO, Philadelphia, Pa.; WJAZ and WDAP, Chicago, Ill.; KDKA, Pittsburgh, Pa.; WGAR, Fort Smith, Ark.; WFAA, Dallas, Tex.; KFJZ, Fort Worth, Tex., and 9BM, Montreal, Canada.

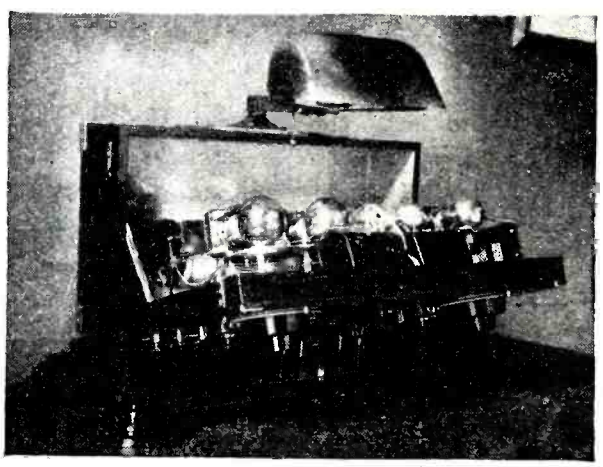
* * *

HAS PICKED UP ALMOST EVERY STATION IN THE CALL BOOK

With a three-tube regenerative, a Cockaday four circuit using five tubes in a push-pull amplifier and a seven-tube superheterodyne all arranged so that he can use any one of the sets on three different antennas, Mr. F. F. Howe of Milwaukee, Wis., is in a position to make some very interesting comparisons of antenna and set efficiency.

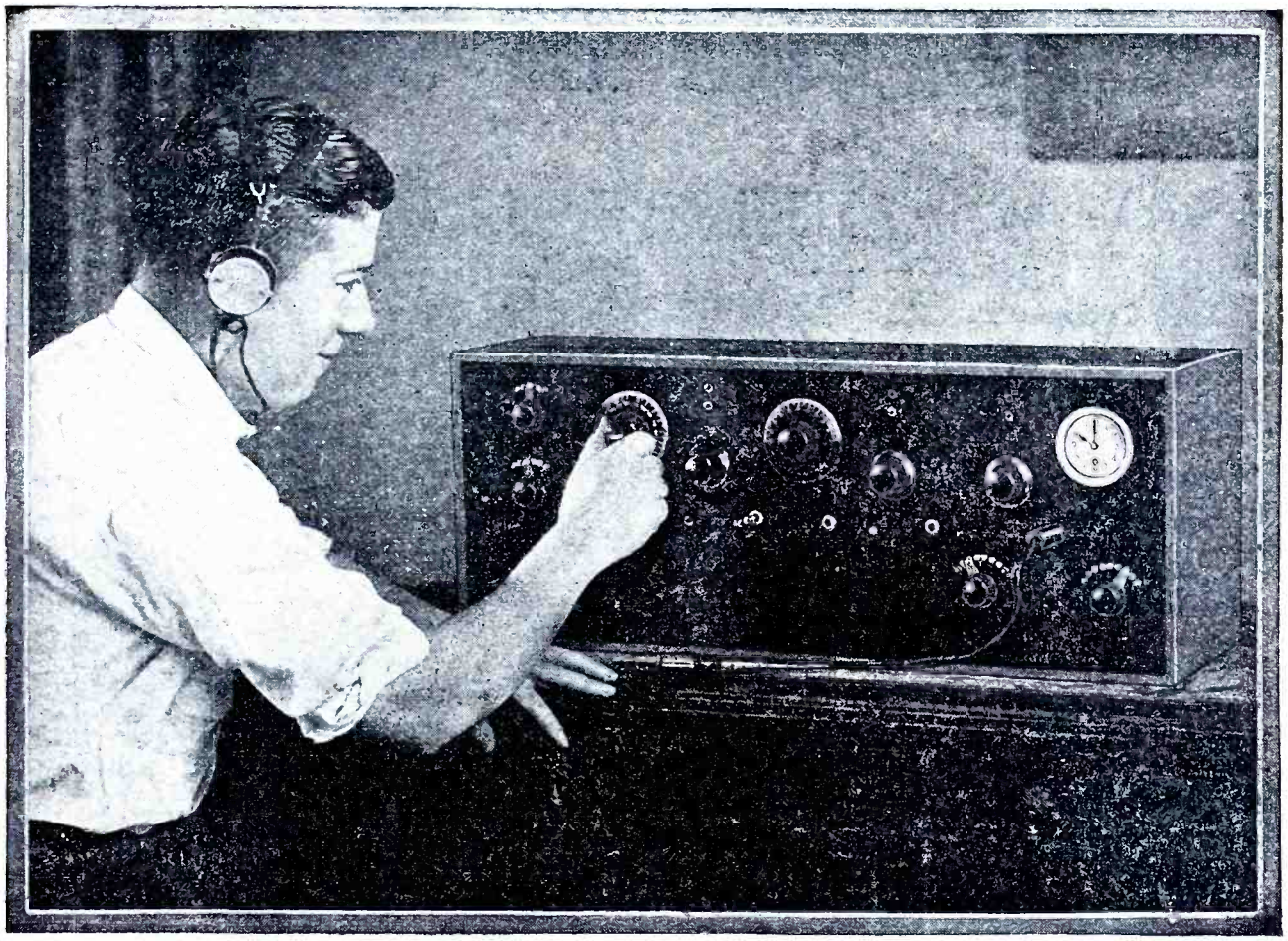
According to Mr. Howe, the outdoor antenna brings in more DX stations when conditions are right, than either the indoor antenna hung in the attic or the loop. He claims that the loop is a last resort to turn to if an outdoor antenna is impossible to construct. Using headphones, he says he has received at one time or another almost every broadcasting station listed in the call book.





A FOUR-CIRCUIT TUNER *DE LUXE*

Judging from the photograph that Mr. Hodge included with his letter, his Cockaday four-circuit set would be hard to beat for neatness and "professional appearance," as he phrases it. Note the desk lamp mounted on the top of the cabinet and the convenient, swing-out panel.



Note the clock in the panel of Mr. Kent's set. With it he checks Government time signals and broadcasting schedules. Note the beauty of the Celoron panel.

What Kent says about panels

Albert Kent builds his own sets. He uses instruments of the highest quality. He has learned that they must be properly insulated to give the best results. He has found that it does not pay to mount his parts on just any old radio panel.

In a letter written to us a few days ago, Mr. Kent said:

"Having completed over thirty radio receivers of various styles, I thought you would like to know of the truly wonderful results obtained with the use of Celoron panels.

"By the process of elimination, I found that Celoron was the only satisfactory panel, mainly because of its extremely low loss of high frequency currents. This characterisic was an absolute necessity to bring in the distant stations loudly and clearly with such a simple hook-up. I find working with Celoron a pleasant task and every completed receiver makes a strikingly beautiful appearance. The first one, after three years' hard use, has not warped yet and still looks like new.

"I wish I could tell every experimenter to begin building his set in the right way by using the best obtainable panel—and that is Celoron."

Send for free booklet

For set builders we have a special free booklet, "Getting the Right Hook-Up with Celoron." It contains valuable hints and suggestions for building and operating a set. Send for your copy today. Write to Department 4 A, Diamond State Fibre Company, Bridgeport, Pa.

CELORON
A BAKELITE PANEL

Diamond State Fibre Company

Bridgeport, Pa., and Chicago, Ill.

Branches in Principal Cities **Toronto, Canada—London, England**

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

The mystery of a

Prices on De Forest D-12 Radiophones

Including loop, self-contained loud speaker, four De Forest tubes, A and B batteries, and all equipment ready to operate.

With Dry Batteries

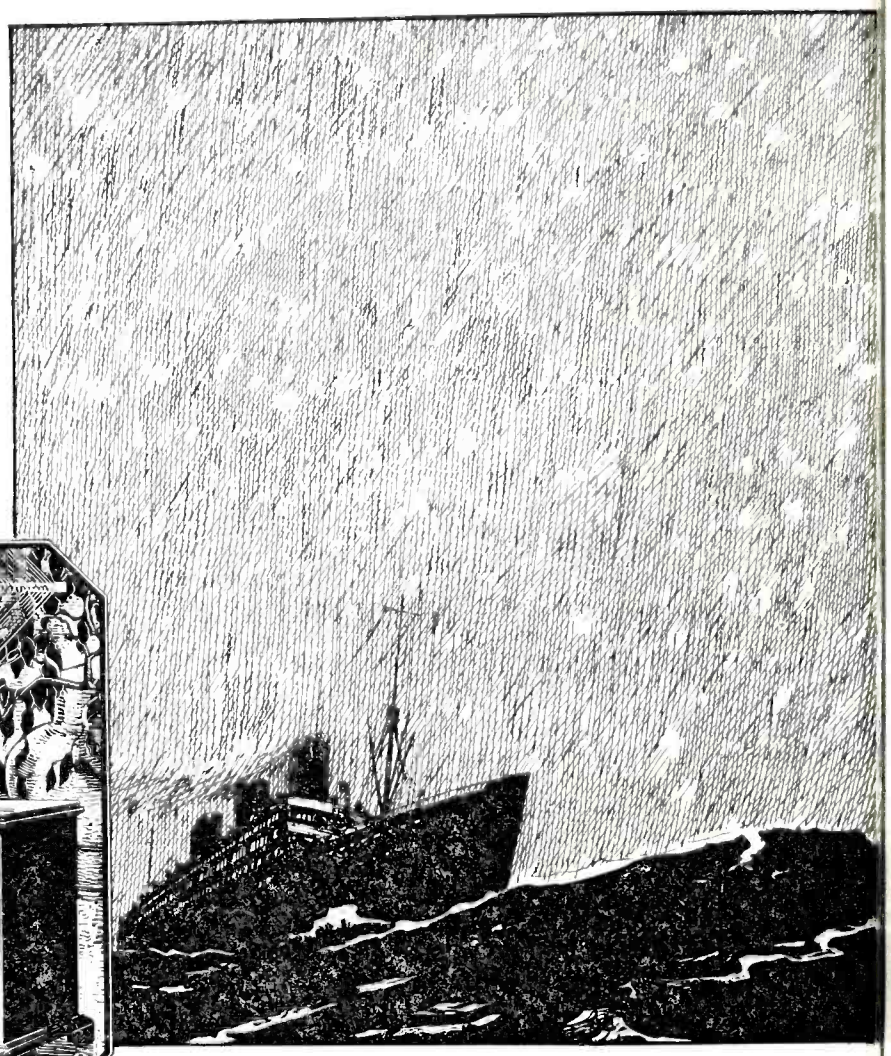
In two-tone gray and black Fabrikoid cabinet . . . $161.20

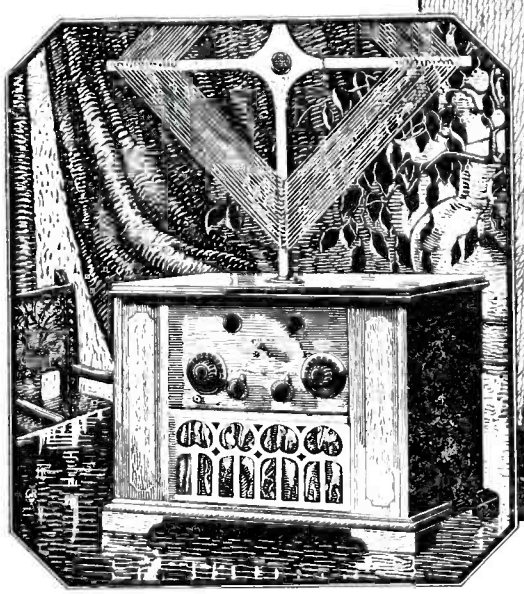
In two-tone Mahogany cabinet 176.20

With Storage Batteries

In two-tone gray and black Fabrikoid cabinet . . . $180.00

In two-tone Mahogany cabinet 195.00





DE FOREST RADIOPHONE D

D 12 REFLEX

FOR BEAUTY AND CLEAR REPRODUCTION

USE the De Forest Loud Speaker. It reproduces naturally, brilliantly, without distortion. The adjustment of the reproducing unit assures uniform response over entire range of audible frequencies. Its horn is shaped to retain the full brilliancy of the original sound, and also to add volume. The complete unit is free from rattles. No rattles can ever develop. Every De Forest Loud Speaker is thoroughly tested and is guaranteed free from defects. Sold by authorized De Forest dealers only. Price, with 6 feet of cord, $25.00.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

a voice in the night

YOU sit at your new De Forest instrument and you "feel it out" with a dial. Suddenly a voice thrills out at you from the night. Its melody is fresh, as dulcet as when it comes from the singer's throat — how far away?

Whose voice is that? You do not know at first; absorbed, you listen. It is a mystery of the high radioways; and the thrill of that mystery is quick within you till you learn from the announcer whose voice it was.

The De Forest D-12 Radiophone offers you the whole thrill of radio — and in an unequalled way. Here is a complete receiver, ready to operate the moment, practically, it enters your home. ***It is the Radiophone ideal for the beginner*** — its operation is so simple. ***It is the Radiophone for the expert*** — it embodies such vast technical skill. Is it any wonder that it is considered to be as standard in its field as is the most famous phonograph, automobile or piano in its own? The De Forest Radiophone is sponsored by Dr De Forest himself, whose great invention, the vacuum tube, has made radio broadcasting possible. So this instrument is extremely practical and simple to operate — it is acutely selective and very easy on its batteries. It depends on no outside wire for results, or no ground wire. And its four tubes do the work of seven. Yet it is sold at a four-tube price — which is about 1/3 less than that of instruments that produce comparable results.

De Forest dealer near you can be useful to you.

De Forest agents are qualified to give you sound and practical advice and help in radio. When you find one you find a man who knows radio — a man who has given us his word that he will see that every machine he sells is properly inspected and properly serviced after the sale. He wants you to get the full benefit and pleasure from your De Forest Radiophone — just as we do.

DE FOREST RADIO COMPANY, Jersey City, N. J.

DE FOREST RADIOPHONE

D 12 REFLEX

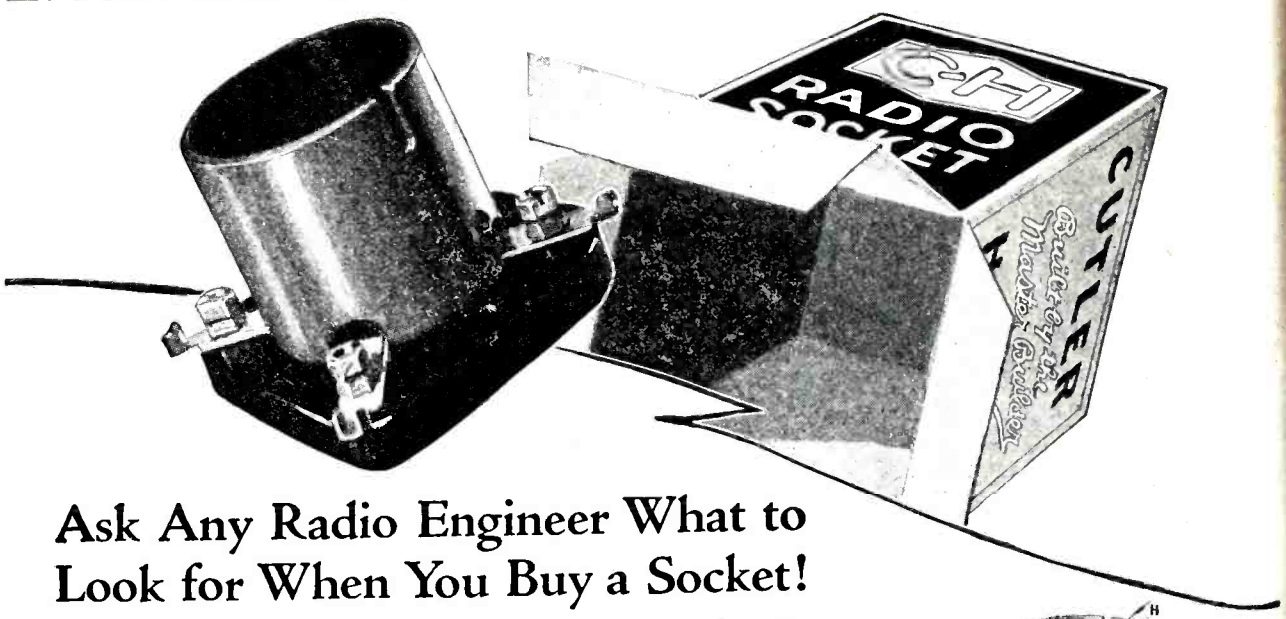
YOUR SET DESERVES DE FOREST TUBES

De Forest DV-3 Tube for use with Dry Cell Batteries.

THE original De Forest three-electrode vacuum tube was the first of many millions of De Forest tubes that have never been excelled in quality of workmanship, or performance. Today, as in the past, De Forest tubes are unsurpassed for giving volume and beauty of tone. They are non-microphonic. They can be used with all standard circuits. The DV-3 is for use with dry batteries, the DV-2 with storage batteries. They are guaranteed against defects in material and workmanship. Sold only by authorized De Forest dealers. Price, $4.00 each.

De Forest DV-2 Tube for use with Storage Batteries.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Ask Any Radio Engineer What to Look for When You Buy a Socket!

Radio experts are continually stressing the necessity of using good sockets. In some of the more sensitive circuits such as the Superheterodyne, poor sockets often completely destroy results. In fact, in thousands of sets today, with scores of different circuits, the so called "static" often mentioned, or "battery noises," are in reality merely the result of poor socket contacts—certain proof of dissipation of the feeble currents that we rely on for distant reception.

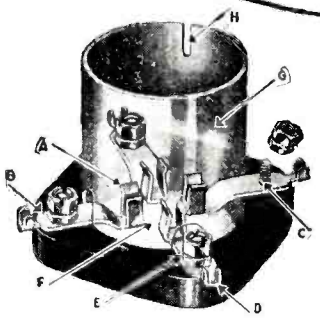
Minimum Dielectric Capacity

In the Cutler-Hammer Socket, designed by the same engineers whose precision rheostats and other radio current control apparatus have justly become world famous, every effort has been bent toward greatest efficiency. Custom has no consideration—and from its striking color scheme to its novel contact construction, the design is radically new.

Maximum Dielectric Resistance

It embodies a minimum of both insulation and metal; capacity absolutely minimized without sacrifice of mechanical strength. The insulation materials (shell of thin orange Bakelite and base of genuine Thermoplax) are ideal—high in quality and dielectric strength; low in dielectric capacity and losses. And all metal parts are widely separated, both in the insulation and in air to conserve every last bit of energy received.

Its contacts—the source of losses and noise in most sockets—are of entirely new construction. Each one is a springy clip that clinches the tube prong without strain; yet cleans it bright



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 screwdriver. 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.

"Built by the

C-H

The Perfect

whenever the tube is inserted or removed. These contacts are formed of phosphor bronze and *silver* plated—because the contact resistance of silver does not increase as it stands exposed to air. The area of contact is greater than that found in any other socket; and the construction is such that these feeble currents which mean so much in radio pass directly from the wire to the prong of the tube without meeting a single joint. *(In so many sockets the wiring is attached to a binding post to which the contact strip is in turn attached below. This presents a joint which causes noise and losses. The* C-H *Socket affords perfect connection even if the screw that holds the contact strip in place is entirely removed.)*

Silver Plated Phosphor Bronze Contacts

No Joints to Cause Noise or Losses

In this socket the tube is inserted and removed without turning—just pushed in and pulled out—to prevent twisting the bulb from its base. And the tube is held tight, absolutely rigid so that any vibration cannot cause contact noises. Its small size and convenient soldering terminals, too, mean a great deal in most sets for space is usually at a premium. The Thermoplax base is only 2 1/8" square—scarcely more than the diameter of the tube, and the soldering terminals extend out far enough from the rounded corners that they may be turned down for under-wiring when this system is used. These terminals have handy ears which are bent up to hold the wire while the solder is being applied—adding much to the ease with which this work is accomplished. For temporary connection, or where soldering is not used, a slotted hex-nut is provided which securely clamps the wire against the contact spring with either wrench or screw-driver.

Convenient and Efficient Terminals

No Twisting to Damage Tube

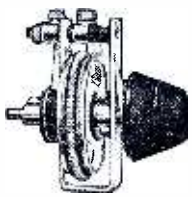
In all it is as perfect a socket as engineering skill can devise. It offers maximum efficiency and ease of installation, coupled with an appearance that adds much to any set. And best of all you will like the price, 90c. *This socket that meets the specifications of the most exacting radio engineer costs no more than most of those on the market today!* If your dealer has not been stocked, you can be supplied direct from the factory at list price plus 10c for packing and postage.

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

Master Builder"

C-H

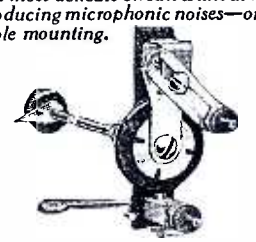
Instruments of Guaranteed Quality Assure Success in Radio



The C-H 4 Ohm Vernier Rheostat
Perfect detector tube control. Also furnished without vernier for amplifier tube control.

The C-H 30 Ohm Radio Rheostat
For control of the ¼ ampere, "UV-201-A-C301-A" type receiving tubes and the "UV199-C299" type; also made in 125 ohm size.

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.



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.

RADIO SOCKET

ATWATER KENT

LOUD SPEAKERS

THE smooth, mellow tones of an ATWATER KENT Loud Speaker will please you — you will be delighted with the fidelity with which it reproduces broadcasts.

It is a faithful sound reproducer, and re-creates the full overtones of voice and violin.

ATWATER KENT Loud Speakers have an adjustable diaphragm operated by a powerful magnet which has been thoroughly aged. The diaphragm is slightly dished and is clamped between rubber rings.

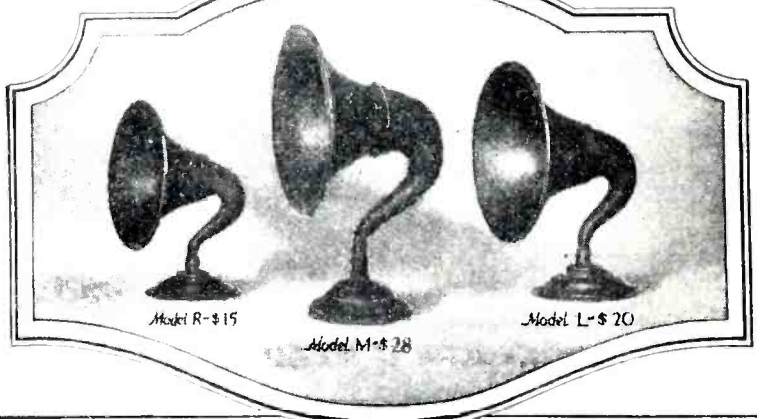
ATWATER KENT Loud Speakers are sturdily constructed from the fine operating mechanism to the heavy pressed steel bell. The base is substantial and is protected with a heavy felt disc.

The design and construction of the ATWATER KENT Loud Speaker is the result of painstaking research; of almost endless tests and experiments: — it sets a new standard in the production of loud speakers.

Everyone can now enjoy an ATWATER KENT Loud Speaker: — there are sizes and prices to meet every buyer's preference.

Descriptive literature on request

ATWATER KENT MFG. CO., 4933 Stenton Ave., PHILADELPHIA, PA.

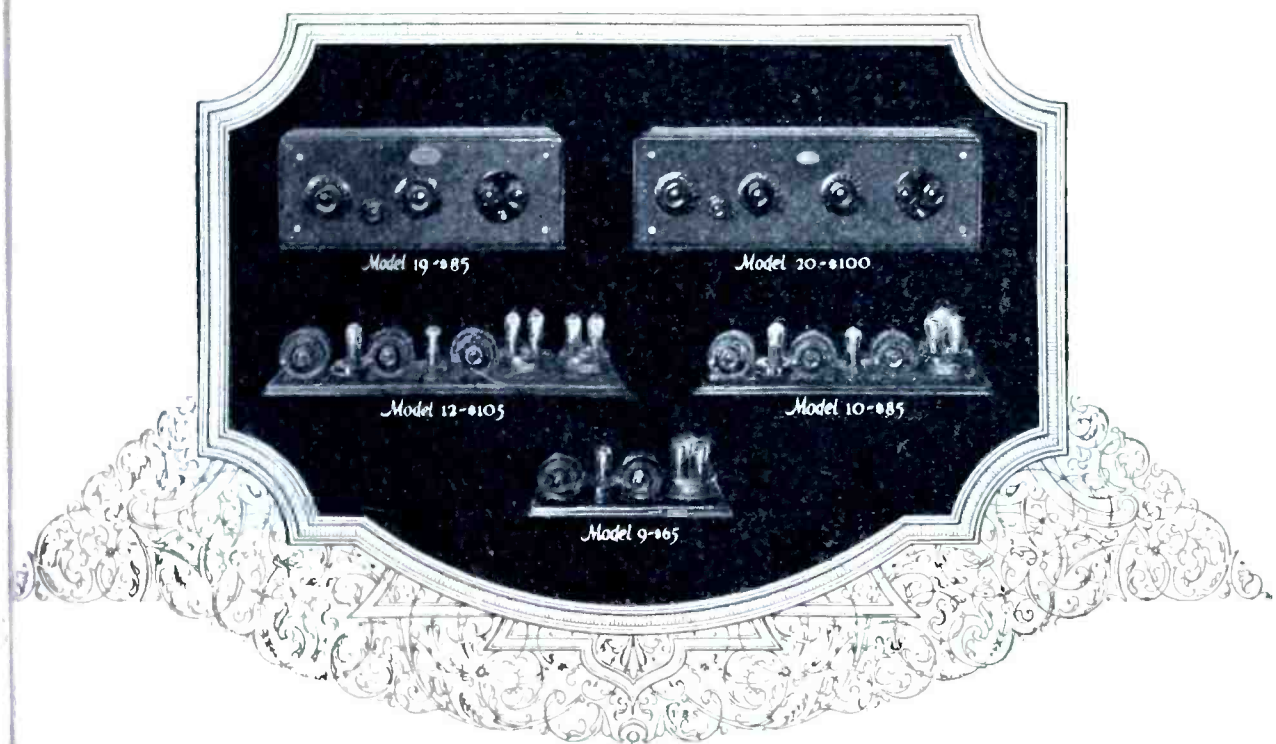


THINK OF WHAT IS BACK OF IT

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

ATWATER KENT

RECEIVING SETS



ATWATER KENT Receiving Sets meet the demands of the buyer who wants definite and uniformly dependable results; distance,—minimum of interference,—volume and clear reception.

The radio experimenter, tinkering with a thousand "hook-ups," finds fascination, but might experiment a life-time without achieving ATWATER KENT results.

No material can be better than is found in ATWATER KENT Radio—no workmanship is finer and it is the last word in Radio designing.

You must examine ATWATER KENT Radio to fully appreciate its value:—It is an outstanding example of quality produced on principles adhered to in the manufacture of scientific electrical instruments for more than a quarter of a century—

You can select any ATWATER KENT Radio Equipment—receiving sets or loud speakers and look forward to freedom from doubt as to the wisdom of your choice.

Instructive literature on request

ATWATER KENT MFG. COMPANY - 4033 Stenton Avenue - PHILADELPHIA, PA.

THINK OF WHAT IS BACK OF IT

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

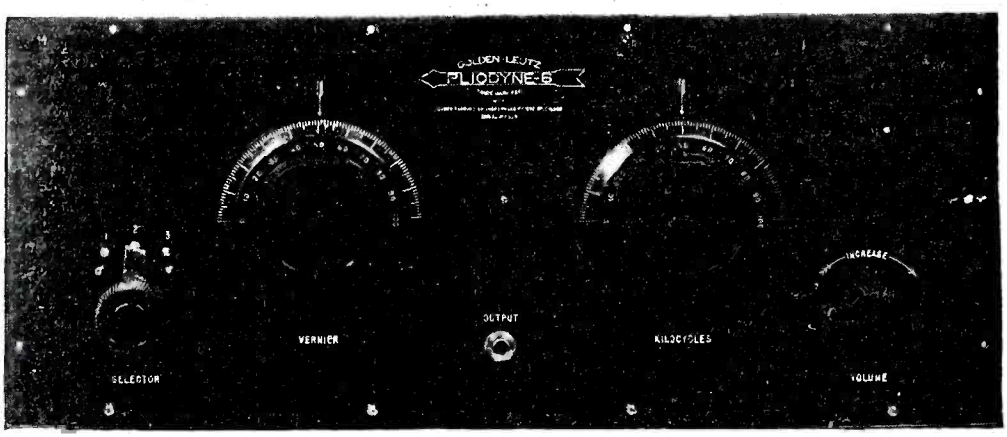
GOLDEN-LEUTZ
SUPER
PLIODYNE-6
SUPER
TRADE MARK REG.

"The Perfect Broadcast Receiver"

A New Superior Broadcast Receiver

SIMPLE - LONG RANGE - HIGHEST QUALITY
NON-RADIATING - NON-REGENERATIVE

Two Stages Tuned Radio Frequency—Detector and Three Stages of Audio Frequency Amplification.



PLIODYNE 6
Front View Showing Simplicity of Control

A New Marketing Plan

Rather than sell this high grade receiver to wholesalers at $190.00 less 50% discount we are going to sell it direct to you at wholesale, saving you $95.00 and at the same time giving you the finest set that can be bought for twice the amount.

Inspect the "Pliodyne 6" at Our Expense

We will send the "Pliodyne 6" C. O. D. transportation prepaid with privilege of inspection. If it does not appeal to you as the finest medium priced broadcast receiver you ever saw, return it to us at our expense.

Otherwise take advantage of

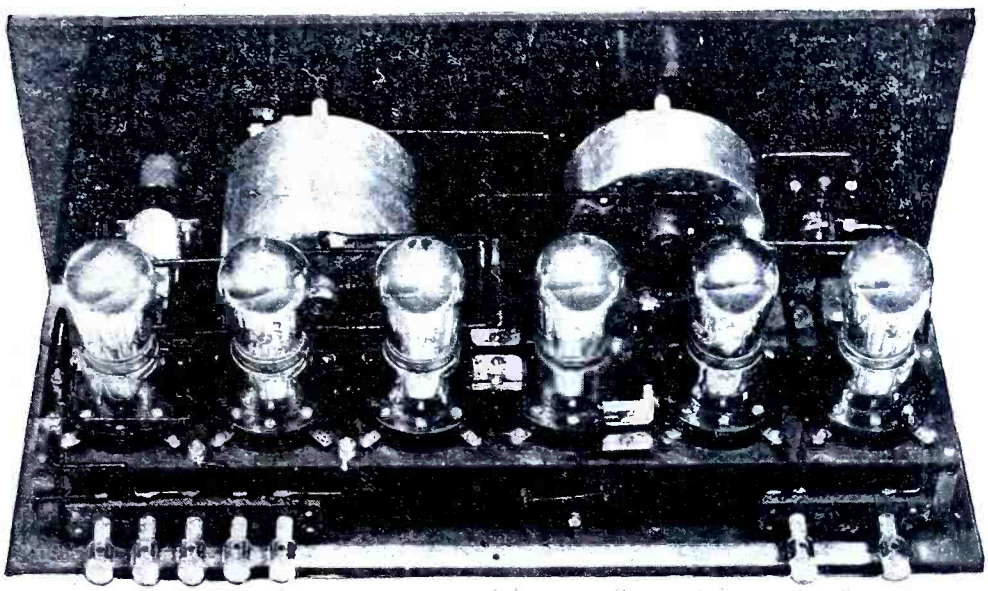
A FREE TRIAL

Accept the C. O. D. and try the "Pliodyne 6" for five days; if you are not satisfied in every way return it at our expense and we will return your money.

$95.00

Completely Constructed

Transportation Prepaid



PLIODYNE 6
Interior View Showing Compact and Efficient Design

OUR GUARANTEE.

We guarantee every Golden-Leutz "Pliodyne 6" to be the finest broadcast receiver that can be manufactured using 6 tubes or less and to be satisfactory to you in every way and to reach you in perfect condition.

You take no risk whatever in sending us your order, for unless you are completely satisfied with the receiver and with your saving, you may return the receiver to us and we will refund your money.

Address

GOLDEN-LEUTZ, Inc.

476 BROADWAY **NEW YORK CITY**

Licensed under Farrand Agreement and Hogan Patent No. 1,014,002

NOTE: We reserve the right to withdraw the Free Trial Offer if our Factory Production is exceeded. Golden-Leutz, Inc.

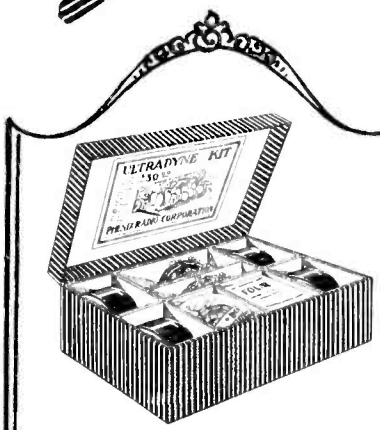
Another

Modulation System

The new Ultradyne, Model L-2, surpasses all conceptions of sensitivity and selectivity—represents the peak of Super-Heterodyne engineering skill.

To the "Modulation System," which has previously made the Ultradyne famous, regeneration is added in Model L-2. The result is ultra-sensitivity, never before thought possible. The regeneration of infinitely weak signals produces tremendous amplification.

Selectivity is so high and amplification so strong that distant stations can be tuned in through local stations and put on the loud speaker. A Loop or outdoor aerial may be used.

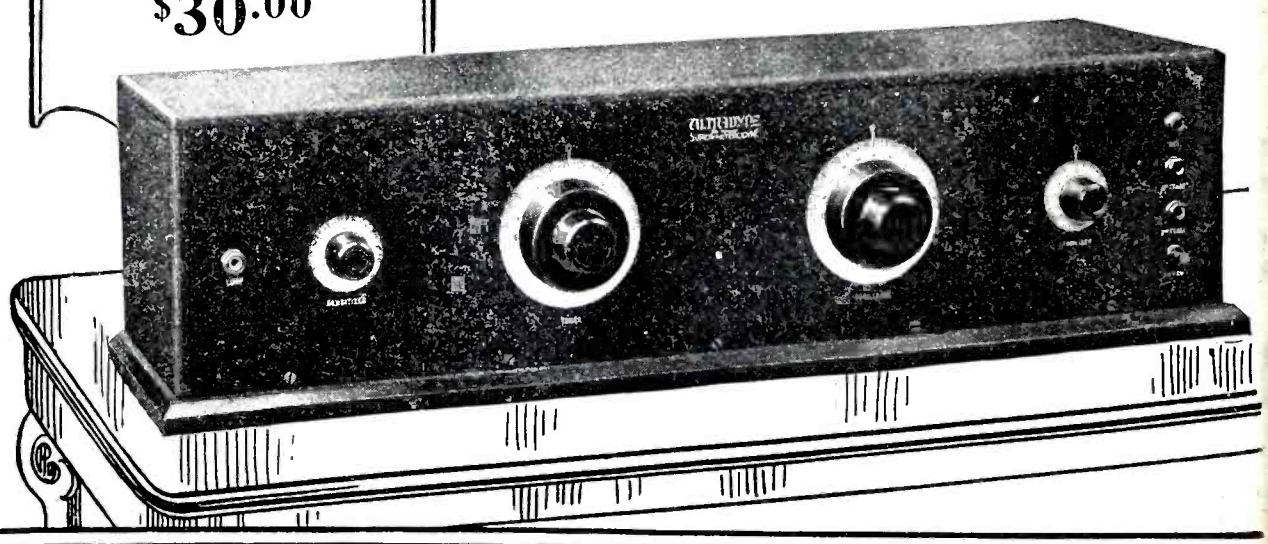


The ULTRADYNE Kit

consists of one low loss Tuning Coil, one low loss Oscillator Coil, one special low loss Coupler, one type "A" Ultraformer, three type "B" Ultraformers, four matched fixed Condensers.

The Ultraformers are new improved long wave radio frequency transformers, especially designed by R. E. Lacault, inventor of the Ultradyne.

$30.00



All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Step Ahead

ULTRADYNE
The Improved
SUPER-HETERODYNE
MODEL L-2

—plus Regeneration

This use of regeneration 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 Signal Corps Laboratories, since his perfection of the "Modulation System," which is used exclusively in the Ultradyne Receiver.

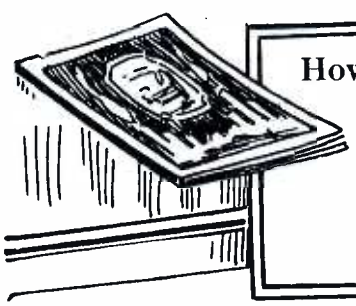
The Model L-2 Ultradyne compels so complete a revolution in all previous ideas of Super-Heterodyne performance, that you can only comprehend its unusual selectivity, sensitivity, volume and range by operating this wonderful receiver.

Write for descriptive circular

R. E. Lacault

whose signal knowledge of radio is founded on facts disclosed through research and experiments covering a period of over 12 years. For four years, he was Radio Research Engineer of the French Signal Corps which conducted field tests night and day, under most adverse conditions. Mr. Lacault is famed also for research on the first reflex amplifiers, and for extensive experiments with short wave wired radio and radio compass equipment—of which the "Modulation System" is the outcome. He is considered one of the greatest radio technicians of the age.

To protect the public, Mr. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers. All Ultraformers are guaranteed so long as this seal remains unbroken.



How to Build and Operate Model L-2 Ultradyne

Send for 32-page illustrated book giving latest authentic information on drilling, wiring, assembling, and tuning the Model L-2 Ultradyne Receiver **50c**

PHENIX RADIO CORPORATION, 7-9 BEEKMAN ST., NEW YORK CITY

Here with a Loaf of Bread beneath the Bough
A Flask of Wine, A Book of Verse—and Thou
Besides me singing in the Wilderness—
And Wilderness is Paradise enow.

OMAR KHAYYAM

MELCO SUPREME RECEIVER

Tuned Radio Frequency

A five tube receiver that embodies every feature demanded by the most discriminating enthusiast for perfect radio reception. The Melco Supreme really amazes in its performance any time and any place.

Your dealer will be glad to demonstrate.
Ask for our literature. It's interesting.

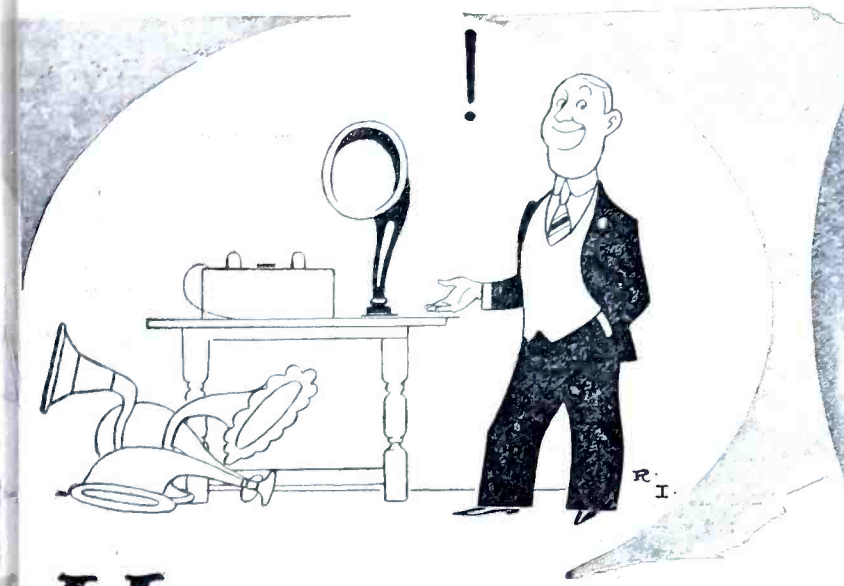
MELCO

AMSCO PRODUCTS INC.

Broome & Lafayette Sts. New York City.

AMSCO

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Hear the difference!

A loudspeaker is a critical thing. Any vibration in the horn adds sounds that nature never gave to the speaker's voice. And limited range thins down the tone to flat, unreal quality. Some people think that a near-real voice is the best that radio can give . . . but not after they have heard a Radiola Loudspeaker!

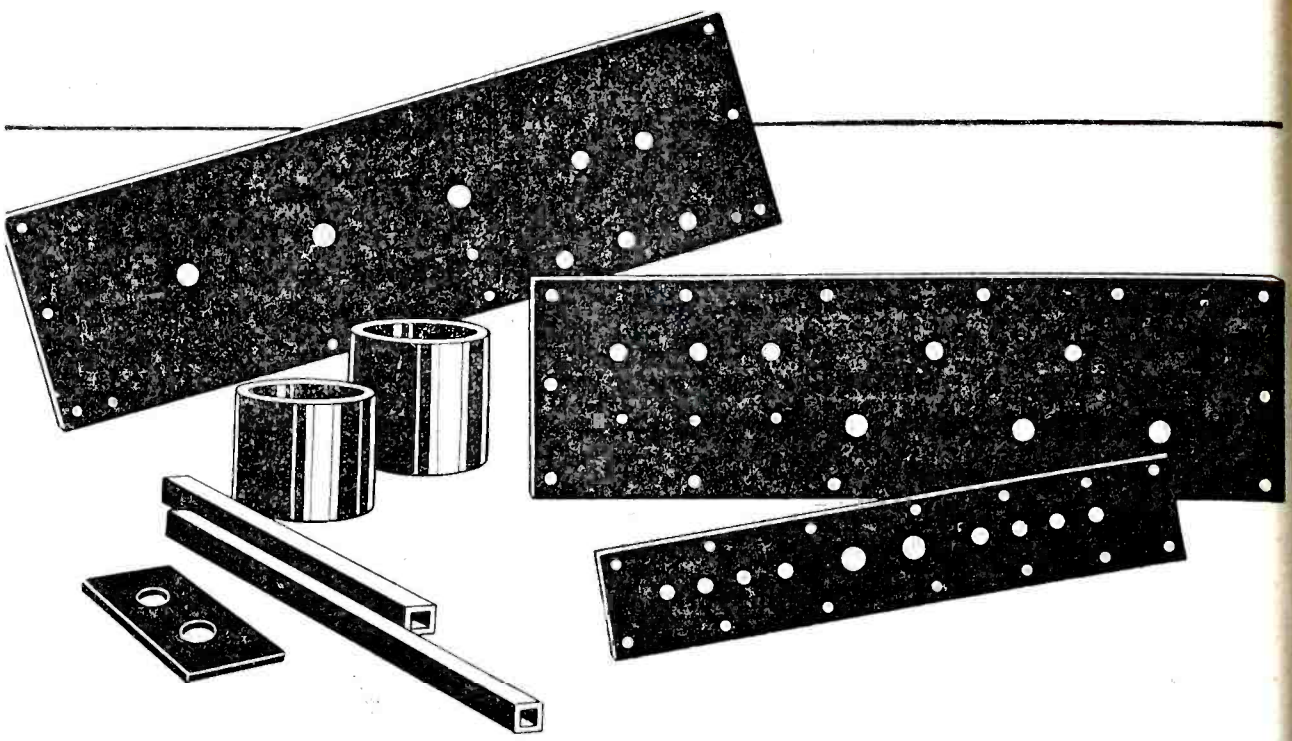
The difference is the result of elaborate experiment and extended scientific study. The Radiola Loudspeaker has an extraordinary range—gets the full richness of tone. And it adds no sound of its own. To know how clear—how mellow—how *real* your music can be—ask to hear a Radiola Loudspeaker.

Radiola Loudspeaker
Type UZ-1325
Now $25.00

This symbol of quality RCA *is your protection*

Radiola
REG. U. S. PAT. OFF.
LOUD SPEAKER

RADIO CORPORATION OF AMERICA
Sales Offices:
233 Broadway, New York
10 So. La Salle St., Chicago, Ill.
28 Geary St., San Francisco, Cal.



Why is Formica the leading radio insulation?

THE demand for Formica for radio insulation has forced the building of the largest plant in the world for the production of laminated bakelite—and the only plant in the world devoted exclusively to this one product. This year 60,000 feet of floor space have been added to assure everyone prompt service.

This volume has been built up because Formica production under close laboratory control has provided the most uniform, best looking, and most easily worked material. It is used by 125 leading radio manufacturers who have tested all materials and who know that Formica is best!

There are four beautiful finishes: Gloss black, dull black, walnut and mahogany. Formica will not sag under the weight of condensers and other instruments: it will not cold flow under the pressure of screws and binding posts; its insulating strength gets better with age.

It is being used by many manufacturers for front panels; base panels; terminal strips; transformer cases; condenser ends; for jack, head phone and loud speaker insulation.

Dealers: Formica advertising and sales promotion will be greater this year than before. No other product is so well known for quality.

THE FORMICA INSULATION COMPANY

4641 Spring Grove Avenue, Cincinnati, Ohio

Sales Offices

50 Church St., New York, N. Y.
422 First Ave., Pittsburgh, Pa.
1042 Granite Bldg., Rochester, N. Y.
419 Ohio Bldg., Toledo, Ohio
1210 Arch St., Philadelphia, Pa.
1026 Second Ave., S. Minneapolis, Minn.
585 Mission St., San Francisco, California
Whitney Central Bldg., New Orleans, La.
516 Caxton Bldg., Cleveland, Ohio
9 S. Clinton St., Chicago, Ill.
708 Title Bldg., Baltimore, Md.
47 King St., Toronto, Ontario

FORMICA

Made from Anhydrous Bakelite Resins

SHEETS TUBES RODS

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

For use Indoors Anywhere!

A Revelation in Radio Reception

PUT up a real indoor antenna—hook it to your set, and *enjoy* Radio. You'll get better results because Talking Tape has all the good qualities of an efficient outdoor antenna and none of its faults.

And it's so easy to install—put it indoors anywhere, behind a door, around the moulding, in a closet—the results will be a revelation in selectivity and quality of reception.

One dollar for 100 feet—a big dollar's worth measured in satisfaction, service and sightliness.

MAXIMUM SURFACE—MINIMUM BULK

Ask for it at your Radio Dealer's Today

REG. U.S. PAT. OFF. TRADE HOPE MARK MADE IN U.S.A.

Manufactured by

HOPE WEBBING COMPANY

For Forty Years

The World's Largest Manufacturers of Electric Tapes

PROVIDENCE, R. I.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

PRECISE Transformers for Best Results

in the

Cockaday New Four Circuit Tuner

PRECISE TRANSFORMERS were chosen by Mr. Cockaday for his latest and greatest achievement.

There's a reason!

Model 285A—$5.00

PRECISE TRANSFORMERS are unequalled for producing volume without the slightest distortion.

Mr. Cockaday, one of the foremost radio engineers of America, has surpassed everything he has previously done and his latest wonderful achievement is coupled with the PRECISE TRANSFORMER.

Millions of radio fans have read of this new development in Popular Radio and the leading newspapers of the United States and Canada.

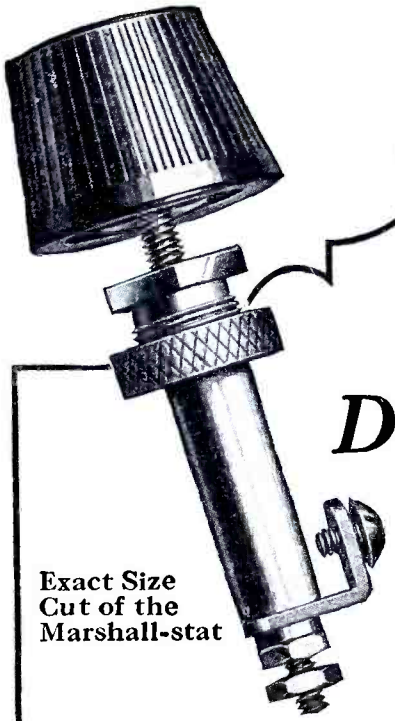
THIS MEANS ONE THING—an enormous demand for PRECISE TRANSFORMERS that may *cause you* delay unless you get your order in now.

Write, wire or 'phone.

PRECISE MANUFACTURING CORPORATION

Rochester, N. Y.

Branches: 53 W. Jackson Blvd., Chicago, Illinois; 821 Market Street, San Francisco, Calif. *Eastern Sales Office:* Niagara Sales Corp., 3-5 Waverly Place, New York, N. Y. *Canadian Distributors:* Perkins Electric, Ltd., Toronto, Montreal, Winnipeg. *Southern Representatives:* Saal Products Sales, Inc., 35 Warren St., New York, N.Y.



Exact Size Cut of the Marshall-stat

Marshall-stat

Do You Want to Hear More Stations?

Getting more stations with the equipment which you have is largely a matter of adjustment on your tubes.

Then why not use the smoothest accurate-adjustment rheostat you can get—the Marshall-stat?

You will find in the Marshall-stat a means of obtaining any desired adjustment with absolute precision. The Marshall-stat varies the resistance, not step by step, but smoothly, continuously, and uninterruptedly from zero to maximum.

The Marshall-stat provides vernier precision throughout its entire range. Yet, there is only one knob to manipulate—no troublesome double adjustment to make.

It brings new stations to your receiving set and clears up for you the stations which you hear only occasionally and at those times indistinctly.

Without having to drill additional holes, any one can install Marshall-stats in his receiving set, whether it is home-made or factory made. And wherever Marshall-stats are used, the pleasure and fun of radio are enormously increased.

ADVANTAGES of the Marshall-Stat

Requires only one hole in panel. Can be inserted in hole from which old rheostat is removed.

Vernier all the way—but only one adjustment to make.

Only two terminals. Connections cannot be made incorrectly.

Can be used with any tube or combination of tubes.

Compact in size. (Note full size cut above). Takes up very little space. Can be fitted anywhere.

Working parts entirely enclosed in nickel-plated chamber.

Knob can be replaced with the knob of your set. Only one special screw (furnished at nominal extra charge) needed to make change.

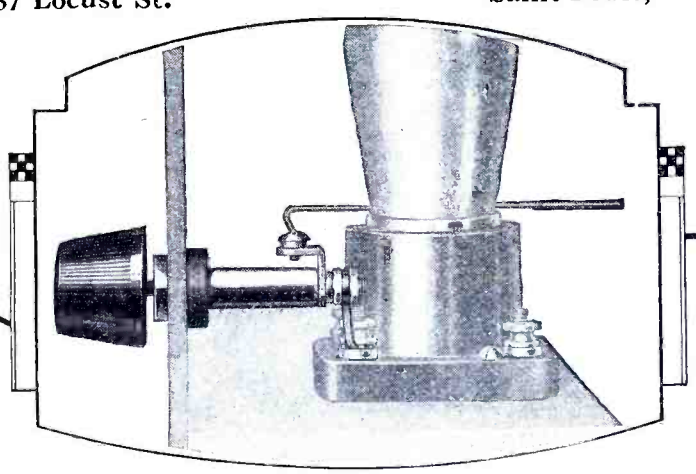
Discs made of specially-treated material which is the result of years of experimental and research work by radio and electrical engineers. Are absolutely uniform throughout.

Mechanical construction and proportions of discs are such that breakage is impossible.

Price $1.75

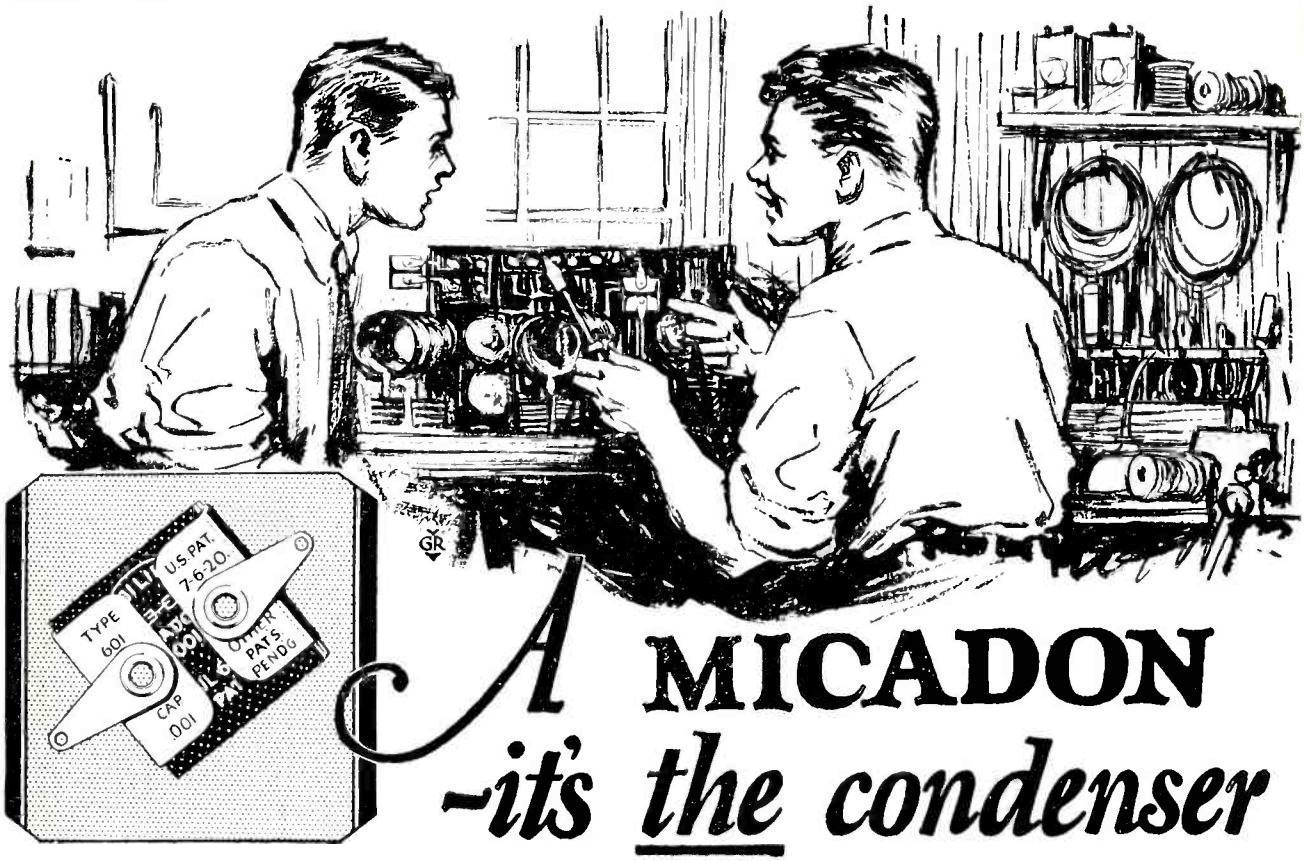
MARSHALL ELECTRIC COMPANY

3237 Locust St. **Saint Louis, Missouri**



Send for Old Man Ohm's descriptive folder on the Marshall-stat

THE IDEAL RHEOSTAT FOR ALL TUBES



A MICADON -it's *the* condenser

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.

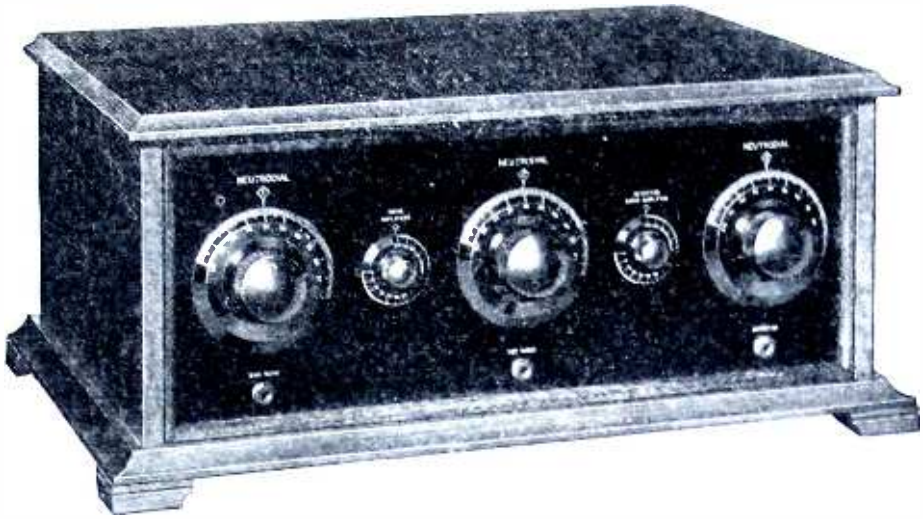
The preference of all these fans and experts has made Dubilier Micadons the Standard.

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



"The air holds no secrets from an Adler-Royal Neutrodyne"

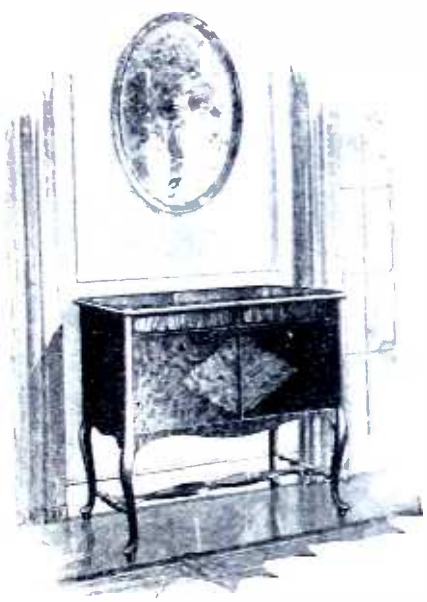
THE Adler-Royal Neutrodyne not only eliminates necessity for technical knowledge, but its range and selectivity are remarkable.
Several outstanding points of superiority of Adler-Royal Neutrodyne are:
Extreme Selectivity—due to the special type of condensers.
Automatic filament control—Adler-Royal Neutrodyne automatically lights the tubes needed.
Freedom from re-radiation—Adler-Royal will positively not become a sending station itself.
Clear amplification—Distant stations can be brought in clearly on the loud speaker without exaggerating interfering noises.
Wired like finest telephone switchboard The workmanship of Adler-Royal is not only a delight to the ear but to the eye as well.
No detuning necessary—separate control for audio and radio frequency. Every Adler-Royal is equipped with two separate binding posts; one for short and one for long aerials.

ADLER MANUFACTURING CO. General Sales Office, 881 Broadway, New York
Factories: Louisville, Kentucky

The Adler-Royal Franchise is Valuable

WE invite correspondence from reputable dealers in territory where we are not adequately represented.

The Adler-Royal is on exhibit only at higher class stores, whose reputation is an additional guarantee of the Adler-Royal line



Adler-Royal Combination Radio and Phonograph
Royal Cabriole—Model 10, in either walnut or mahogany.

Adler-Royal
NEUTRODYNE

Adler-Royal equipment may be purchased by partial payment if desired.

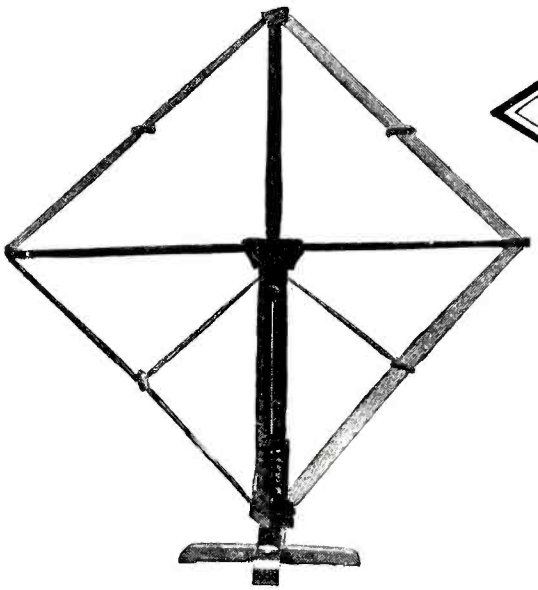
Licensed by Independent Radio Manufacturers Inc. Reg U.S. Pat Off. NEUTRODYNE Reg U.S. Pat Off. Pat March 27 1923 and April 1, 1924 Hazeltine Pats. Nos 1,450,080 and 1,489,228 Other Patents Pending

The Adler-Royal Neutrodyne is licensed under the Hazeltine Neutrodyne patents, granted to King-Hinners Radio Company

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

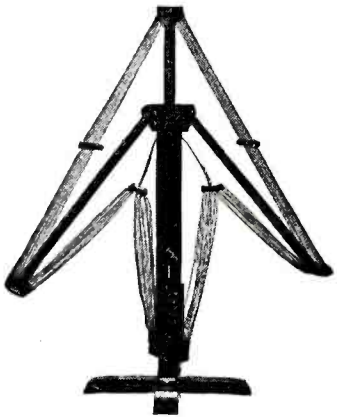
THE AMPLIFEX LOOP

A Revolution and a Revelation In Loop Construction



AMPLIFEX

Trade Mark
Pat. App. For



The AMPLIFEX LOOP collapses by simply turning a thumb-nut in the center.

Wound with 40 strands No. 38 Double silk covered enameled Litz wire. Has a compass in the base for directional adjustment. Size when extended 39 ins. wide and 43 ins. high.

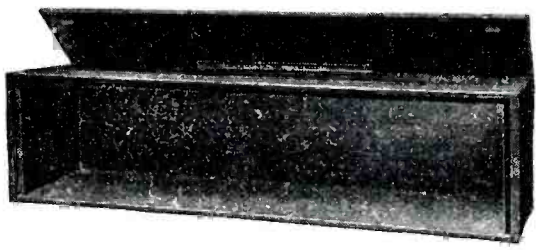
The Amplifex Loop by a series of six numbered binding posts can be tapped for six possible combinations giving 3, 4, 6, 9, 10 and 13 turns with a wave length range of 88 meters to 1,000 meters, **without any dead-end losses.** The most important and revolutionary factor in loop construction.

PORTABLE - DIRECTIONAL - EFFICIENT - LIST PRICE, $18.50

We have some territories still open on an exclusive basis to interested Jobbers

Manufactured by the

AMPLIFEX RADIO CORPORATION, Arlington, Mass.



Quality Cabinets

—Priced Exceptionally Low Because We Sell Direct to You

No radio cabinet on the market compares with our style "A" model, pictured above, for beauty and high quality. And you save amazingly on every size, buying right from the maker. Compare prices and see for yourself.

Genuine Cuban Mahogany, beautifully finished Front rabetted to fit panel. Nickel-plated piano hinges. Built to resist any climate.

Size	Unfinished	Finished
7 x 10 x 7	$1.95	$2.60
7 x 12 x 7	2.10	2.75
7 x 14 x 7	2.25	2.90
7 x 18 x 7	2.40	3.05
7 x 21 x 7	2.55	3.20
7 x 24 x 7	2.70	3.35
7 x 26 x 7	2.85	3.50

By "finished" is meant a waxed, rubbed finish.

Unfinished and unassembled, if desired, at still lower prices.

Cabinets shipped promptly on receipt of purchase price.

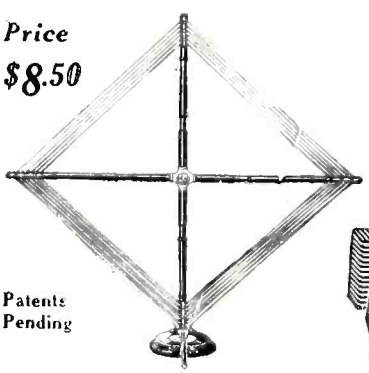
Bulletin showing our complete line of cabinets, sent on request.

A. HALL BERRY

71 Murray Street **New York**

Duo-Spiral Folding Loop

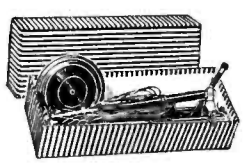
Price $8.50



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.*

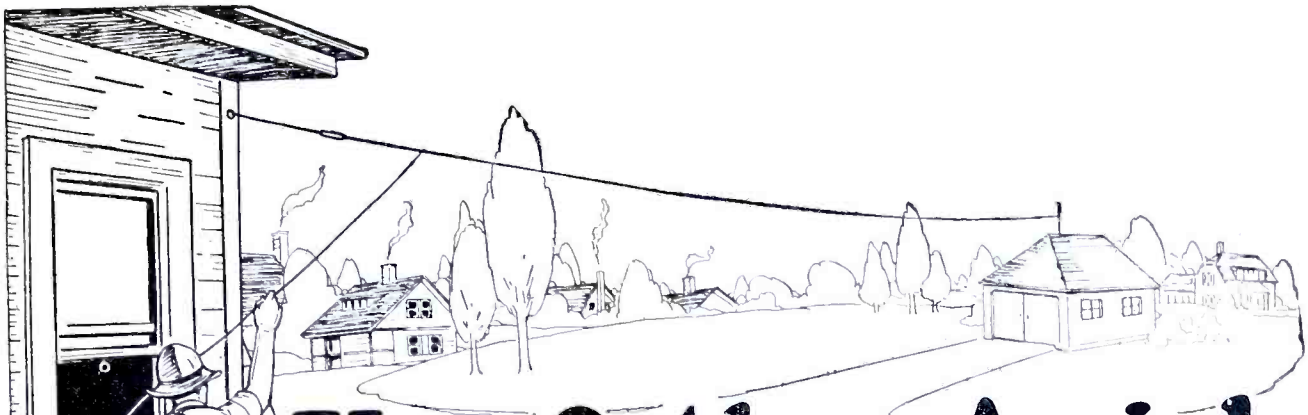
TINY-TURN

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.



Your Outdoor Aerial Should be *Enameled*

Smoke, grime and moisture attack the outer surface of ordinary bare aerial wire. The corroded surface introduces resistance in the aerial circuit, because high-frequency currents flow along the surface of conductors. This means that ordinary aerial wire deteriorates as soon as it is installed, and its resistance to radio-frequency oscillations increases daily.

Beldenamel Aerial Wire is coated with several layers of weatherproof, corrosion-proof enamel. Its conductivity does not change, because the Beldenamel coating keeps the wire surface bright and shiny. With a Beldenamel Aerial, your signal strength remains constant from year to year, other things remaining the same, and does not weaken through increased aerial resistance. Tests made by U. S. Bureau of Standards establish the superiority of enameled aerial wire.

Get all the facts in our latest booklet, "Helpful Hints for Radio Fans." Read how to install an outdoor aerial and how to increase your range with Beldenamel Aerial Wire. It's free! Use the coupon.

Magnified Section of Aerial Wire

Sold Through Dealers Only

Other Belden Radio Products

Belden Radio Products, sold in distinctive cartons, include insulated or shielded hook-up wire, magnet wire, battery cords, loop and litz wire, sockets, headset cords, tips and terminals and dozens of other items.

Belden

Manufacturing Company

2316 S. Western Ave. · Chicago, Ill.

DEALERS! Attach the coupon to your business letterhead for complete dealer information on the Belden Line of Radio Products.

Free Booklet!

Belden Manufacturing Company
2316 S. Western Ave., Chicago, Ill.

Please mail me, *free*, your new booklet —"Helpful Hints for Radio Fans."

Name _____

Address _____

_____

Perfect Results On The Super-Heterodyne with the marvelous M.&H. Superformers & Precision Selector

What Fans say about them

"All DX Stations, including West Coast, easily heard on 4-foot loop." *A. W. Parkes, Instructor Physics, Lafayette College.*

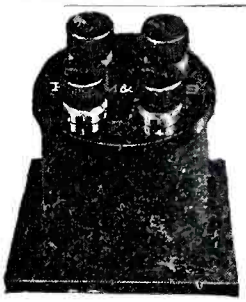
"Here at last is a Super-Heterodyne I can recommend to my dealers." *Henry M. Neely, Radio in Home for March.*

"Reproduction perfect. Speech and music heard 200 feet from speaker. Have heard many sets, operated thirty, but there is only one real set—your 8-TUBE SUPER-Het." *Drue Allman, Holmesburg, Phila.*

"Logged 30 distant stations in 3 hours first time used set." *H. F. Rollmann, 1973 Diamond St., Phila.*

M.&H. Superformer and Precision Selector are two wonderful Radio Parts that simplify and make Super-Het perfect. Give Selectivity, Volume, Distance, clarity never possible before. Dials always log. No squeal, no distortion.

Utilize Your Old Parts—Build Your Own Set



M. & H. Superformer

$7

Designed especially for Super-Heterodyne for amplification at 6,000 meters, for use with UV-201A, C-301A, DV-2, UV-199, C-299 tubes.

Small in size, minimum "feedback." Carefully insulated for voltage greater than ever used. Guaranteed.

Booklet giving description and Plan how to build Super-Heterodyne. Mailed 25c

M. & H. Precision Selector $10

The marvelous Selectivity, Long-distance reception, etc., of M.&H. Super-Het are due to this scientific instrument. No adjustment. Last indefinitely. Hard rubber case. Illustrations one-half size.

Complete Parts for 8-Tube Super-Heterodyne Set, Special $96.50

With Booklet giving full description and plans. Postage prepaid.

Dealers Write for Proposition

MOSKOWITZ & HERBACH
512 Market St., Philadelphia, Pa.
Established 28 Years

America's Best Phones

Regardless of Price

$5

One Model
One Quality
In Canada, $7

WE challenge comparison with America's best known headphones. Globe Phones always show up best where the opposition is greatest. And the quality is there to last for years.

There is long experience in making hearing aids for the deaf behind the amazing tone purity and reaching qualities of Globe Phones.

As beautiful as they are efficient. Leather covered head bands, heavily nickeled parts, extra powerful magnets.

If your dealer fails you, write us.

Sales Department
THE ZINKE COMPANY,
1323 S. Michigan Ave., Chicago

Manufactured by
GLOBE PHONE MFG. COMPANY
Reading Massachusetts

Stop Tube Noises

BENJAMIN CLE-RA-TONE SOCKET

CLEARER RADIO TONE

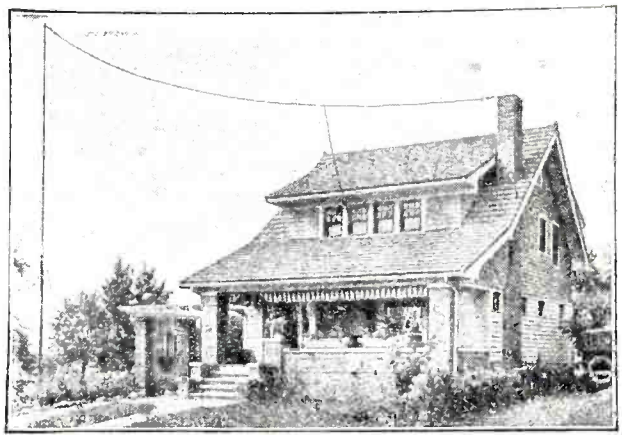
Shock absorbing. Tube holding element "floats" on perfectly balanced springs. Takes up all jar and mechanical vibrations which interfere with clear reproduction. A vital necessity for and used by leading makers of portable sets. Made of molded Bakelite. Underside of base provided with smooth bosses for accurate mounting. Contact springs keep tube prongs clean. In two sizes, for standard and UV-199, etc., tubes.

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.
120 S. Sangamon St., Chicago
247 W. 17th Street, New York
580-582 Howard Street, San Francisco



The 40 Ft. Hercules Mast in Yard

The HERCULES Aerial Mast

This mast is made in sizes to get 20 Ft., 40 Ft. or 60 Ft. clearance and is the answer to an efficient aerial system. What is more, this graceful mast is an improvement to any property, whether it is installed on the roof or in the back yard. It can be erected in a few minutes. It is shipped knocked down for convenience in handling. All parts are made of steel and are light and strong.

LONG RANGE RADIO RECEPTION

It has been said time and again that the best results are obtained only by the intelligent use of the best apparatus procurable. This is an oft repeated statement, but the more it is propounded the truer it becomes and applies not only to the receiving equipment proper, but also to the antenna system. This applies most emphatically to receivers of the crystal detector type and to non-regenerative audion outfits. THE AERIAL MUST BE EFFICIENT if the reception of long distance stations theoretically within range of the receiver, is desired.

PROPER AERIAL CLEARANCE

Very few novices realize the importance of a good aerial installation. The feeble currents from long distance stations will never reach the receiving set if the aerial is strung too close to surrounding objects that tend to absorb the energy. It is with this interference that we have experimented for years—and present the answer—THE HERCULES AERIAL MAST.

20 Ft. Hercules Mast on Roof

HAVE BUILT RADIO TOWERS FOR YEARS

For years we have been building radio towers for important broadcasting stations.

20 Ft. Mast $10
40 Ft. Mast $25
60 Ft. Mast $45

PREPAID

Order from this "Ad" if you wish.

Included among the names of our customers is THE UNITED STATES GOVERNMENT SIGNAL CORPS.

Only after years of experience and development work have we been able to perfect this wonderful steel aerial mast to sell at a price within reach of the amateur.

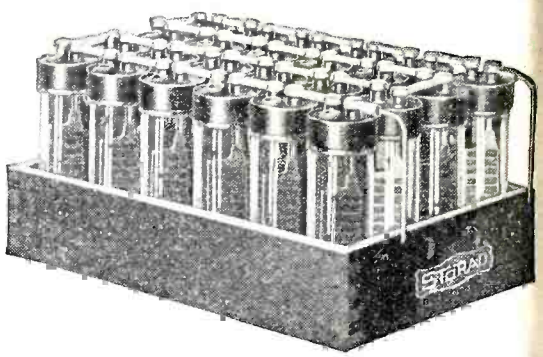
GIVE YOUR SET A CHANCE

Not only will the proper aerial clearance thus obtained, give you the supreme pleasure of long distance radio reception, but the appearance of this beautiful mast on your property will give you a reputation. This reputation will grow as you bring in stations such as you, yourself, never dared hope for.

MAIL POST CARD for full particulars and literature about the HERCULES Aerial Mast.

S. W. HULL & CO. Dept. B
2048 E. 79th St. Cleveland, Ohio

STORAD



Storage "B" Batteries

Built to meet the service requirements of all multi tube sets. Storad engineers know storage batteries and how to build them for radio use.

Combination wood and perforated rubber separators; special exclusive screw rubber caps; heavy glass jars; extra heavy plates—full $\frac{5}{16}$" thick; large acid capacity; burned on connectors; 4½ amp. hr. (4500 M.A.H.) capacity; are the Storad features.

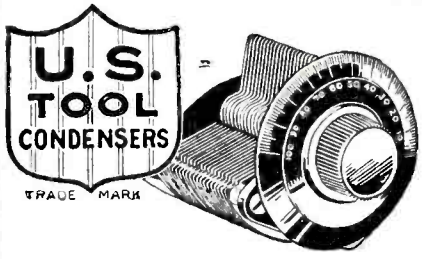
Storad "B" batteries are built in two sizes—24 and 48 volt units.

No. 4524—24 volt unit
No. 4548—48 volt unit

Insist on Storad Products

Protect yourself against inferior battery products by demanding Storads from your dealer. The Storad line consists of "A," "B" and "C" batteries and "B" battery charger. Circulars sent on request.

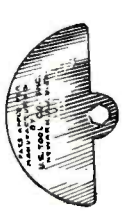
The Cleveland Engineering Lab. Co.
2129 Superior Viaduct, N.W. Cleveland, O.



Point Numbe Two

New Hexagon Shaft

The Second of Five Unique Features



The rotor blades, stamped with hexagon hole, are gripped tightly by the hexagon shaft, preventing fanning of rotor blades. Found in four new types—types 3 (plain) and 4 (all-vernier), celoron end plates; types 5 (plain) and 6 (all-vernier), low loss—metal end plates. Ask to see them at your dealer's.

100% GUARANTEED

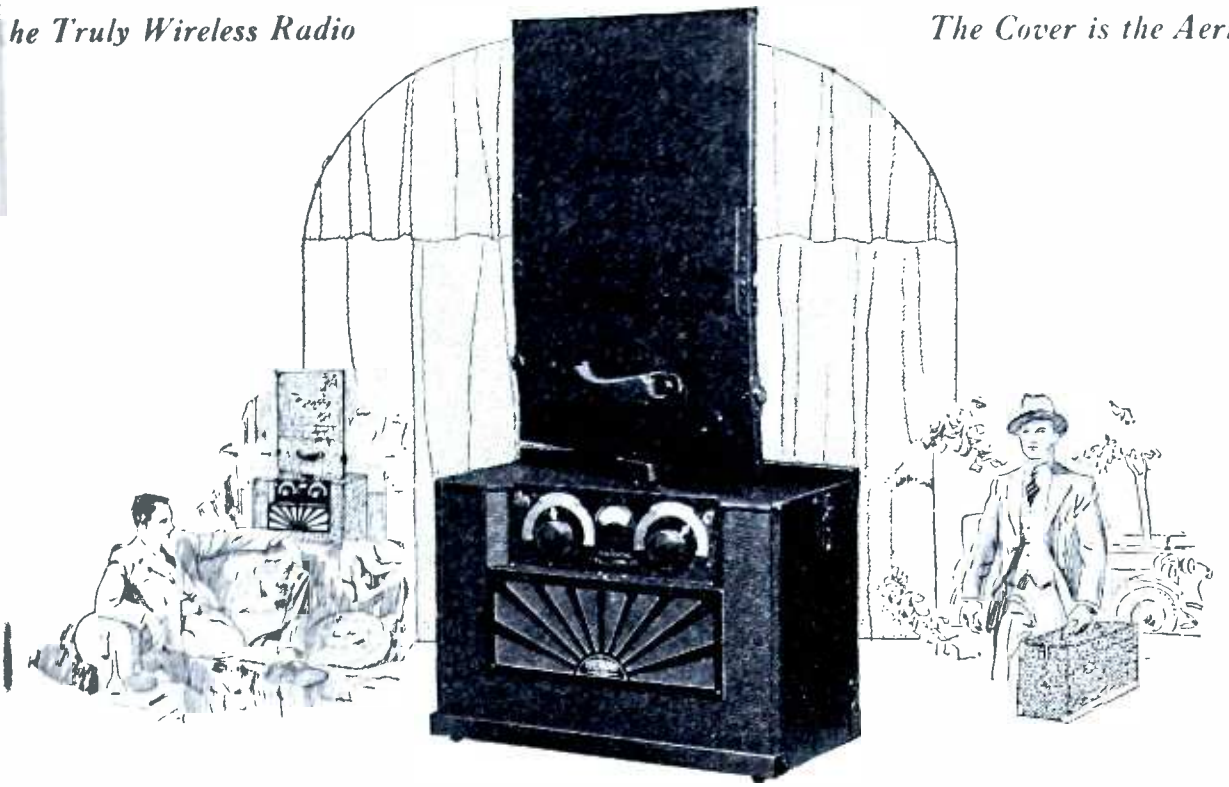
Write for Literature

U. S. TOOL COMPANY, INC.
112 Mechanic St., Newark, N. J.

Mfrs. of special tools, dies, jigs automatic machinery and sub presses.

Presenting The 1925 Operadio

he Truly Wireless Radio *The Cover is the Aerial*



The Original Self-Contained Radio Set

With many revolutionary improvements and a new application of the Cascade Radio Frequency Circuit (capacity compensated)

he 1925 Operadio develops still further the unique radio idea—a radical departure in radio design.

Operadio engineers set for themselves task—to produce a radio set of the nest efficiency, to give it beauty worthy any surroundings, to do away with the d of external wires or connections and design it in so compact a form that it be easily carried anywhere.

ntroduced last year, the Operadio ated a country wide sensation. Many busands are now in use. In the new del all the former features are retained he loud speaker, six tubes, dry cells l all parts are fitted into a compact inet and the necessity for aerial and und is eliminated by a patented wave-dge located in the cover. To these are ded new refinements and no less revolu-nary improvements.

The 1925 Operadio ideally fulfills every need for an easily operated, reliable, long range home set—complete and ready for instant operation and easily taken with you anywhere.

The 1925 Operadio is marked by extreme beauty of appearance and efficiency of performance. The wave band is expanded to include reception from radiocast stations of all wave lengths. Utmost simplicity of tuning—only two controls. Razor-sharp selectivity.

The remarkable efficiency of the set is due to the perfected application of cascaded radio frequency amplification, capacity compensated. For example, the set contains removable radio and audio units. In each of these are hermetically sealed all the finely adjusted parts in perfect and unchanging balance, thereby insuring absolute uniformity of performance and virtually eliminating the possibility of damage.

There are many additional exclusive features—a specially designed condenser with planetary disc control, safety fuse for tubes, "A" and "B" battery tester, space for largest size "B" batteries, etc. Write at once for particulars.

The Operadio Corporation, 8 South Dearborn Street, Chicago

Dealers: Write on your letterhead for our sales proposition and full particulars about the 1925 Operadio.

OPERADIO

MAIL THIS COUPON

The Operadio Corp.,
8 So. Dearborn St., Chicago, Ill.

Please mail me complete particulars about the 1925 Operadio.

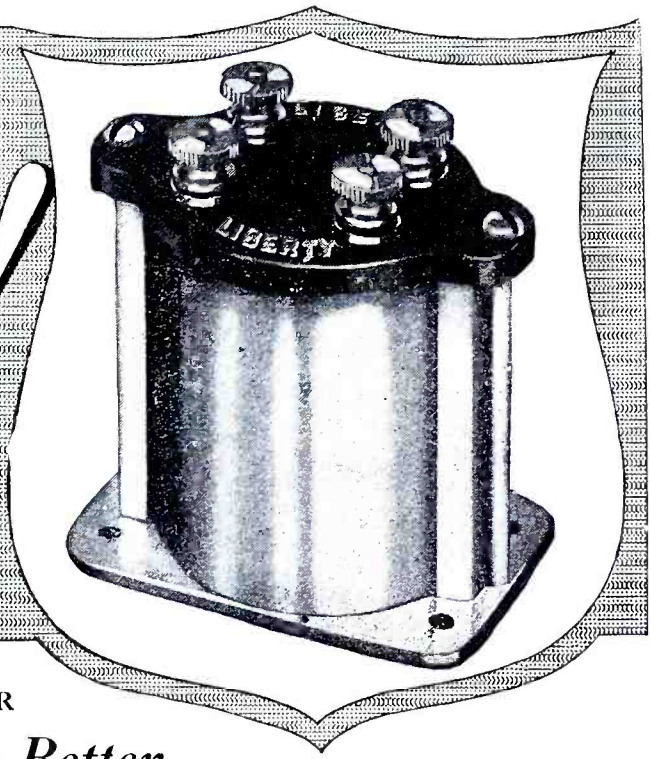
Name .....

Street .....

City ..... State ..

Clear Tone!

ossible with other ransformers; Certain ith LIBERTY



LIBERTY
AUDIO FREQUENCY TRANSFORMER

akes Any Good Set *Better*

Your money back if it fails to do so

take the time to build a transformer erly. We can afford to, because the ERTY is naturally so economical and le in design that all materials and kmanship can be the best obtainable at price.

BERTY TRANSFORMER CO., Inc.
N. Parkside Ave., Chicago

SHOPPING LIST

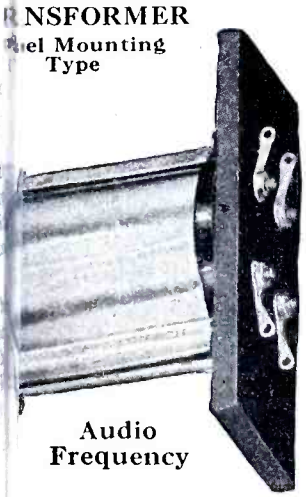
Obtain these goods from your dealer or postpaid from factory at price listed:

LIBERTY AUDIO FREQUENCY TRANSFORMER

Base Mounting Type	Panel Mounting Type	Ratio	Price
L-5	L-20	3 to 1	$4.50
L-6	L-21	5 to 1	4.75
L-8	L-22	9 to 1	4.75

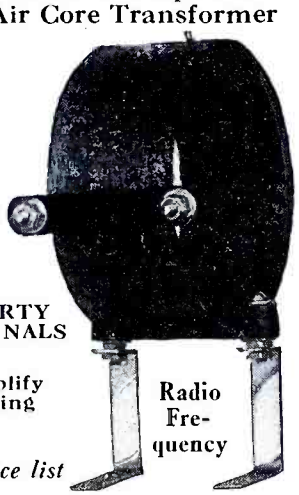
SPECIAL AIR CORE RADIO-FREQ. TRANS. $1.50
LIBERTY SEALED FIVE RECEIVER, mounted in handsome walnut cabinet 100.00
LIBERTY TERMINALS per dozen 10
per thousand 4.00
Booklet, "Choosing the Right Radio" . . . . . FREE
Folder, "Liberty—the Key to Clear Tone" . . . . FREE
(Describes construction of Liberty Transformers.)

IBERTY
NSFORMER
el Mounting Type



Audio Frequency

LIBERTY Special Air Core Transformer



LIBERTY TERMINALS
Simplify Wiring

Radio Frequency

See price list

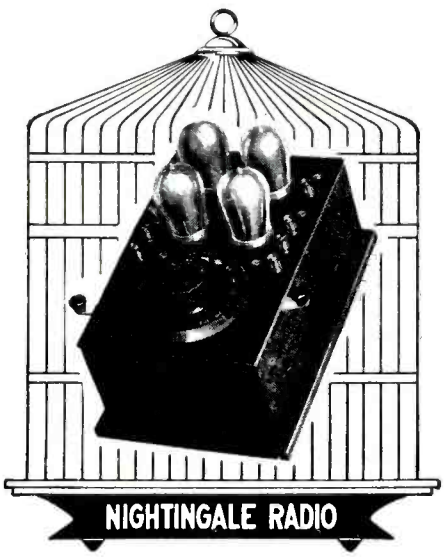
This is the LIBERTY Sealed Five receiver. (See free booklet listed above.) Liberty Transformers give it amazing tone quality.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Hansen "BIRD-CAGE" Radios

NIGHTINGALE RADIO

4 Tube Radio Set Without Accessories **$32.50**



A simplified, loud speaking, long range set at a price within the reach of all.

Hansen BOBOLINK. 2 Tube Reflex	$25.00
Hansen CARDINAL. 3 Tube Reflex	$50.00
Hansen BLUE BIRD. 4 Tube Radio Frequency	$57.50

AMERICAN EAGLE. This we believe to be the best high grade 6-tube loop set on the market today.. **$150.00**

E. D. Nunn RECEIVERS

4 tube very selective..... **$90.00**

6 tube loop..... **$135.00**

Write for New Catalogue

Dealers and Jobbers—Our line is interesting and profitable

RADIO DEPARTMENT
HANSEN STORAGE CO.
"THE MILLION DOLLAR WAREHOUSE CO."
120-134 JEFFERSON ST., MILWAUKEE

Perfection HYDROMETER

If it's a good hydrometer, it's a PERFECTION

A glance instantly gives condition of your battery.

It's in the float. If the name PERFECTION is not on the float it is not a genuine PERFECTION.

Look for the name "PERFECTION" — it represents supreme quality in a hydrometer.

Abutments in nozzle preserve clear air passage and prevent clogging and leaking. Float studded to prevent sticking.

Every detail is perfected to give the Radio set owner the finest hydrometer obtainable.

$1.00 At All Radio Dealers

Bemco Manufacturing Company
243 W. 55 St.
N. Y. City

Genuine Miller-B-Metal Crystal

Loud Alive

Miller-B-Metal is the extremely sensitive metal you hear about. Every spot is a real "hot-spot"—the loud-talking crystal.

Ideal for all crystal and reflex work. Made in 3 types of crystals ranging in price from 50c to $1.00. Money refunded without question if not satisfied.

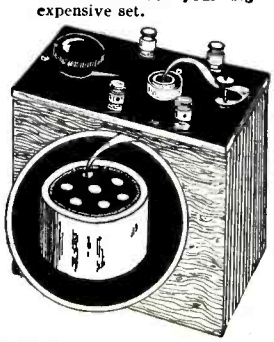
Also other Miller Products illustrated in catalog — sent on request.

Order from your dealer or direct from factory

The A. H. Miller Radio Co.
1216 20th St., Detroit, Mich.

Special Set $1.79

Equipped with Miller-B-Metal $1.00 Crystal this set gives wonderfully clear volume up to 600 meters. A fine set to own for local work and saves your big expensive set.

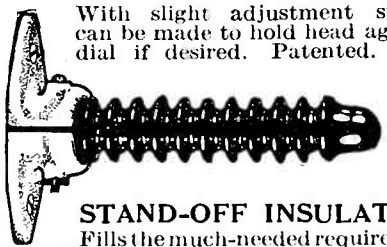


All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Fleron
RADIO SPECIALTIES

VERNIER ADJUSTER

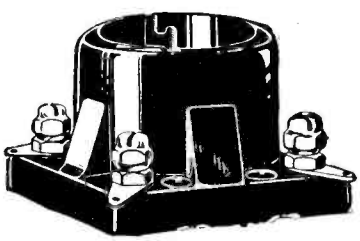
The best adjuster on the market. Spring holds head away from dial when not in use.



With slight adjustment spring can be made to hold head against dial if desired. Patented. 65c.

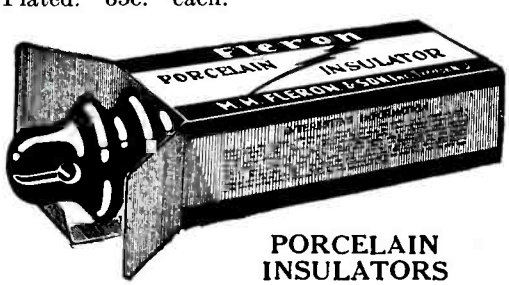
STAND-OFF INSULATOR

Fills the much-needed requirement for a strong, good-looking and practical stand off insulator. Meets every requirement of the Board of Fire Underwriters. $1.25 each.



PORCELAIN SOCKETS

Lowest losses of any socket. Very carefully made. Black Body, Black Glaze. Side and bottom contact springs of reinforced phosphor Bronze. Solder Tabs. Cap Nut for screw driver or Spintite Wrench. All parts nickel Plated. 65c. each.

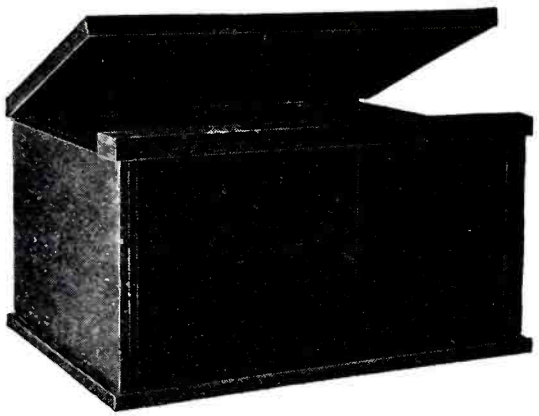


PORCELAIN INSULATORS

Lowest power losses in the antenna Dialectric absorption reduced to minimum because of very low phase difference of Fleron Porcelain. Very tough body. Solid Black Glaze. Seven sizes, 20c to $1.00. Each insulator in a separate carton.

For Sale by all Good Jobbers and Dealers

M.M. FLERON & SON, Inc.
TRENTON, N.J.



RADIO CABINETS
Strong and Rigid.

Remember that we pay mail and express charges—it makes quite a difference when c o m p a r i n g prices.

Specifications

Hardwood, rubbed mahogany finish. Top hinged, ends of top spleined to prevent warping.

Panel size	Depth	Price
7 x 14	10	$3.00
7 x 18	10	3.25
7 x 21	10	3.50
7 x 24	10	3.75
7 x 26	10	4.50
7 x 27	9	5.00
7 x 28	10	6.00

Mail and express prepaid East of the Mississippi River.

We also make Radio Desks and Tables.

Send for free catalogue.

THE SOUTHERN TOY COMPANY, Inc.
Dept. P. Hickory, N. C.

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.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

EVEREADY
Radio Batteries
–they last longer

EVEREADY RADIO BATTERIES FOR EVERY RADIO USE

Each one supremely economical and efficient for the use for which it is designed—each one made under the supervision of the world's greatest electro-chemical battery laboratory

Eveready "B" Batteries

THERE are Eveready Batteries for portable sets where small size and light weight are more important than long life. There are Eveready medium size batteries that come between the small and the large sizes. There are Eveready large size "B" Batteries that afford maximum economy and reliability of service when used with average one, two, three or four tube sets. And now there is a newer Eveready heavy duty, extra large size "B" Battery that gives similar economy to owners of multi-tube heavy drain receiving sets and power amplifiers.

For maximum "B" Battery economy, buy Evereadys, choosing the large sizes (Nos. 766, 767, 772) for average home sets, and the heavy duty, extra large (No. 770) for multi-tube heavy drain receiving sets and power amplifiers. For portable sets choose the Eveready No. 764 medium size, unless space is very limited, in which case choose the Eveready No. 763 small size "B" Battery.

Eveready "C" Battery

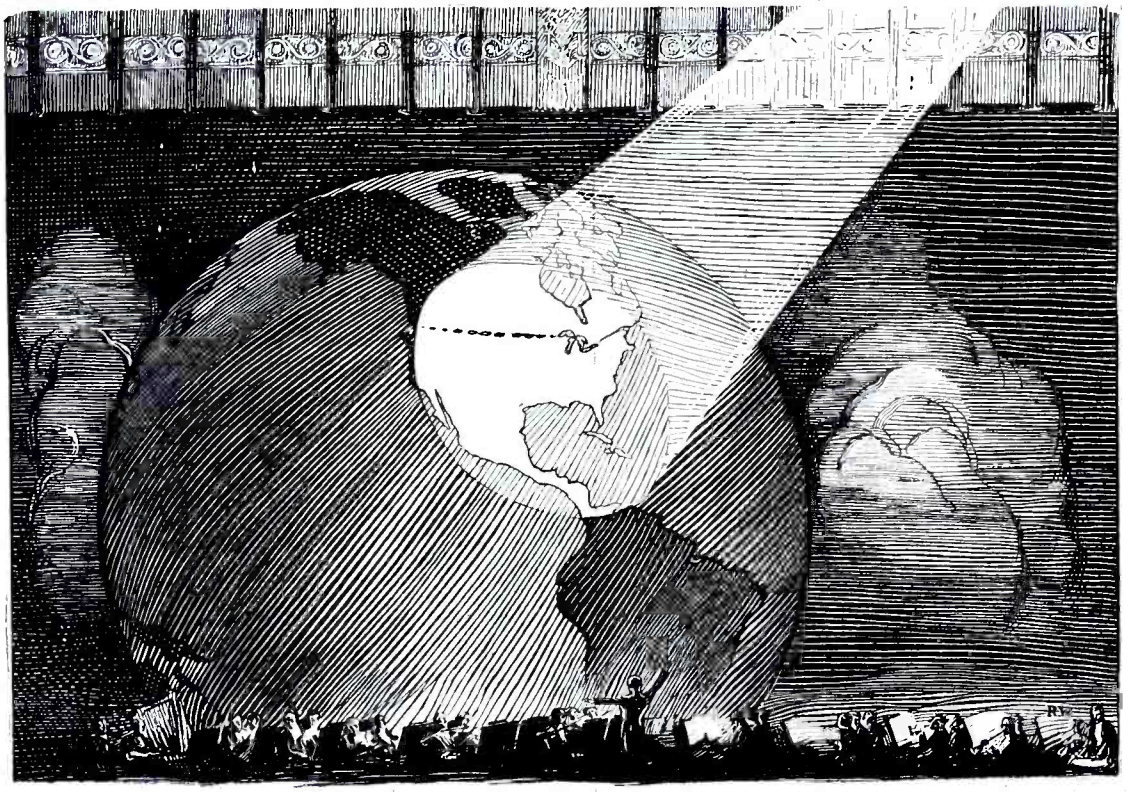
Eveready makes a long-lasting "C" Battery with terminals at 1½, 3 and 4½ volts. May also be used as an "A" Battery in portable sets.

Eveready "A" Batteries

Eveready offers you "A" Batteries for all tubes, both storage and dry cell. For storage battery tubes, use the Eveready Storage "A." For dry cell tubes, use the Eveready Dry Cell Radio "A" Battery, especially built for radio use.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

BUY THEM FROM YOUR DEALER



When the Curtain Rises on the World's Entertainment

WHETHER you settle down comfortably to enjoy some special event or just to taste the casual pleasures of the ether, the *Mercury* Receiver holds up a faithful mirror before the original studio performance.

The ethereal whisper of a violin, the mighty rushes of an orchestra, the lyric loveliness of a precious voice and the reedy depths of a great organ—*all* music is reproduced by the *Mercury* with an impartial fidelity very new in radio.

MERCURY RADIO PRODUCTS CO. ~ 50 CHURCH ST., NEW YORK CITY

Visit your dealer or write direct for De Luxe Catalog

TECHNICAL

Highest existing development of Grimes Inverse Duplex System. Four tubes reflexed and equal to six straight (two tuned radio frequency, tube detector and three stabilized audio frequency). Operates from loop (furnished) also indoor or outside antenna *without change in set*. "Last word" low-loss engineering at every point.

MERCURY

BROADCAST RECEIVER

Licensed under Grimes Patents — issued and pending

"The STRADIVARIUS *of* RADIO"

APPEARANCE

Solid American Walnut Cabinet. Hand rubbed *genuine* piano finish. Inclined panel of heavy-gauge, etched ordnance bronze. Set rests on rubber protecting buttons. Balanced panel arrangement of controls. All "A" and "B" dry batteries self-contained. Price, with loop; but *without* tubes and batteries, $165.00 list.

INVERSE DUPLEX SYSTEM ~ INSURES NATURAL TONE QUALITY

THE NEW MODEL C-7 SUPER-HETERODYNE

Important Today

"The Rolls-Royce of Reception"

THE EXPERIMENTERS INFORMATION SERVICE, Inc., has been recommending the Super-Heterodyne method of reception since the early part of 1922. In February, 1923, a Super-Heterodyne of our design was installed on the S. S. *Western World*, pier 1, Hoboken, N. J., in the cabin of Dr. Horatio Belt. On the voyage to Rio de Janerio, Brazil, at a distance of 3,000 miles, southeast of New York, the entire Greb-Gardner fight was received from WJZ, with sufficient audibility for the entire cabin full of passengers to hear the bout, blow by blow, plainly. At 3,300 miles southeast of New York, an entire evening church service was received from Pittsburgh. At that time there was not another single firm advertising or advocating the Super-Heterodyne. Since then Mr. A. Ancieux, Engineer, Trarivia Elec de Arequipa, Arequipa, Peru, has reported consistent reception from KDKA, WDAP, WEAF, WGY and others, a distance of over 5,000 miles, using a Model "C" Super-Heterodyne. The Pratt & Brake Corp., of New York City, sent a Model C to Rio de Janeiro which received American broadcast station at a distance of over 7,000 miles.

Practically all concerns now featuring Super-Heterodyne have copied our original Model C design, and to prove again that we are far in advance of competition, we present this Improved Model C-7 Super-Heterodyne as the *Most Sensitive*, *Most Selective*, and finest reproducing Broadcast Receiver that can be built.

MODEL C-7 SUPER-HETERODYNE

Wave-length Range, 200 to 575 meters. Dimensions, 40 in. x 8 in. x 8 in.
Tube Arrangement: Regenerative Detector, Oscillator, 2 Stages Radio, Detector, 2 Stages Audio

7 Tubes Give the Results of 10

The Reason: — When regeneration is added to a one tube non-regenerative receiver, the increased amplification is about equal to adding two stages of tuned radio frequency amplification. Heretofore it has been impossible to add regeneration in the 1st Detector of a Super-Heterodyne and accordingly this has been a big loss.

The new Model C-7 Super-Heterodyne has a special 1st Detector circuit with a split antenna inductance so arranged that normally the detector would oscillate continually. However, in addition, a neutralizing condenser is inserted in the circuit which gives absolute control of the oscillations to such an extent that the circuit can be adjusted to just below the oscillating point, as this adjustment gives the maximum regenerative amplification. The new circuit has a bias potential on the 1st Detector grid, in place of the usual grid leak and condenser, and this allows infinitely weak signals to be regenerated and heterodyned through the radio frequency amplifier, which an ordinary grid leak and condenser would block. On a weak signal the difference in sensitivity is very noticeable. Using a 22-foot indoor antenna in the suburbs of New York loud speaker reception has been obtained from KGO, Oakland, California. A normal range of 2,000 miles is easily obtained on an average small antenna at night under average conditions.

General Information

ANTENNA: Single wire, 30 to 150 feet long. Provision has been made for use of either a short or long antenna. Indoor antenna works very satisfactorily.

TUBES: 7 Radiotrons UV201A or C201A, requiring one 6 volt storage battery and one 90 volt B Battery either dry or storage.

DRY CELL TUBES: Radiotrons UV199 or C199 may be used if desired, but the results obtained with dry cell tubes are not as satisfactory as with the Radiotrons UV201A or C201A.

LOOP: As a loop takes considerable space and is objectionable looking, and furthermore an inefficient collector, no provision has been made for loop reception. Local reception can be had without antenna or ground. An indoor antenna 30 to 50 feet long is suggested in place of a loop.

SELECTIVITY: The degree of selectivity is so high that distance stations can easily be tuned in through the local stations. For example, with a C-7 located five miles from WJZ operating on 455 meters, WCAE Pittsburgh on 462 meters can be tuned in without interference with WJZ.

TUNING: There are only two tuning adjustments, one for the detector circuit and one for the oscillator. Each station has a definite point on each dial and will always be found at these calibrations. Individual Verniers are provided for each dial. A third Vernier controls the volume.

CONSIDERATIONS: The Second Harmonic feature could be used with a view to eliminating another tube, but we feel that the many advantages of having a separate oscillator more than compensates for the extra tube. For a similar reason we have refrained from Reflexing the circuit to reduce the number of tubes.

STANDARDIZATION: All the component parts specified are readily obtainable on the market through high-class dealers.

PARTS: The parts specified in this design are all selected with expert consideration with a view to giving the maximum results obtainable. While it may appear that certain other parts could be used to economize, we strongly recommend that you take advantage of our engineering experience and follow the specifications to the letter.

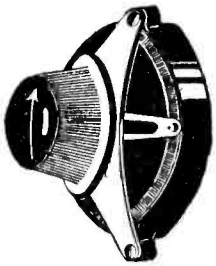
Original Blue Print showing all data, diagrams, circuits, details, etc., $1.00, postpaid

EXPERIMENTERS INFORMATION SERVICE, INC.

476 BROADWAY, NEW YORK CITY

Designers of the Highest Class Radio Apparatus in the World

New Book, "Modern Radio Reception," by Charles R. Leutz, over 250 Pages, over 150 Illustrations, Fully Bound, $3.00 Postpaid



Cico Bakelite Rheostat

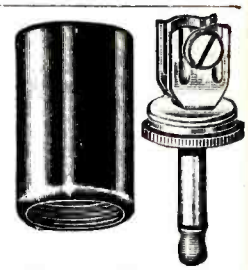
One point mounting. Binding post connections. Vernier or plain types, 6-10-20-30 ohms. Absolutely uniform resistance. Plain, $1.35. Vernier, $1.50.

CICO

RADIO PRODUCTS are *UNQUALIFIEDLY* GUARANTEED against all defects

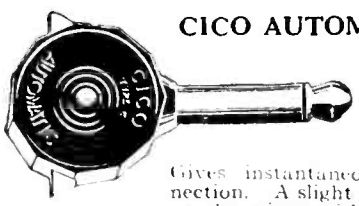
Look for the distinctive GREEN CICO BOX

Consolidated Instrument Co. of America
41 East 42nd St, New York



Cico 2-Way Plug

Two sets of headphones or loudspeaker and one set of phones may be connected simultaneously. Fits all standard jacks. Takes all types of tips. Price, 40c.



CICO AUTOMATIC PLUG

Gives instantaneous connection. A slight pressure on the wings with thumb and index finger releases tips for change. Bakelite body. Metal parts nickle-plated. Takes all tips. Price 75c.

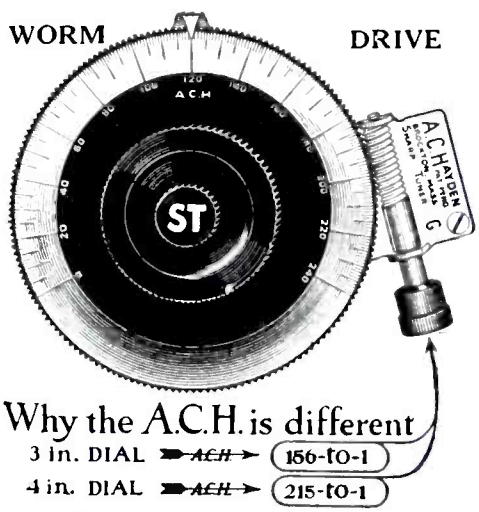
CICO BAKELITE JACK

Something entirely new. An improved new principle. Moulded completely from bakelite. No metal in frame construction. Short springs of special phosphor bronze which is non-corrosive. No soldering. Sterling silver contact points assure perfect contacts. Scientifically perfect in every detail. Unusual in design and value. Something well worth all the pride you will take in it.

No. 30-Single circuit open $.80
No. 31-Single circuit closed .85
No. 32-Double circuit..... .90
No. 33-"A" Battery Switch .90

A Pleasant Surprise Awaits the User of the A.C.H. Tuning Instrument

WORM DRIVE



Why the A.C.H. is different

3 in. DIAL ~~A C H~~ 150-TO-1
4 in. DIAL ~~A C H~~ 215-TO-1

Use on Instruments you already have.

Money Back Guarantee

Price 3-inch size....$2.50 Price 4-inch size....$5.00
Regular fitting 5/16 shaft ¼ and 3/16.....5c each extra

Extra Advantage of the A C H

1. Can be attached or removed from any instrument.
2. Rough tuning same as any dial.
3. Movement so fine that the eye cannot detect but the ear can.
4. Automatically locks instrument so no jar can disturb it.
5. Dial grounded reducing the body capacity to a minimum.
6. Special dial 2 graduations where ordinarily one.

MAIL ORDERS SENT PREPAID IN U. S. A.

A. C. HAYDEN RADIO & RESEARCH CO.
25 E. Battle St., BROCKTON, MASS., U. S. A.

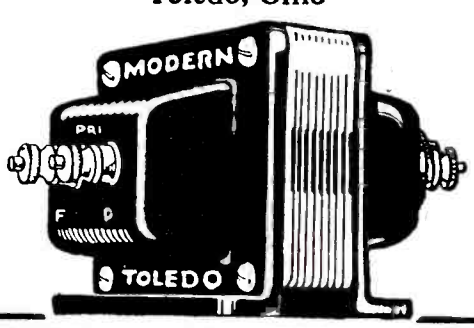
MODERN Super-Six Reflex

This is the peer of all Reflex circuits. It works on a loop. Months of laboratory tests were made by MODERN engineers before the MODERN Radio Frequency Transformers used in this Super-Six circuit were offered the Radio world.

This circuit has three stages Radio Frequency and three stages Audio Frequency. Uses crystal detector.

Large size wiring diagram mailed on receipt of 4c. in stamps. Send today.

The Modern Electric Mfg. Co.
Builders of Transformers Exclusively
Toledo, Ohio

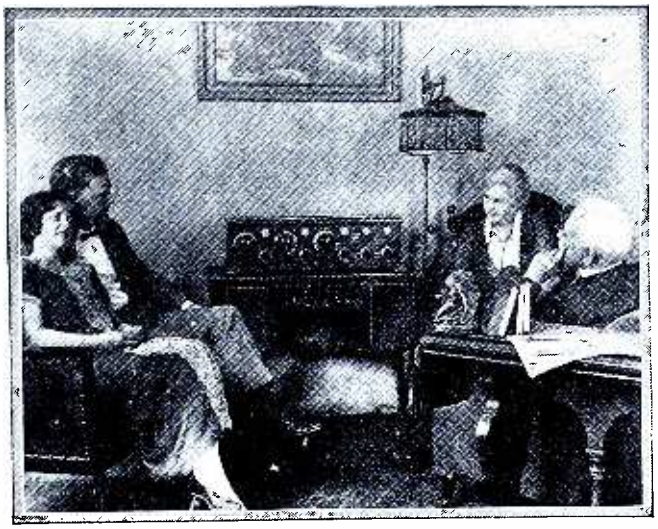


All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Radio Without the Horn!

Goodbye to the Old-Fashioned Horn Speaker!

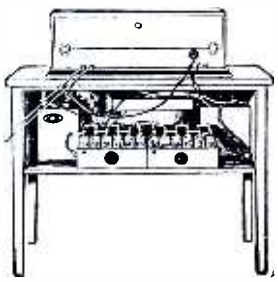
A Vastly Better Reproduction With this New Radio Console!



"Our old horn speaker never gave tones like this! An artistic addition to the living room—everything in its place—it's a joy."

New Console Has Its Own Perfect Loudspeaker!

Ample Space for All the Rest of Your Outfit!



HERE is something that enables you to enjoy radio in the home without the clutter of unightly apparatus that plays havoc in the decorative scheme of your living room! The horn peaker is out of date and out of place in radio or the home. This console with its in-built oudspeaker is scientific and sightly.

A Truly Wonderful Tone

It does a better job of reproducing, for it has he best unit of all that have been tried and its ound-box is of resonant wood instead of metal, ibre, or composition.

The appearance of a Windsor loudspeaker con- sole is a delight. Its convenience is a joy. A piece of real living room furniture of pleasing ines and finish—and it accommodates all the miscellany of equipment which hitherto had no place except on table tops, shelves or floor. Ample space on top for any set, with plenty of elbow room in front. Nothing in sight but the dials. Everything else goes inside—from behind—in spaces cleverly designed to hold the largest batteries and outfit—besides the self-contained loudspeaker—all unseen and protected from dust or disturbance.

You Need This Console Whatever Your Present Outfit Is

It makes no difference what kind of radio outfit you have—this console was designed for your use. The graceful exterior of this console gives no hint of its inner utility, for it is a simple and effective piece of furniture in every line. But a glance at the interior reveals a most ingenious arrangement of the in-built loudspeaker with space either side and in front. These spaces are ample for the largest A battery, and the largest wet B batteries and the largest charging outfit. It is 38 in. long, 18 in. deep, and 29 in. high. Notice the artistic grill that conceals soundbox, and the provision of "knee room" beneath. Made in mahogany or walnut finish, *and the price is only $40!* (West of Rockies, $42.50)

Dealers!

The sale of these consoles has already reached extraordinary figures. They are selling in surprising quantities in even smallest stores where there is one in the window or on the floor. It is a convenience and a value not to be duplicated.

Write us for discounts and particulars of big newspaper advertising campaign.

INVESTIGATE!

Dealers everywhere are now showing the Windsor loudspeaker console, and have them for immediate delivery to your home. If you haven't already seen this remarkable contribution to radio enjoyment and convenience, write us now for the name of a nearby store where you may view it. We will also send you complete information. Remember, this console gives you not alone a marvelously faithful reproducing unit and sound box, but an altogether new beauty and utility in the provision for your entire radio outfit. Mail coupon or postal.

WINDSOR FURNITURE COMPANY (PR)
1422 Carroll Ave., Chicago

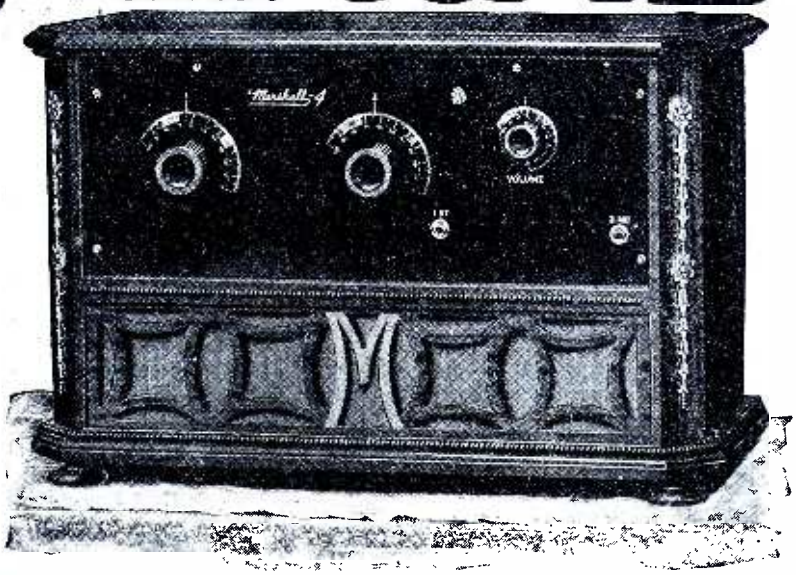
Please furnish pictures and full details, also name of nearest dealer who has the new Windsor loudspeaker console.

Name.....

Address.....

Marshall 4 and 5 Tube Sets

The Greatest Advance yet made in RADIO



Receiver and Loud Speaker in Combination Cabinet of Solid mahogany

This Beautiful Marshall 4 Tube Non-Oscillating Receiver

only $5.00 DOWN

Complete with all accessories

WRITE TODAY for full particulars of this most exceptional offer. Marshall Sets embody the very latest improvements known to radio. The wonderful new principle involved is proving the sensation of the 1924-25 radio season. Zero Coupling—the problem which radio engineers have been working on for years—has at last been solved. As a result, the Marshall has no need of neutralizing condensers or other make-shift methods of avoiding internal oscillations which invariably reduce efficiency. The Marshall Tuned Radio Frequency Receiver brings to radio a new degree of musical quality. Its selectivity will delight the experienced radio operator. Yet it is so easy to tune that the novice will handle it like an expert.

Small Monthly Payments—2 Weeks Free Trial

That is the remarkable offer we are prepared to make you. Two weeks to prove that the outfit you select is everything we have said for it. If it doesn't make good our claims, back it comes, and your deposit will be cheerfully refunded. But if it fulfills all your expectations, you may pay for it in easy monthly installments. You don't risk a cent when ordering from us. You *must* be satisfied, or we don't do business.

Is it any wonder that radio buyers, the country over, are rushing to take advantage of such an offer? If YOU are interested, figure on getting your order in early, while prompt shipment can be made. Everyone predicts a serious shortage of radio supplies this season. Send for full particulars today.

Beautiful Solid Mahogany Combination

Compare the beautiful Combination Cabinet, pictured above, with the usual radio box and horn. Here the Receiver and Loud Speaker are contained in a single handsome cabinet. Or, if you prefer, we also have the Receiver in a separate cabinet of the same design. These cabinets are the work of a master designer—fashioned of solid mahogany. They will harmonize with the furnishings of the finest homes. In spite of the extra value, these Marshall sets are surprisingly low in price. Compare them with others which sell for cash. Then remember you can order a Marshall outfit on two weeks' free trial and pay for it on very easy terms.

Complete Outfits If Desired

In buying from Marshall, you have the choice of a set complete with all accessories, or the set alone. You have choice of dry cell or storage battery outfits. Unless you already own the accessories, you can buy them from us at less-than-market prices, with your set, on easy terms. Your outfit will come all ready to set up and operate within a few minutes—saving time and trouble—and saving money, too.

MARSHALL RADIO PRODUCTS, INC.
Marshall Blvd. and 19th St., Dept. 58-38 Chicago, Ill.

Send Coupon for Special Offer!

If you have any idea of buying a radio set this year, don't let this chance slip by. Our terms and liberal guarantees have set a new pace in the radio business. The low prices we will make you on a 4, or 5 tube Marshall set will surprise you. A letter, postcard, or just the coupon will do. But send it today.

We also have a most favorable offer for radio dealers. Write.

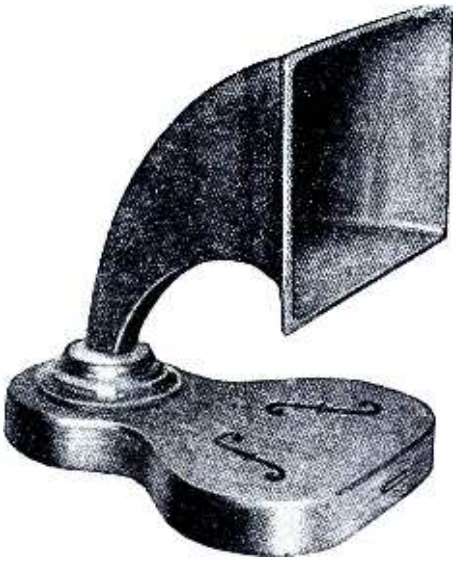
Marshall Radio Products, Inc.
Marshall Blvd. and 19th St., Dept. 58-38 Chicago

Please send me your special offer price, terms and full description of Marshall Radio Outfits. Though I may change my mind on receiving your proposition, my preference now is for a:

.....4 Tube .....5 Tube (Please check)

Name .....

Address .....



Timbretone is now handled throughout the United States and we ask that you direct your inquiries to the nearest office

ALBANY, N. Y., Albany Hardware & Iron Co.
AUSTIN, MINN., Hommel Electric Co.
BOSTON, MASS., The Post and Lester Co., 223 Columbus Avenue.
BRISTOL, VT., V. I. Patnode & Co.
HARTFORD and all of CONN., New England Radio Corporation, 438 Asylum Street; The Post & Lester Co., 112 Allyn Street.
KANSAS CITY, MO., Sweeney Radio & Electric Co.
MONTREAL and all of CANADA, Scott Bros., 232 St. Catherine Street, West.
NEW YORK, N. Y., E. J. Edmond Co., 1976 Broadway; W. M. Baker, 157 Cedar Street.
PHILADELPHIA; John Wanamaker; Atlas Asbestos Co., North Wales.
ONEIDA, N. Y., W. H. Hess Electric Co.
OMAHA, NEB., James Corr Electric Co.
PITTSFIELD, MASS., The Meyer Store, Inc.
PORTLAND, ME., The Post & Lester Co., 17 Temple St.
PROVIDENCE, R. I., The Post & Lester Co., 89 Broadway.
SALINA, UTAH; Ivie Radio Co.
SCHENECTADY, N. Y., I. T. & D. B. Lyon Co., State St.
SPRINGFIELD, MASS., The Post & Lester Co., 147 Dwight Street.
ST. LOUIS, MO., Wellston Radio Co., 1479 Hodiamont Avenue.
SYRACUSE and all of NORTHERN N. Y., Electric Parts Corporation, 318 East Genesee Street.
TOLEDO, O., Aitken Radio Co., 504 Superior Street.
WASHINGTON, D. C., Star Radio Co., 403 11th Street, N. W.
WORCESTER, MASS., The Post & Lester Co., 672 Main Street; Waite Hardware Co., 185 Front Street.
BERMUDA; Thos. J. Wadson & Sons, Hamilton.

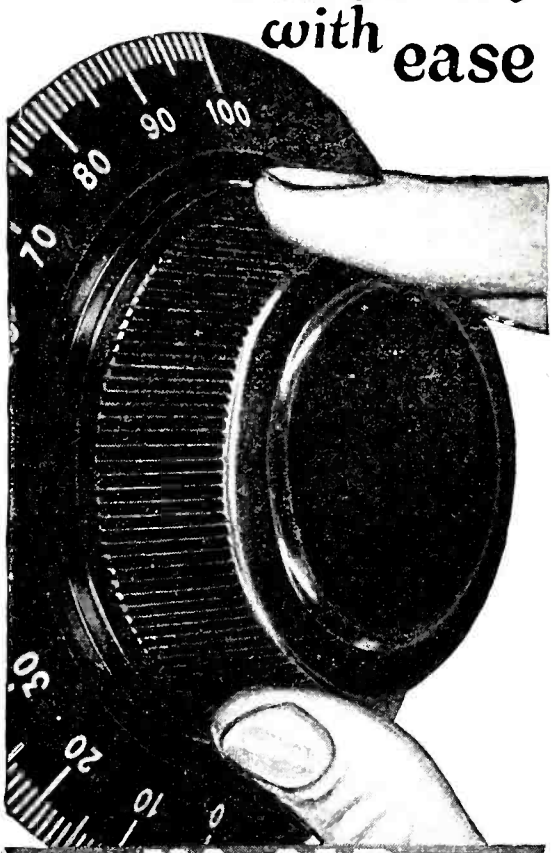
TIMBRETONE MFG. COMPANY

Hoosick Falls **New York**

Timbretone will be exhibited at the Grand Central Palace,

November 3d to 8th in booth 44.

Tune in- with ease



NA-ALD

Super DeLuxe Dials

Where eye and hand are in scientific balance

Test these dials with any other and see how much more quickly you can turn to any degree or fraction of a degree.
Shorter intermediate lines; numerals on the bevel and a generous knob are the reasons.

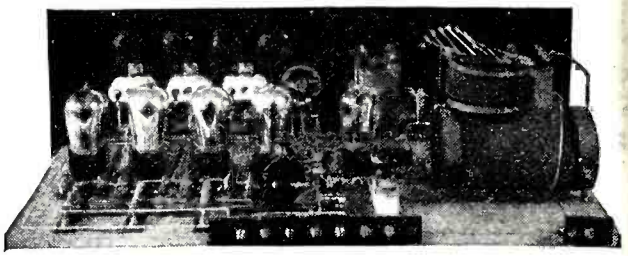
These are truly beautiful creations which give that final touch of dignity and attractiveness to the quality set. On the set you buy look for the minute Na-ald trademark as you would for "Sterling" on silver.

75c. Other prices of Na-ald Dials are: 3⅞" 50c, 3" 35c and 2" (rheostat) 35c.

ALDEN MFG. CO.
Dept. C. Springfield, Mass.

NA-ALD

COCKADAY



Four Circuit Tuner with resistance coupled amplifier and "Popular Radio" blue prints $64.00.

We suggest the following to go with it:

Five No. 201A Radiotrons at $4	$20.00
100-ampere hour Exide battery	19.60
Aerial equipment	2.00
3 "B" batteries—"EverReady" at $3.75	11.25
"Music Master" loud speaker	30.00

Full co-operation of our special service bureau.

Headquarters for all guaranteed parts.

Jewett phonograph unit	$12.50
No. 51 Crosly 2-tube receiver	18.50
Hydrometers	.50
O-50 volt meters	.95
Rubber ear phones, per pair	.50
Malone-Lemon wave traps	12.00
Radio extension cords, 30 ft	2.50
Milo adjustable loud speaker	15.00

Everything in Radio.

Nine years of prompt, fair and courteous dealing

Hartt & Lane, Inc.

780 Sixth Ave., near 44th St. New York City

GREATEST LOUDSPEAKER ACHIEVEMENT

3-Way-Control Balanced Armature

O'NEIL AUDIPHONE LOUD SPEAKER

A Masterpiece

Demand a Competitive demonstration IN YOUR DEALER'S STORE

Will not "Blast" or "Chatter" on Neutrodyne or Super-Heterodyne circuits.

WITH 12" HORN, $25; 14" HORN $28

Written Guarantee With Every Speaker

Write for Literature

O'NEIL MFG. CO.

714 Palisade Ave., West New York, N. J.

PARAGON
FOUR
$65

A basically new four-tube receiver, employing the new *Paradyne Circuit*. Capable of loudspeaker reception over practically unlimited range. Extremely simple to operate. Major dial control. Operates with UV199, C299, UV201A or C301A tubes, either as a three-tube or a four-tube set. Handsome mahogany cabinet. Cheap in no respect but price.

REVOLUTIONARY!

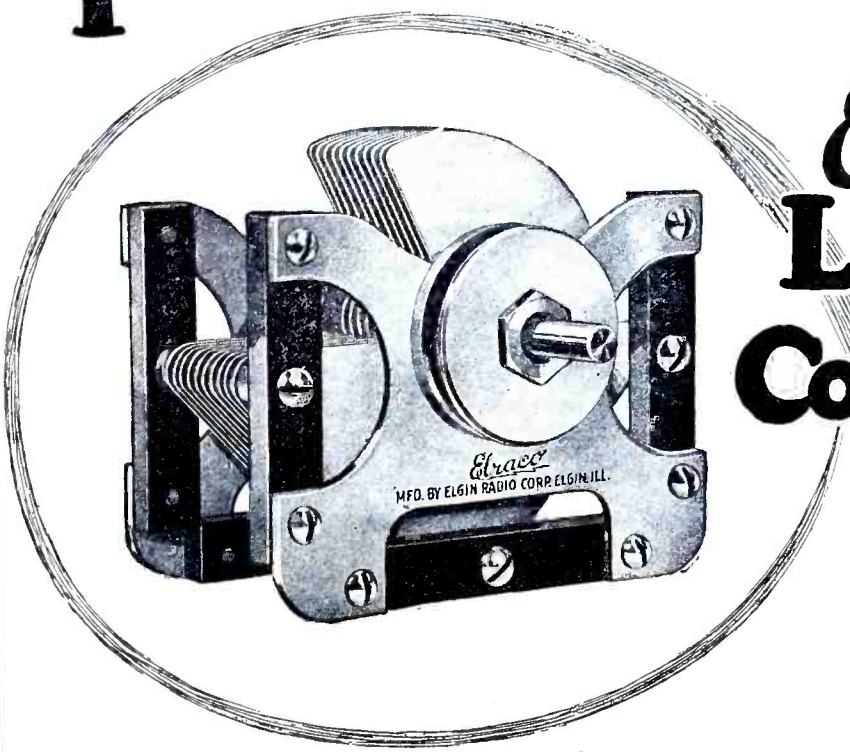
EVERY year there's a big advance in radio knowledge. This year's advance has *revolutionized* Paragon Receivers and produced a brand new line having all the Paragon fine tone, sensitivity, selectivity and high quality of the past with new *simplicity of control* and new *lower prices*. In addition to this new four-tube set, there are also the New Paragon *Three*, price only.....$48.50
And the New Paragon *Two* at..... 27.50
Ask to see these new receivers at your radio dealer's. Free descriptive folder on request.

ADAMS MORGAN COMPANY, Inc.
6 Alvin Avenue, Upper Montclair, N. J.

DEALERS: Write for attractive new Dealer Proposition and address of nearest Paragon Distributor.

The New, Remarkable

Elgin Elraco Low Loss Condenser



Capacity	*Each*
.00025 M. F. .	$4.50
.00035 M. F. .	4.75
.0005 M. F. .	5.00
.001 M. F. .	6.50

The new Elraco Low Loss Condenser is a remarkable instrument. The improved design is correct in every way. Each detail in the manufacture is carried out with all the care and precision that distinguish Elgin craftsmen. The result is a variable condenser of practically no loss—a condenser which will give you greater selectivity in your set.

See These Features:

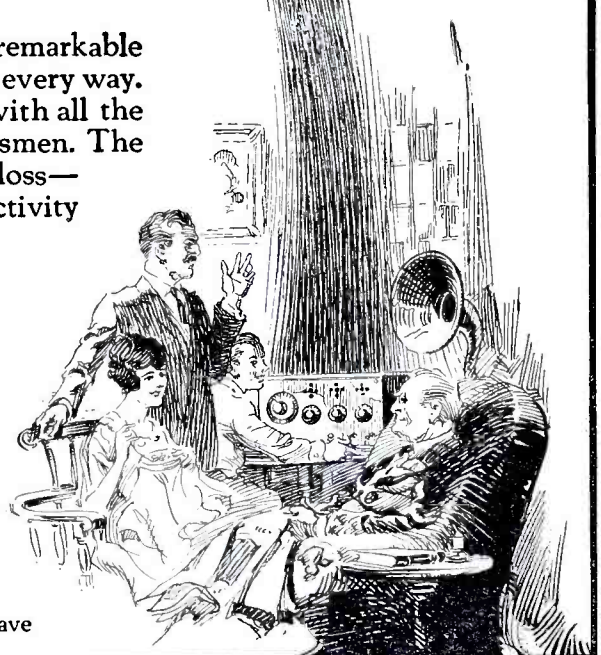
Rotor is grounded to the end plates of nickeled brass.
Rotor and stator plates are special patented leveled brass.
Single hole mounting in ½ inch panel hole.
Bearing split in middle to take up center of bearing. Adjustable ball end thrust. Special contact construction assures perfect contact at all times.
Highest grade insulation, with large air spaces. Reversible stops for clockwise and anti-clockwise dials.

Losses so low that they are negligible

The Elraco Low Loss Condenser is the condenser you have been waiting for. You will find it superior in every way. And yet the price is reasonable.

Ask your dealer—or send in the coupon today

ELGIN RADIO CORPORATION
Radio Division The Elgin Tool Works, Inc.
67 North State Street Elgin, Illinois



Elgin Radio Corporation, *Elgin, Ill.*

Send me..... M. F. Elraco Low Loss Condenser. Enclosed find $.....
..... Send me full particulars.

Name .....
Address .....
My Dealer is .....

Your Condenser Makes a Difference

Branston Announces—

Eight Matched Transformers

$35.00

Three Stage Long Wave R. F. Transformers No. R-200

Contains three perfectly matched long wave transformers each designed to give highest voltage amplification per stage without distortion.

PRICE $13.50

Twin A. F. Transformer No. 204

Two carefully designed A. F. Transformers in one unit, giving all the amplification possible, with wonderful tone reproduction throughout the musical scale.

PRICE $8.00

Single Stage Long Wave R. F. Transformer No. R205

Gives highest amplification on long wave or Super Heterodyne circuits. None more efficient at any price.

PRICE $4.50

No. R201-Long Wave Tuned R. F. Transformer.....$4.50
No. R203-Special Tuned Coupling Transformer.....$4.50

Short Wave R. F. Transformer No. R202

Efficiently designed Short Wave R. F. Transformer with self-supporting coil windings. Will function with maximum amplification over entire broadcast wave band. Excellent for your Reflex Set.

PRICE $4.50

New Super Transformers and *New* Kit No. R-199

Designed by an engineer who has specialized in Super Heterodyne construction. He had tried all standard makes of transformers but none would give him the results for the perfected *strictly loop* set he desired.

He wanted a receiver that would amplify distant stations to the volume of a local station. This was accomplished by embodying short wave radio frequency into the set.

Present receivers were too bulky and required eight, ten and more tubes. By making various tubes do double duty, he was able to reduce the number to seven 199 or 201A tubes, and reduce the size of the panel required to 7″ x 21″.

In order to eliminate unnecessary detail in constructing, to simplify wiring, and beautify the panel layout, the three long wave R. F. Transformers were embodied in one compact unit and the two Audio Frequency Transformers in another, saving space, permitting short leads and greatly increasing efficiency.

Only two tuning controls are required allowing accurate logging of stations.

His greatest task was designing the transformers. After a year of constant research, he was satisfied with results—a receiver that could accomplish just a little more than others, greater distance, greater selectivity, ease of tuning and almost perfect reception.

We now offer these transformers, precision built, to handle the radio energy with superior accuracy and extraordinary efficiency.

Every transformer is perfectly matched to the same resonant frequency. Each transformer besides being tested for mechanical and electrical defects is given an operation test. Every one absolutely guaranteed.

Complete blue-prints and layouts covering Super Heterodyne, Radio Frequency and Honeycomb Coil circuits sent for 25c in coin or stamps. Also complete catalog of BRANSTON QUALITY RADIO PRODUCTS.

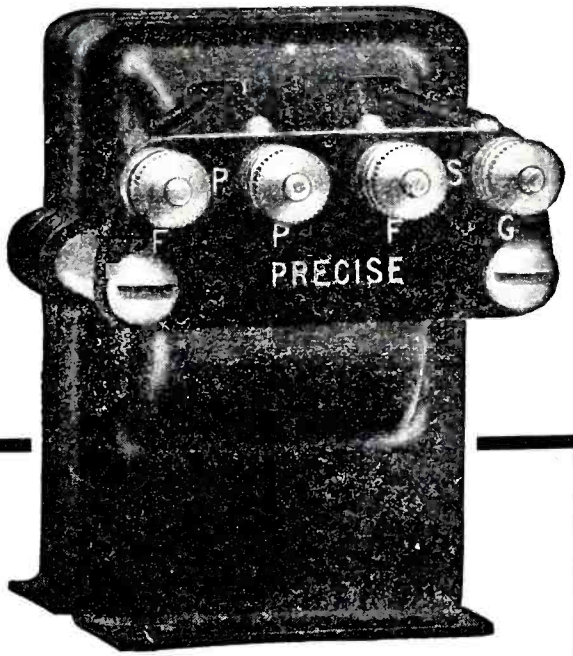
Your Dealer has Branston Kits or can get them for you

CHAS. A. BRANSTON, Inc.

811 MAIN STREET **BUFFALO, N. Y.**

Manufacturers of Branston Violet Ray High Frequency Generators

In Canada—CHAS. A. BRANSTON, Ltd., Toronto, Ont.



Because

MR. LAURENCE M. COCKADAY

employs only one Audio Frequency Transformer in his new 4-Circuit Tuner with

RESISTANCE COUPLED AMPLIFIER

the Transformer is the very heart of the set. Only a

PRECISE TRANSFORMER

can give such wonderful results.

When you build your new Cockaday set insist upon the genuine PRECISE No. 285 Transformer.

Your set will duplicate the wonderful performance of Mr. Cockaday's own laboratory set, described in the October issue of POPULAR RADIO. It's more than a transformer. "It's a PRECISE."

INSIST UPON A "PRECISE" WHEN YOU BUY A TRANSFORMER

NIAGARA SALES CORP.

Eastern Sales Office
PRECISE MANUFACTURING CORP.

3-5 Waverly Place, New York

JOBBERS and DEALERS:
Get your share of this tremendous demand. Write us at once.

Model A
2400 Ohms
$4.00 List

Model B
3000 Ohms
$5.00 List

The Air Belongs to You

Tune in tonight with the confidence that the air-world is yours. Your set, no matter how powerful, will be matched by Repeater Phones. No distance is too great to lose any single note or quality when received through Repeater Phones.

If your dealer doesn't have Repeater in stock send order direct to factory.

One Reason

Repeater Phone is known as the "Single Pole" Phone. Much of the extra power and unusual quality of reproduction is due to the "Single Pole" feature. Our illustrated booklet explains in detail. Send for it.

Dealers

Think what it means to carry a line like Repeater Phones. You can cheerfully recommend the nationally advertised Repeater and know your sale will be complete.

Our discounts are sure to interest you. Find out about them, also our Sales Plan and dealer helps.

MOSS-SCHURY MFG. CO., INC.
Radio Division
2013 Franklin Street - - Detroit, U. S. A.

RAJAH

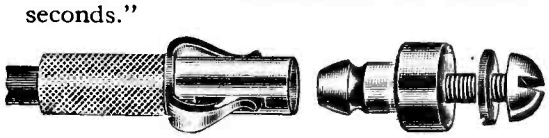
SOLDERLESS SNAP TERMINALS

For Aerial, Ground and Battery Connections

Approved by POPULAR RADIO LABORATORY

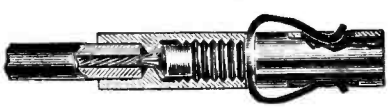
In the description of the NEW COCKADAY CIRCUIT, on page 387 of POPULAR RADIO for October, Laurence M. Cockaday says:—

"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."



Patented June 20, 1924

Instantaneous in Operation—Positive Contact



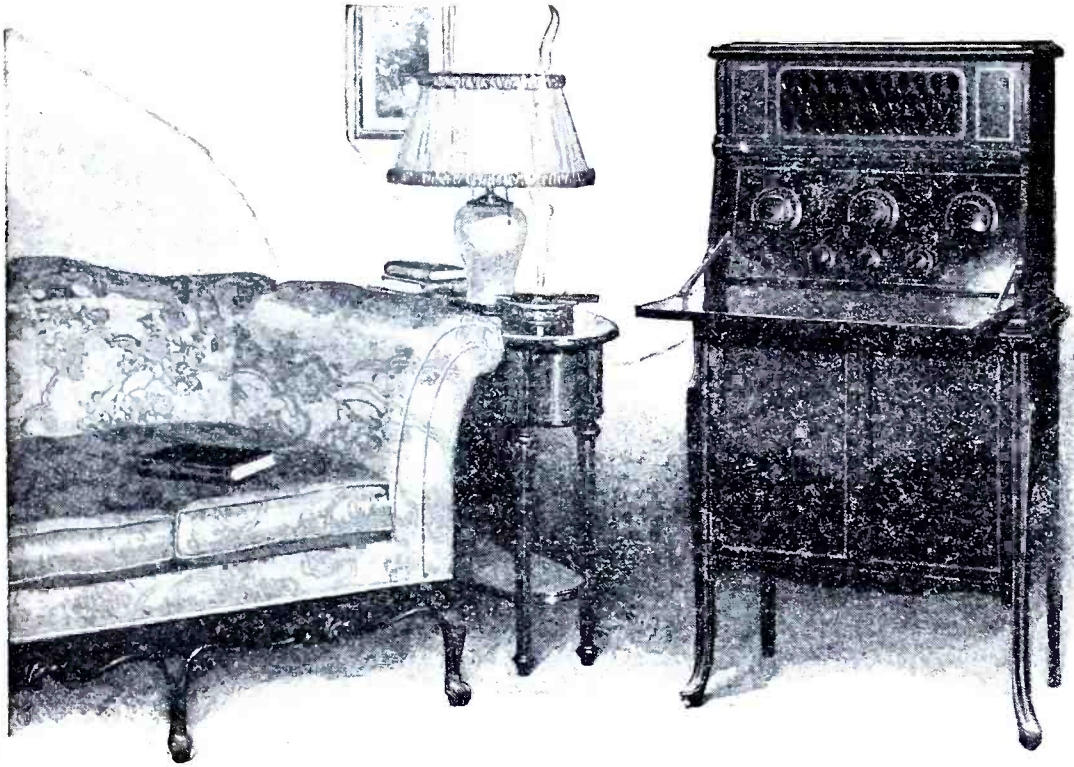
Solderless Attachment to Wire

Patented June 20, 1924

Price 20c each. Extra studs may be had at 6c each.

Rajah Auto Supply Company

Bloomfield, N. J., U. S. A.



The FADA Neutrola Grand

~ *new beauty, new perfection in Radio*

AN EXQUISITE instrument. Encased in beautifully finished genuine mahogany. A gem of the cabinet designer's art. A piece of furniture that will adorn any home.

Here in this new FADA Neutrodyne is a real achievement in receiving beyond anything you ever heard. Wonderful naturalness of tone. The high C of the coloratura soprano and the lowest bass of the human voice are reproduced precisely as sung. In selectivity the FADA Neutrola is remarkable.

Ease and simplicity of tuning make it the ideal receiver for all the family.

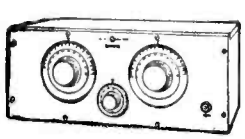
FADA Neutrola Grand

The de luxe five-tube FADA Neutrodyne, with self-contained loud speaker. Receiver and cabinet in genuine mahogany, artistically decorated with wooden inlay. Ample space for all batteries and charger. Drop desk lid that hides receiver when not in use. Price, exclusive of tubes and batteries, $295.

The FADA Neutrola Grand is the finest of the complete line of FADA Neutrodynes, which includes a model to suit every taste, every radio requirement, every pocketbook. Three, four and five tube FADA Neutrodyne receivers in plain or de luxe cabinets are now available at your dealer's. See them to-day and make your selection. You will never regret buying a FADA.

You have a range from $75 to $295 from which to select —six models, each extraordinary in results; each a remarkable value.

F. A. D. ANDREA, INC.
1581 Jerome Avenue, New York

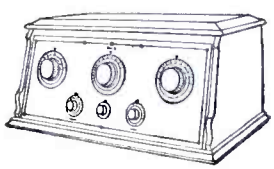


FADA Neutro Junior No. 195

Three-tube Neutrodyne. A wonderful performer. Price (less tubes, batteries, etc.) $75.

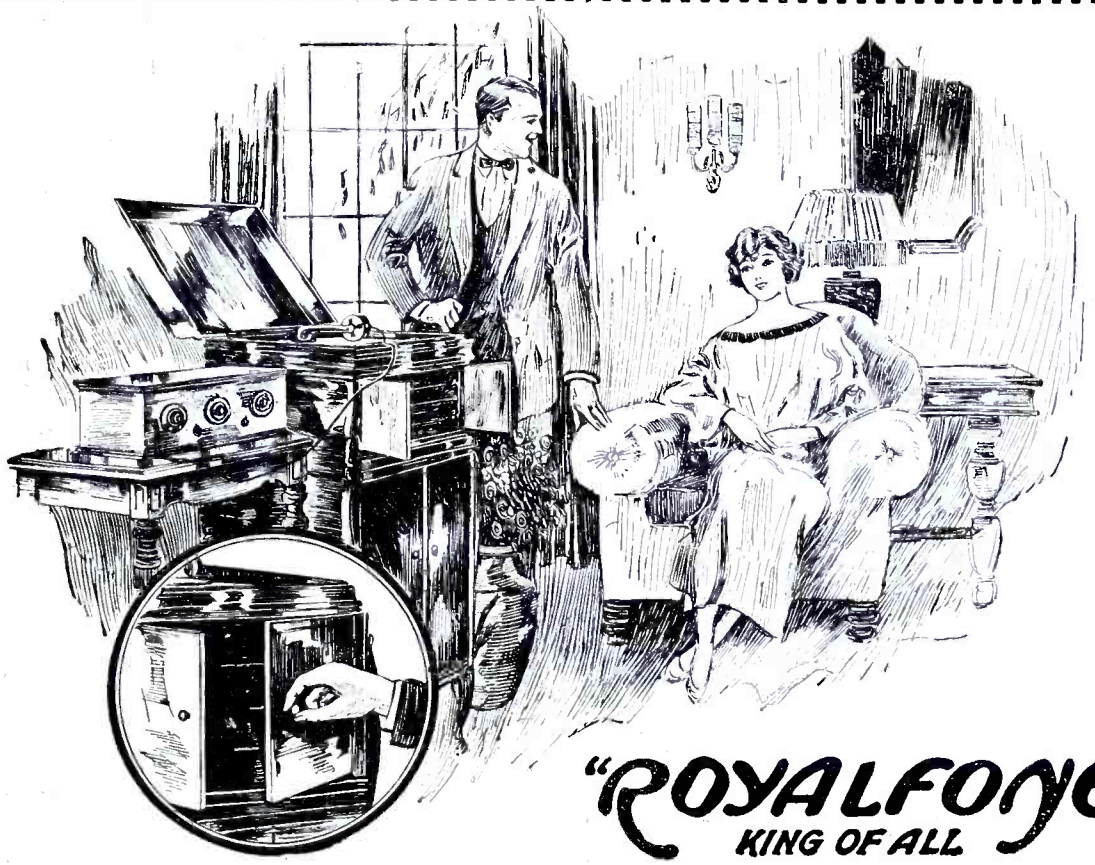
FADA Radio

LICENSED BY INDEPENDENT RADIO MANUFACTURERS, INC. NEUTRODYNE PAT. MARCH 27 1923 AND APRIL 1 1924 OTHER PATENTS PENDING F.A.D. ANDREA INC. 1581 JEROME AVE. N.Y.C.



FADA Neutroceiver No. 175-A

Mahogany cabinet. Inclined panel and roomy battery shelf. Five tubes. Price (less tubes, batteries, etc.) $160.

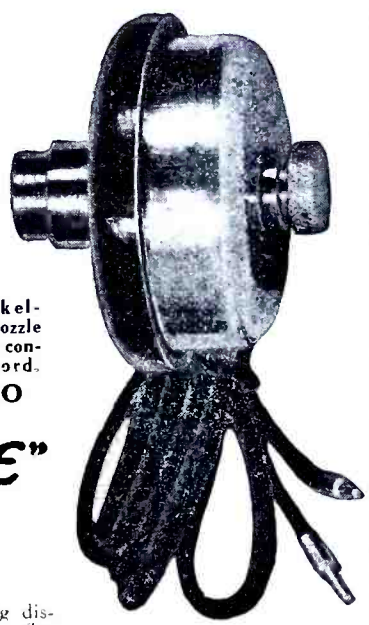


"ROYALFONE"
KING OF ALL

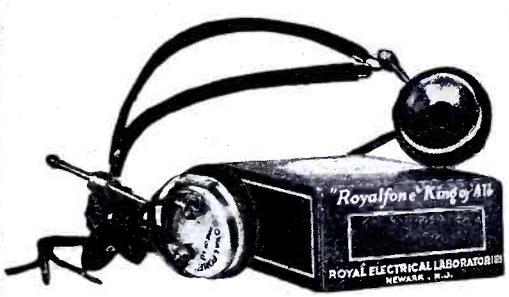
LOUD-SPEAKER UNIT

Adjustable Tone Volume

SOFT or loud, for a small or large room, simply by turning the adjusting screw on the back of the Royalfone Unit—just the tone volume you wish, however strong the reception. The *Royalfone Unit* makes your phonograph or any horn, a high class loud speaker, adjustable to the acoustics of the room, as easily as you open or close the doors of your phonograph to regulate the volume of sound. A decided advantage added to a balanced diaphragm which entirely banishes distortion. The most economical way to buy a *real good loud speaker.*



Heavy nickel-plated nozzle and ample connecting cord.
$5.00



"ROYALFONE"
KING OF ALL

HEADSET

Especially designed for tuning in long distance. Sensitive enough to catch the faintest signal. Balanced diaphragm gives the true tone so essential for perfect tuning. List Price **$4.50**

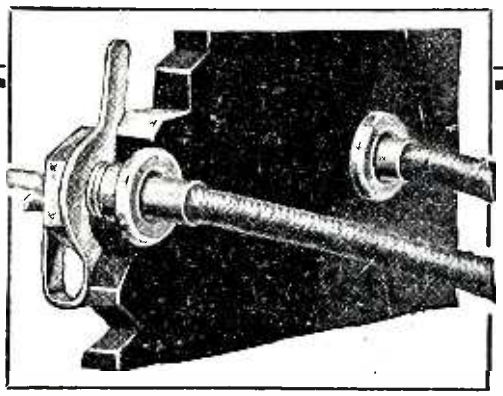
You can buy the *Royalfone Loud-Speaker Unit* and the *Royalfone* Headset direct by mentioning your dealer's name

Manufacturers and Jobbers of phonographs and loud speakers—write for interesting offer

ROYAL ELECTRICAL LABORATORIES

NEWARK Dept. P.R. NEW JERSEY

Just Plug In



Union Radio Tip Jacks

25c a pair

The greatest little part in all radio — the height of ease and convenience, just what you need when building sets or trying new hook-ups. Replaces binding posts and gives quick, positive, electric connections. Just plug in. Heavily nickeled, they add to the appearance of your set.

Because of superior merit over binding posts, they are now being used by many of the leading set manufacturers.

Two sizes for all mountings. *Standard Type A* for panels up to ¼" thick. *Special Type B* for panels, cabinet walls and partitions from $\frac{5}{16}$" to ½". Will firmly grip all wires from No. 11 to No. 24 B & S Gauge. Can easily be reamed to hold antenna wire.

Other Guaranteed Union Radio Parts

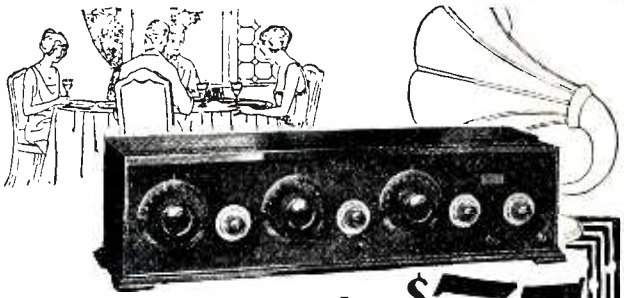
TUBE SOCKETS of highly polished moulded condensite. Phosphor bronze contact springs. Reinforced bayonet slot. For all standard tubes. . . . . **Price 70c**

DIAL ADJUSTERS for minute adjustment of dials, necessary for close tuning. . . . . **Price 60c**

RETAILERS— WHOLESALERS

Write for free samples of our guaranteed reasonably priced Quality Radio Products. Get details of our dealer proposition. Also write for your copy of our Illustrated Pamphlet "H".

UNION RADIO CORPORATION
200 MT. PLEASANT AVENUE, NEWARK, N.J.
NEW YORK OFFICE — 116 WEST 32nd STREET.



and now! for only $75

The Marvelous MIRACO Ultra 5

[FIVE TUBE OUTFIT]

Send for Bulletin Today

Built for loud speaker reception from stations thousands of miles distant through local interference; composed of the finest parts; beautifully wired; encased in a beautiful hand rubbed solid mahogany cabinet; and fully guaranteed. At $75 this fine, handsome, efficient Miraco "Ultra 5" five-tube outfit offers unquestionably the most astounding value the radio world has ever known.

UNSURPASSED SELECTIVITY, SENSITIVITY, RANGE, VOLUME AND TONE COMBINED

Non-radiating, non-howling, non-distorting. Equipped with filament switch, phone jack for tuning, bakelite panel, bakelite sub-base under which all wiring is concealed and other latest refinements. Two stages tuned radio frequency amplification, detector and two stages audio frequency amplification.

OTHER MIRACO LONG DISTANCE SETS $14.35 up
3 tube loud speaker outfit, $29.50. Write for latest bulletins, testimony of users proving coast to coast reception. Agents, Dealers, write!

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
479-C East 8th Street, Cincinnati, Ohio

MIRACO RADIO GETS 'EM COAST to COAST

Increased Signals

ACCURATE, constant, unchanging condenser capacity is demanded for greatest possible selectivity, clearness and loudness. Ben Franklin Micadensers, of all-metal and mica construction are individually tested by a special direct reading instrument. Accuracy guaranteed within 10% or your money back. Made in all standard capacities. Most popular capacities priced as follows:

.0001	35c	.001	40c	.006	75c
.00025	35c	.002	40c	.015	$1.75
.0005	35c	.005	60c		

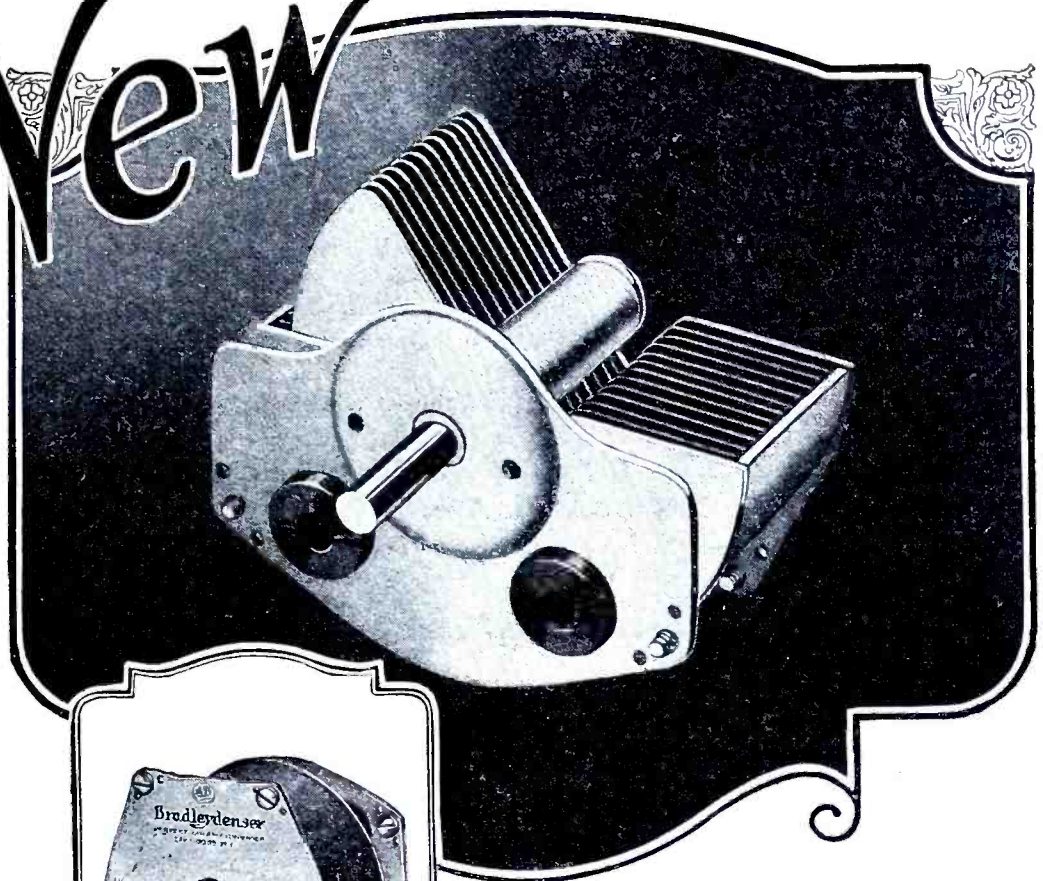
.00025 with Brackets for Grid Leaks . . 45c
.00025 with Self-contained Grid Leak . . 50c
.00025 in Matched pairs, per pair . 95c
(Both condensers warranted exactly same capacity)

We will furnish any *exact capacity value* in Micadensers, or *duplicate the capacity value of any condenser* you send us, at 10c above regular price.

At all good Jobbers and Dealers. If dealer can't supply, Ben Franklin Micadensers will be sent prepaid, on receipt of remittance with order.

The Ben Franklin Radio Manufacturing Co.
2650 Superior Avenue Cleveland, Ohio

New



The Bradleydenser
Perfect Variable Condenser

The Bradleydenser

PERFECT VARIABLE CONDENSER

Brass Plates—Grounded Rotor—Low Loss

PERFECTION to the last detail! Even the unique bearing of the new Bradleydenser is a marked improvement over the older types. The rugged brass plates, the grounded rotor construction, and the new detachable dust shield are other details that serve to increase the high-frequency efficiency of the Bradleydenser. Exhaustive laboratory tests reveal exceptional improvements in efficiency. In fact, the Bradleydenser sets a new low record for losses. It tunes the weakest oscillations with the least energy loss, and, therefore, increases the range of any set. There are many other new and striking features of the Bradleydenser. Our new literature explains them, fully. Send for our latest bulletin today.

Standard Capacities

0.00025	M-F	. .	$4.50
0.0005	M-F	. .	5.00
0.001	M-F	. .	6.00

Furnished without vernier plates, only.

Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Ave. A·B Milwaukee, Wis.

Standard Carton

The Bradleydenser is sold in the well-known Allen-Bradley checkered box by all leading radio dealers and jobbers.

Baltimore **Birmingham** **Boston** **Buffalo** **Chicago** **Cincinnati** **Cleveland** **Denver** **Detroit** **Knoxville** **Los Angeles** **New York** **Philadelphia** **Pittsburgh** **Saint Louis** **Saint Paul** **San Francisco** **Seattle**

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

The New Goodrich V. T. Socket

A Spring Lock—No Turning or Twisting the Tube

The socket in which the tube can be either inserted and fastened or unfastened and removed without turning or twisting.

A spring lock—an exclusive Goodrich feature—accounts for this tremendous socket improvement.

Tube locks automatically when inserted—touch the spring lock . . . it is released.

"Wiping" type contacts automatically cleaned when tube is inserted—can be further cleaned without unlocking tube with slight turn back and forth.

Completely eliminates danger of tube breakage due to forgetting which way to turn tube to unlock it—a vast improvement over bayonet lock style.

Socket construction of specially treated hard rubber—so dielectric losses are much lower than in sockets made of other materials. Furnished complete with all fittings. Get the new and improved Goodrich V. T. Socket today.

THE B. F. GOODRICH RUBBER COMPANY

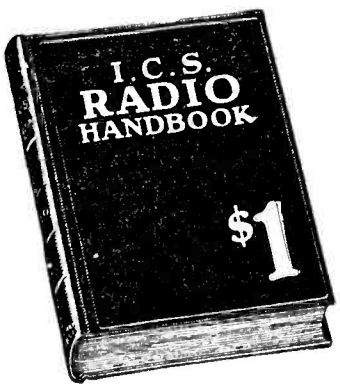
Akron, Ohio

ESTABLISHED 1870

Goodrich V. T. *Socket*

Now you can UNDERSTAND RADIO!

Know all about it—build and repair sets—explain the vacuum tube—operate a transmitter—be a radio expert!



1 VOLUME
514 PAGES

Compiled by
HARRY F. DART
E.E.

Formerly with the Western Electric Co., and U. S. Army Instructor of Radio.

***Technically Edited by* F. H. Doane**
100,000 ALREADY SOLD

Every question you can think of is answered in this remarkable book, the biggest dollar's worth in radio to-day. Over 100,000 homes rely on the I. C. S. Radio Handbook to take the mystery out of radio. Why experiment in the dark when you can quickly learn the things that insure success? Hundreds of illustrations and diagrams explain everything so you can get the most out of whatever receiver you build or buy.

It contains: Electrical terms and circuits, antennas, batteries, generators and motors, electron (vacuum) tubes, every receiving hook-up, radio and audio frequency amplification, broadcast and commercial transmitters and receivers, wave meters, super-regeneration, codes, license rules. Many other features.

A practical book. Written and edited by experienced engineers, in plain language. Something useful on every one of its 514 pages. The authority that covers every phase of radio, all under one cover in one book for one dollar. Don't spend another cent for parts, turn a dial or touch a tool until you have mailed $1 for this I. C. S. Radio Handbook.

Send $1 at once and get this 514-page I.C.S. Radio Handbook—the biggest value in radio to-day. Money back if not satisfied.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 8252-D, Scranton, Penna.

I enclose One Dollar. Please send me—post-paid—the 514-page I. C. S. Radio Handbook. It is understood that if I am not entirely satisfied I may return this book within five days and you will refund my money.

Name.....

Address.....

LISTEN-IN RADIO RECORD

REGISTERED U.S. PAT. OFF.

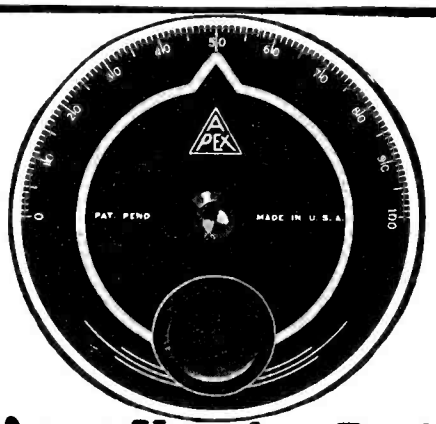
THE ONLY "LISTEN-IN" BOOK

KEEP A RECORD OF STATIONS HEARD, DIAL SETTINGS, RECEIVING CONDITIONS, ETC.

Flexible cloth binding. Gold stamping. 160 pages. Printed on Bond Paper. Contains introductory article "How to Receive Radio Broadcast," by Lloyd C. Greene, Radio editor Boston *Globe*. Many Radio Hints and Tips. Complete list of Broadcasting Stations and double page map of United States.

PRICE
75 cents
At Your Dealers or Sent Prepaid on Receipt of Price

LISTEN-IN PUBLISHING CO.
110 MAIN ST.
CAMBRIDGE, MASS.



Apex Vernier Dial

Do not bother with geared condensers, requiring many holes in the panel and careful lineup of pinion shafts, when this marvelous instrument provides the fine adjustment for tuning in distant stations. Ratio 10 to 1—quickly applied to any shaft. For sale by all good radio dealers. If unable to obtain, fill in coupon and enclose $2.50 for nickle finish or $3.50 for Gold Plated finish.

Coast To Coast On An 18-Inch Loop
Assemble Your Own 7 Tube Super-Heterodyne

—on a 7 x 18 panel in three hours, $97.50 buys the parts complete, including drilled and engraved panels, condensers, sockets, transformers, dials, connecting plugs, cables, etc., with drawings, diagrams and instructions. Price of cabinets to fit—furnished on application. If your dealer cannot supply these parts for this complete Microdyne Radio Set, fill in coupon, mail check or money order and send dealer's name.

Apex Electric Mfg. Co., Dept. 1102.
1410 W. 59th Street, Chicago, Illinois.
Gentlemen: Enclosed find $..... for which send me

.....

Name .....

Street .....

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

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

A VIOLIN *could crash it!*

TUNE a violin exactly to the tremors of the greatest of skyscrapers. Amplify sufficiently—and rock whole buildings to the ground.

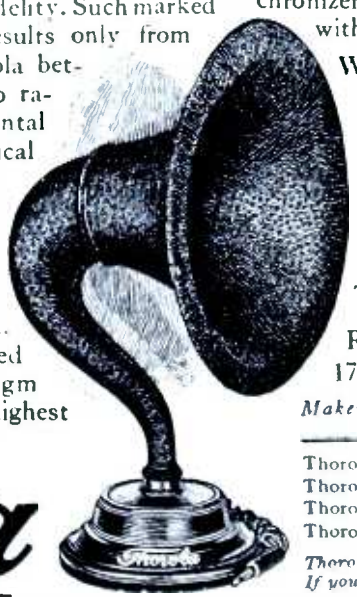
Unthinkable? Hardly more so than the proportionally greater amplification which is Radio itself.

Out of the air your antennae sifts infinitely tiny impulses. Your receiver nurses them along; amplifies them stage by stage; and transforms them into sound waves—whispers which can be made audible a city block distant by Thorola Loud Speaker.

The extreme volume which only Thorola makes possible, allows you to tune down for local stations, and it does bring in weak, distant signals with strength never known before. Double the power of your set and hear new stations for the first time with Thorola.

Thorola power alone marks a radio epoch. Even greater is the exquisite reproduction. Famous operas; works of greatest composers; entertainers' personalities all come to you with unprecedented fidelity. Such marked advancement results only from the many Thorola betterments new to radio, but fundamental in a great musical instrument.

The Thorola reproducer, in size and design, permits true precision construction. Thorola Controlled Mica Diaphragm brings radio the highest development in sound reproduction. The exclusive Thorola Separix eliminates blurring and preserves every overtone. The Thorola horn compound, Thorite, ends compromise with acoustical laws. And, finally, the exclusive Thorola Synchronizer harmonizes *your* Thorola with *your* receiver.



No External Battery Needed. Simply Plug in Same as Headphones

Whatever your opinion of radio now, go hear Thorola. New character of entertainment; new stations most likely await you. The Thorola 10-Day Refund Warranty is a guarantee to users that Thorola fulfills all claims.

REICHMANN CO.
1729-35 W. 74th St., *Chicago*
Makers of the Famous Thorophone

Thorola 4, $25	Thorola 3, $20
Thorophone *Powerplus Speaker* . .	$45
Thorola 6, *Phonograph Attachment*	$15
Thorola 9, *Cabinet Loud Speaker* .	$40

Thorola demand outpaces distribution. If your dealer is not stocked, we ship any model direct on receipt of price

Thorola
THE SPEAKING LIKENESS

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF POPULAR RADIO, Published monthly at New York, N. Y., for October 1, 1924.

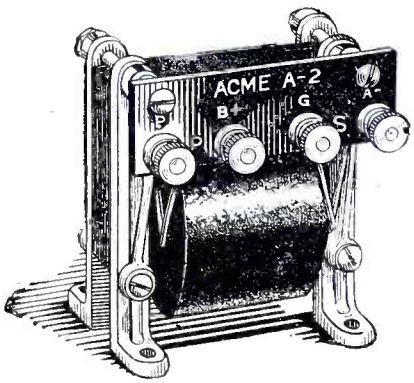
STATE OF NEW YORK } ss.
COUNTY OF NEW YORK }

Before me, a Notary in and for the State and county aforesaid, personally appeared Douglas H. Cooke, who, having been duly sworn according to law, deposes and says that he is the Business Manager of POPULAR RADIO, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, POPULAR RADIO, Inc., 627 West 43rd Street, New York; Editor, Kendall Banning, 627 West 43rd Street, New York; Managing Editor, Katrine A. Campbell, 627 West 43rd Street, New York; Business Manager, Douglas H. Cooke, 627 West 43rd Street, New York. 2. That the owner is: POPULAR RADIO, Inc., whose stockholders are: New Fiction Publishing Corporation, 627 West 43rd Street, New York City, whose stockholders are: Douglas H. Cooke, 627 West 43rd Street, New York City; Vernal W. Bates, 46 George Street, New Haven, Conn.; Wiley Blair, 4607 Ross Avenue, Dallas, Texas; Harold B. Emerson, 9 East 40th Street, New York City; William Green, 627 West 43rd Street, New York City; *Harfis Corporation, 34 Pine Street, New York City; Le Roy Sargent, St. Petersburg, Fla.; Abel I. Smith, 120 Broadway, New York City; Louis H. Strouse, Samuel Falk and Frank C. Fisher, Trustees in bankruptcy of Metropolitan Finance Corporation, 9 East 40th Street, New York City. *Harfis Corporation with the following as Trustees in dissolution of Harvey Fisk & Sons (1921) now dissolved: John Donovan, 30 Church Street, New York City; Harvey Fisk, 34 Pine Street, New York City; Wilfred Jessup, Connersville, Ind.; Henry W. Peacock, Jr., 34 Pine Street, New York City; Joseph M. Shellabarger, 30 Church Street, New York City. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) DOUGLAS H. COOKE, Business Manager.

Sworn to and subscribed before me this 19th day of September, 1924.
[SEAL] JOSEPH T. COONEY, *Notary Public.*
My commission expires March 30, 1926.

Give your loudspeaker a chance!



ACME A-2
—for volume

NO matter what loudspeaker you have, it can't give you loud, clear reproduction unless you have proper audio amplifying transformers.

If your audio transformers don't deliver clear, strong, undistorted energy, you can't expect your loudspeaker to correct the faults for which your audio transformers are responsible.

The thing to do is to put ACME Audio Transformers in your set and then listen to your loudspeaker. ACME Audio Transformers will give your loudspeaker a chance to entertain you with all the thrills and enjoyment you expected and which you are entitled to.

Send 10 cents 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
Dept. 94 Cambridge, Mass.
Transformer and Radio Engineers and Manufacturers

ACME
~ for amplification

ACME APPARATUS COMPANY,
Dept. 94, Cambridge, Mass.

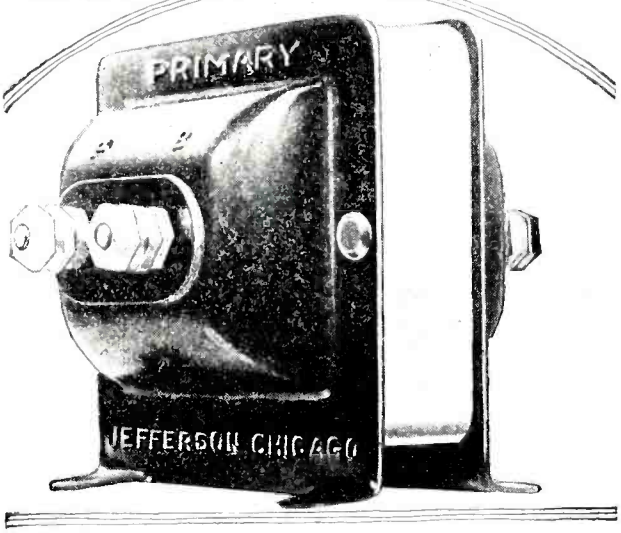
Gentlemen: Enclosed find 10 cents for copy of "Amplification without Distortion."

Name .....

Street .....

City ..... *State* .....

Jefferson Transformers



-the choice of experts

THE fact that Jefferson Transformers are preferred for experimental work by many radio experts and authorities is a clear indication of Jefferson supremacy.

Proper amplification — perfect reproduction — clear, undistorted reception; that's the why and wherefore! To radio authorities the country over Jefferson means the utmost in transformer performance.

Jefferson Transformers are the result of twenty years experience in the manufacture of transformers. To maintain a uniform quality every Jefferson Transformer is subjected to a series of exacting electrical and mechanical tests which must be successfully passed before leaving our hands.

Jefferson Transformers meet matched construction specifications.

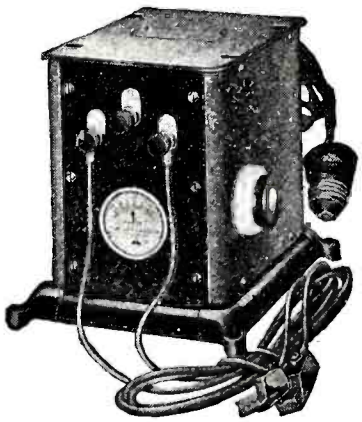
Jefferson Electric Mfg. Co.
427 S. Green St. - Chicago

Manufacturers of

Jump Spark—Make and Break Coils	Testing Instruments
AutoTransformers	Bell Ringing Transformers
Toy Transformers	Automobile Ignition Coils
Sign Lighting Transformers	Oil Burner Ignition Coils
Radio Transformers	Furnace and Oil Burner Transformers

FORE'S MASTER FORE BATTERY CHARGER

Charges RadioA-6 Volt and 48 Volt B Battery in Series or 2-48 Volt B Batteries in Multiple Any Charging Rate



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

AMERICAN BRAND CONDENSERS with the ~100 to 1~ Worm Drive Vernier Finest Condenser Made and the Greatest Radio Value Offered the Public

23 PLATE, only $5.00 In Canada $7.00

AMERICAN BRAND CORPORATION
NEWARK, N.J.

The Traffic Cop of the Air

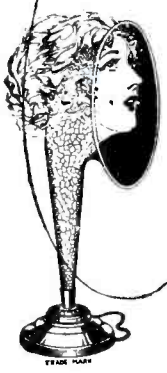
FERBEND Wave Trap

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 $8.60, or C. O. D. plus postage.
Send for *free* booklet.
Ferbend Electric Co.
21 E. South Water St., Chicago

Atlas

TRADE MARK

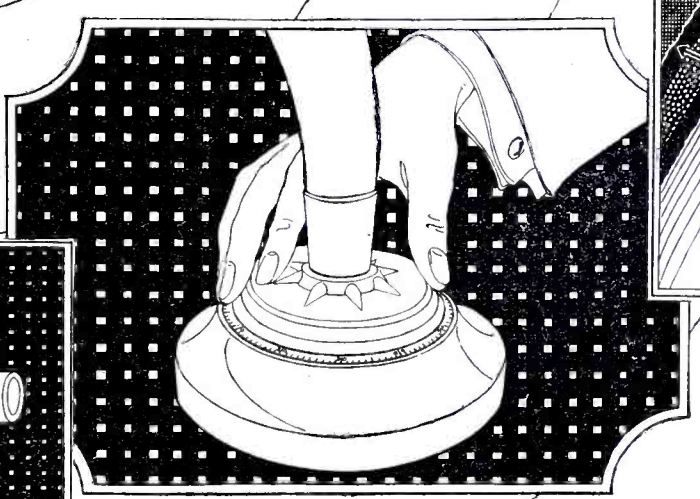
RADIO REPRODUCTION *Speaker*

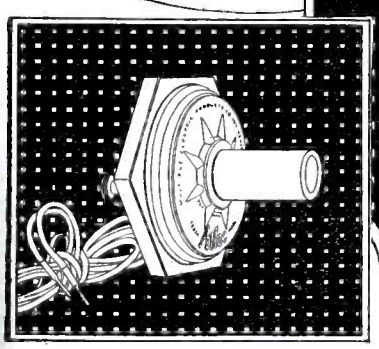


Radio . . as you *ought* to hear it!

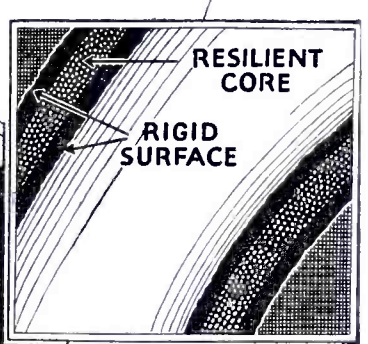
ATLAS Radio Reproduction is *harmonized* Radio Reproduction–a speaker in harmony with your receiving conditions. A slight turn of the *harmonizer** gives you radio as you *ought* to hear it–from near and distant stations–with 3 tubes or 8–on speech, or song, or instrumental music.

*Patent Applied for





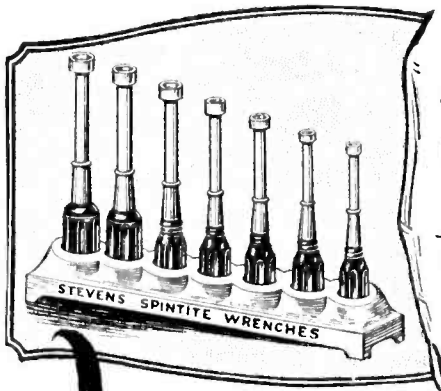
Atlas unit, complete with attachment couplings for all standard Phonographs.



Cross-section of an Atlas horn—
—resilient in the center to absorb vibrations of the material,
—rigid at the surface to conserve the pure tones of the compound diaphragm.

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

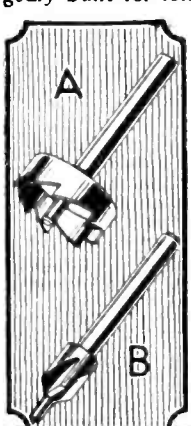


No leaks when you use Spintite WRENCHES

Don't underestimate the value of TIGHT CONNECTIONS! The best built set in the world won't operate right if there are leaks.

You'll never be troubled with leaky connections when Stevens Spintite Wrenches are on the job. These handy little tools spin the nuts down tight, with vise-like pressure, making joints that are as solid as if soldered. No chance of losing the most delicate electrical impulses.

Spintites get into the cramped places where pliers are useless. No fumbling and fussing. Anyone who likes good tools will appreciate Spintites—they're *real tools*, made of tempered steel, in one piece; ruggedly built for long wear.



Set of Spintites for Round Nuts, in 3 most popular sizes, $1.00.

Set of Spintites for Hex Nuts, in 3 most popular sizes, $1.00.

Set of Spintites in 7 sizes for *all* Hex Nuts, on stand, $3.50.

Spintites are made in every size and style.

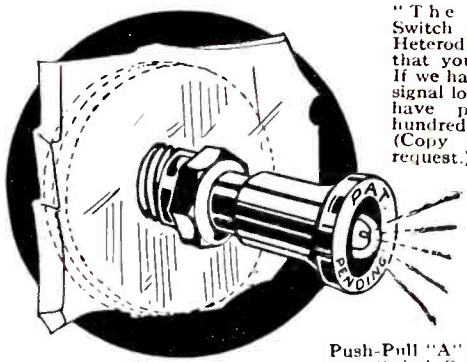
Stevens Panel Cutters (see A) for cutting peek or socket holes in rubber or bakelite panels. 3/4" size, 75c. 1" size 85c. 1 1/2" size, $1.00. Set of 3, $2.50.

Stevens Combined Drill and Countersink (see B). Drills and countersinks in one operation. Price 35c.

Write for Booklet 21 today, describing complete line of radio tools. If your dealer can't supply Stevens Tools order from us direct.

Stevens & Company
375 Broadway New York

Stevens SPEED UP Tools



"The Kant-Blo Switch on our Super-Heterodyne does all that you claim for it. If we had installed this signal long ago it would have paid for itself hundreds of times." (Copy of letter on request.)

Push-Pull "A" Battery Switch Style

YOUR MONEY BACK IF YOU BLOW A TUBE

When your radio set is equipped with a Kant-Blo

Only one Kant-Blo needed to protect any number of any kind of radio tubes

Kant-Blo SIGNAL

SWITCH BINDING POST

"Lights on any Short Circuit"

The Kant-Blo Signal is easily installed. Simply takes the place of either the ordinary push-pull "A" Battery Switch or one "B" Battery Binding Post now on set.
Kant-Blo Signals—both Binding Post Style and Switch Style—are at all the best radio stores. If your dealer is out of stock send us $2 for a Kant-Blo Binding Post Style, or $3 for the Switch Style, and we will ship any number of KANT-BLOS direct to you, charges prepaid.

Sole Distributors
APEX RADIO COMPANY
Suite 208, 503 Fifth Ave., New York, N. Y.
Manufactured by Ganio, Kramer Co., Inc., New York

DONGAN

$3.50 List

Type C Audio Transformer

The Transformer They Are All Asking For

It is the Dongan Type C which Set Builders are recommending to one another. Made right to give real performance with every type of hook-up. Will outlast the set.

Voltmeter

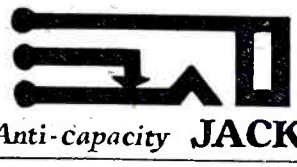
Voltmeter readings mean nothing if the instrument consumes a high amount of current. Really correct indications can only be obtained by using such an accurate instrument as Dongan Double Duty High Resistance Voltmeter. Write for Radio Catalog.

Dealers

Dongan Radio Products are dependable merchandise that show you a steady profit and satisfied customers.

DONGAN ELECTRIC MANUFACTURING CO.
2983 Franklin St. : : Detroit, Mich.

Transformers of Merit for 15 Years

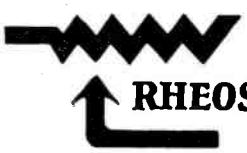


Anti-capacity **JACKS**

Anti-capacity **SWITCHES**

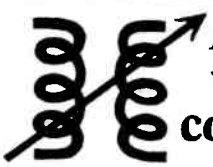
Lower-Loss Vernier **VARIABLE CONDENSERS**

Lower-Loss **PHONE PLUGS**



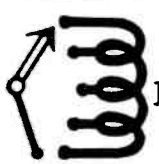
Lower-Loss **RHEOSTATS**

Lower-Loss **SOCKETS**

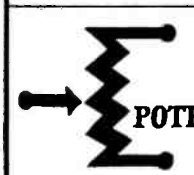


Lower-Loss **VARIO-COUPLERS**

Lower-Loss **GRID LEAKS**



Lower-Loss **INDUCTANCE SWITCHES**



Lower-Loss **POTENTIOMETERS**

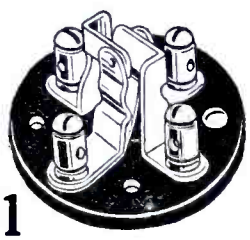
NO SOLDERING—LESS DRILLING—SCIENTIFICALLY BUILT

For Your New Hookup—

Build with less work and have a better set. **Build with Jos. W. Jones Radio Parts.**

Less drilling—no soldering—contact by simple binding posts.

Whatever the hookup, Jos. W. Jones parts will increase its efficiency.



$1

JOS. W. JONES *Anti-Capacity*

$1

Double Circuit JACKS

"A" Battery SWITCHES

Jos. W. Jones Jacks—made for radio use only—have no long parallel leads, and so eliminate capacity effects. Binding posts make connections simple—no soldering. Jos. W. Jones Switches are also anti-capacity. No soldering. The little red button shows outside the panel.

For Better Results Build With JOS. W. JONES

Jacks — Switches — Variable Condensers — Phone Plugs
Vario-Couplers — Rheostats — Potentiometers — Grid Leaks
Inductance Switches — Sockets

JOS. W. JONES RADIO

TRADE MARK

"IMPROVED"

radio parts

JOS. W. JONES RADIO MFG. CO., Inc., 40 W. 25th St., New York
(Formerly Radio Improvement Co.)

Headed by Jos. W. Jones—for 28 years a successful engineer and builder of precision instruments

Who brags the most?

WHO brags the most—the fellow who built his own—or the perfect nuisance who just bought a FREED-EISEMANN?

Listen to that FREED-EISEMANN fan . . . . he's the man who owns one. His distance stories are apt to be true. His report about volume and selectivity is absolute fact. But what he says about reality of reproduction is something you won't believe until you hear the FREED-EISEMANN Radio Receiver yourself.

The FREED-EISEMANN is so designed, so built and so inspected, that electrical distortion is reduced to its scientific minimum. It delivers an electrically pure output to the Loud Speaker—for conversion into musically pure sound.

FREED-EISEMANN engineers have done a job—The Public has approved. Witness—ten million dollars' worth of FREED-EISEMANN apparatus in daily use.

If you want to be shown, let us remind you that we do a big business in Missouri.

FREED-EISEMANN RADIO CORPORATION

Manhattan Bridge Plaza **Brooklyn, New York City**

Handsome new four-tube and five-tube models. Price, $100 up . . . . slightly higher in Canada and west of the Rockies.

Our new booklet, "Buying a Radio," is interesting and informative—with a personal word to the radio expert. It is free on request.

FREED-EISEMANN

RADIO RECEIVERS

NEUTRODYNE

Cockaday specifics

EVERY part for the New Cockaday Four Circuit Tuner, with resistance coupled amplifier, exactly as Cockaday himself built it. Not a chance of going wrong when you buy this AMPLEX KIT.

The AMPLEX Kit is the only complete Cockaday Kit. It is the result of the co-operation of the manufacturers of all the parts used by Cockaday, Popular Radio Magazine, and the "Amplex Kit Way" engineers.

Never before has set building been made so safe, so simple. The AMPLEX Kit for the New Four Circuit Tuner contains everything from the authorized coil, the official Popular Radio blueprint, right down to the brass brackets and the last bus wire. And every part doubly guaranteed by the manufacturers and by us! All guesswork is eliminated.

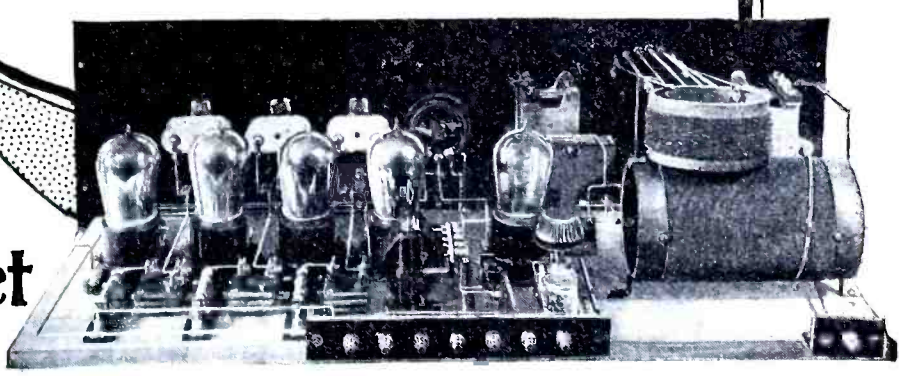
Look over this list of parts. Compare it with the article by Cockaday in the October Popular Radio and convince yourself. If you want a set with a 3,500 mile clear and undistorted loudspeaker range, go to your dealer at once for this AMPLEX Kit, or send us your remittance if he cannot supply you!

1 "Precision" Cockaday Coil Set	$5.50	$5.50
1 "Cardwell" Vari. Cond. .0005	5.00	5.00
1 "Cardwell" Vari. Cond. .00035	4.75	4.75
2 "Accuratune" Dials	3.50	7.00
1 "Amplex" GRID-DENSER	1.25	1.25
1 "N. Y." Fixed Cond. .00025	.35	.35
9 "N. Y." Fixed Cond. .005	.60	5.40
5 "Benjamin Cle-ra-tone" Sockets	1.00	5.00
1 "Bradleyleak"	1.85	1.85
3 "Bradleyohms" No. 25	2.00	6.00
1 "Amsco Dubl-Wundr"	2.00	2.00
1 Switch Lever	.30	.30
4 "Amperites" No. 1-A with mountings	1.10	4.40
3 "Improved" DC Jacks	1.00	3.00
1 "Improved" SC Jacks	$ .70	$ .70
1 "Improved" Battery Switch	1.00	1.00
1 "Precise" Transformer	5.00	5.00
3 "Electrad" ½ meg. Leaks	.50	1.50
3 "Electrad" Mountings	.25	.75
8 Binding Posts	.10	.80
4 Y Brass Brackets	.05	.20
7 Switch points and 2 stops		.14
X1, X2, X3 Panels—3 for		.75
Bus Bar		.25
Baseboard		1.00
Set of POPULAR RADIO Blueprints and Instructions		1.10
Official Total List Price		**$64.99**

FREE—*A completely drilled and engraved mirror-finished bakelite panel free with every kit*

AMPLEX INSTRUMENT LABS.
88 West Broadway **Dept. P. 11A** **N. Y. C.**

The *NEW* Cockaday Set



All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Even better prepared to serve you than before

Our one aim has been to serve dealers better. They have appreciated our efforts. As a result we have outgrown our old quarters and are now in a six story building in the heart of Pittsburgh.

There we maintain an Inspection and Repair Dept. for your service, where we test all tubes for filament emission and oscillation before shipment and quickly repair most defective sets returned by you without sending them to the factory.

In our new quarters we carry larger stocks to better serve you. In order that your stock may move quickly, we carefully choose the lines we stock and sell you. Your sales are assured if you carry the lines listed in the shield to the right.

When material becomes scarce you know that all we get goes to you, for we wholesale only and do not retail to your customers.

Write today for Hommel's Encyclopedia of Radio Apparatus 256-P. It's free and will help you.

DISTRIBUTORS FOR
Radio Corporation of America
RCA
Westinghouse General Electric

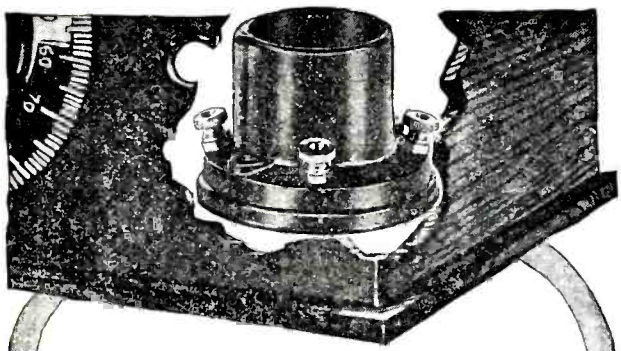
Baldwin Brandes Burgess
Cardwell Crosley
Cutler-Hammer
Dubilier Fada Freed-Eisemann
Freshman Frost
General Radio Grebe
Haynes-Griffin Magnavox
Remler Rhamstine
U.S. Tool Western Electric
And other
leading manufacturers

WHOLESALE EXCLUSIVELY

LUDWIG HOMMEL & CO

929 PENN AVENUE — LUDWIG HOMMEL & CO. — PITTSBURGH, PA.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



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. *"It's the contact that counts."*

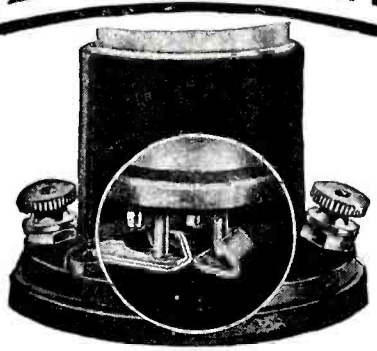
Make your Superheterodyne set free from socket trouble by using Na-ald De Luxe Sockets.

Sockets and panel mounts for all tubes. Prices 35c to 75c.

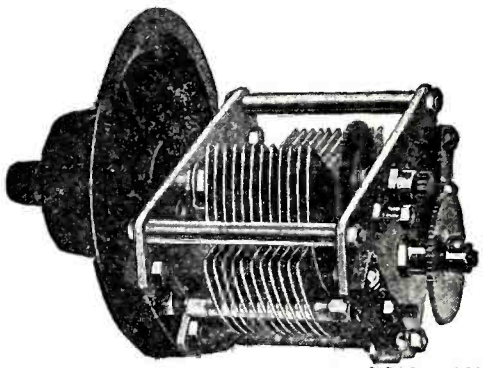
Send for Catalogue

ALDEN MANUFACTURING CO.
Dept. C.
Springfield, Mass.

NA-ALD



LOMBARDI GROUNDED ROTOR CONDENSER



An ACCURATE, ATTRACTIVE CONDENSER of moderate dimensions with the following special features:
LOWEST DIELECTRIC LOSSES.
PIGTAIL CONNECTION and STOP.
GEARED VERNIER ACTION, that takes ANY SIZE DIAL.
45 DEGREE TAPERED BEARING and BALL and THRUST TYPE with adjustable spring tension (PATENTED).
ALUMINUM END BRACKETS and PLATES and ACCURATE SPACING.
TESTED by YALE LABORATORY to be one of the BEST.
Actual test sent on request.
Condensers furnished plain or geared Vernier or with Vernier dial.

Literature sent on request

THE LOMBARDI RADIO MFG. CO.
71 MINERVA ST., DERBY, CONN.

Radio Dealers HEADQUARTERS

The House of a thousand values

Eight Big Warehouses

Write for Catalog C1003

WAKEM & McLAUGHLIN
225 E. ILLINOIS ST. — CHICAGO

PEERLESS RADIO

349 Fulton St. Brooklyn, N. Y.

COMPLETE PARTS on hand for the 5 TUBE COCKADAY FOUR-CIRCUIT TUNER with resistance coupled amplifier as specified by Laurence M. Cockaday in October's Popular Radio.

Also drilled and engraved panels for the above

Headquarters for "Hard-to-get-Apparatus".
Special discounts to builders.
Send for catalogue P. "Bargains Galore".

Everyone interested in Radio should have this

68-page book of approved parts and sets—it's free!

Ward's New Radio Catalogue

Write for Your Free Copy

ONE copy of Ward's New Complete Radio Catalogue is yours Free—you need merely to write for your copy.

It shows you everything new in Radio, everything that has been tested and approved by the Radio laboratories. Simple instructions are furnished with every Ward receiving set, enabling you to put up and operate it without outside help.

And the prices on everything in this book are surprisingly low!

A Price and Quality Guide

Study this Catalogue every time you need *anything* in Radio, whether parts or a complete set. See what *is the lowest price* for standard quality goods.

Everything shown in this Catalogue has been selected by an expert. Everything is standard. Remember at Ward's we never sacrifice quality to make a low price. Yet our prices are always low because we sell direct to you by mail—and without the usual "Radio Profits."

Bring the Joy of Radio Into Your Home

You can get the most enjoyment out of Radio only by using standard, high grade equipment. You know what you are getting when you buy at Ward's. You are sure of high quality as well as a big saving when you order from this book, for our Radio equipment is sold under the same liberal guarantee we have made for 52 years on every article sold by Ward's—"Satisfaction Guaranteed or Your Money Back."

Write for your free copy of the new Radio Catalogue. Write to our house nearest you and address 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

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Dear Jim:

Last night I heard them sing, "Give a Man a Horse He Can Ride", from old WTAM.

I'm going to write a new title for that song. "*Give a Man a Radio Battery He Can Charge,*" I say.

Willard Rechargeable Radio Batteries remind me of a fine big clock. A good clock keeps time, all the time, because you wind it occasionally.

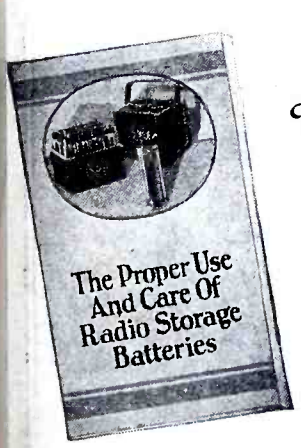
That's the way with Willards. They keep the power in the radio set and you don't have to wind them often. Just a little freshening charge once in a while and they're good as new again. Seems like you can't wear 'em out. I know lads who have had them for several years and their Willards are just as good now, as the day they bought them.

Get the kind that last, I say,

Sam.

WILLARD RADIO BATTERIES

FOR SALE AT WILLARD SERVICE STATIONS AND RADIO DEALERS



Write for WTAM's new booklet, "The Proper Use and Care of Radio Storage Batteries." Mailed to you with our compliments.

Write to **WTAM** *for this booklet—*

The Voice of the Storage Battery

WTAM is the Radio Research Laboratory and Broadcasting Station of the Willard Storage Battery Company, Cleveland, Ohio.

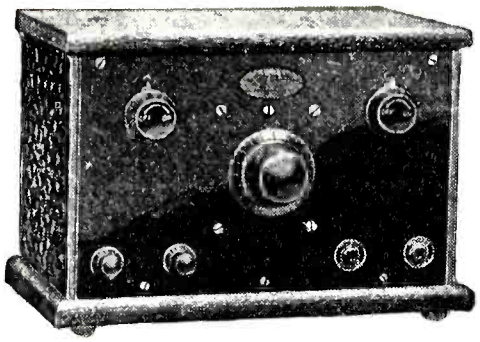
Its function consists of research which is being done to improve the quality of radio reception and the broadcasting of radio programs for your entertainment.

Tear me off the page and mail me to WTAM. I'll bring you "The Proper Use and Care of Radio Storage Batteries."

..... Name

..... City and State

..... Street Address P.R.-3



$18.00

Model C-12 Two-tube Receiver, **$18.00**—*A great distance getter; puts local stations on the horn; single dial tuning.*

KODEL $5.00 to $32.50

for { *every purpose* / *any purse*

RADIO'S latest triumph—the wonderful KODEL Circuit, brilliant discovery of an independent experimenter. So simple it can be sold at amazing low prices, so effective that it gives as good or better results than receivers costing much more. Single dial tuning except in the 3 and 4 tube models which have only two dials.

Powerful, compact, great for distance, works perfectly without an outdoor antenna, all at prices anyone can afford. Cabinets finished in handsome black leatherette. You may use either storage battery or dry battery tubes.

See the KODEL line at your dealer's. If he does not carry these marvelous sets send us his name and address and we will send you the interesting KODEL catalog, from which you can order direct. Money returned if any KODEL set does not more than satisfy you.

Dealers: the KODEL is a sensation wherever introduced. Write for terms.

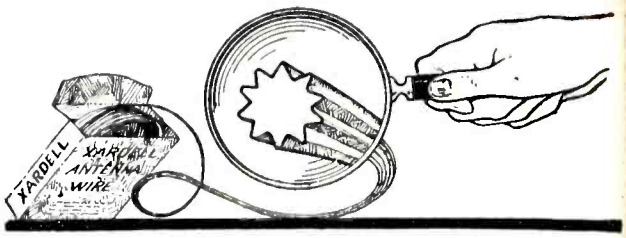
Kodel Manufacturing Company

Under the same management that made the HOMCHARGER *famous*

132 West Third Street, Cincinnati, Ohio

FREE! *Write for instructive* KODEL *catalog, entitled, "Radio for Every Purpose and Any Purse." FREE!*

DX - 10 - POINT



ANTENNA WIRE

$2.00

PER HUNDRED FEET

F. O. B. UTICA, N. Y

Supersensitive and designed especially for long distance reception.

It is not a make-shift, being hard drawn from best electrical copper, having ten collecting points or corrugations on the circumference. This gives greater collective surface to high frequency radio currents, resulting in increased distance and clearness of signals.

The antenna is the heart of your receiving set. Many are not satisfied with the reception or range of their sets when the fault is entirely in the poor and inefficient antenna installation.

Use this antenna wire and you will enjoy the full possibilities of your set.

Sold in 100 and 200 foot coils.

Order direct or from your nearest dealer.

Dept. R

XARDELL CORPORATION

UTICA, N. Y.

Get REAL Radio Results

FROM all parts of the country with voisometer quality sets. It is not unusual to bring in coast to coast, Canada and Cuba. No coils to loosen or break, no soldered wiring and all parts within easy reach of operator at all times. Voisometer quality sets are now being sold direct from the manufacturer to the consumer. Oak or mahogany finished cabinets for the following prices. 1 tube sets $18.00; 2 tube sets $30.00; 3 tube sets $40.00. Complete wiring diagram of sets with all instructions and booklet of voisometer testimonials from all parts of the country sent free upon request. All parts can be purchased in separate units if desired.

CO-OPERATIVE SALES CO.

401 Calumet Bldg. St. Louis, Mo.

Use Only the Best SPAGHETTI

Acme "Spaghetti" is varnished tubing to slip over bus bar wire to insulate it from other wires in a set. Flexible as rubber; will not harden or crack. Water, oil, acid and gas proof. In five beautiful colors to fit No. 12 to 18 wire. Ask your dealer, and send for free folder on Acme Radio Products, which also tells how to solder.

Acme Wire Co., Dept. P, New Haven, Conn.

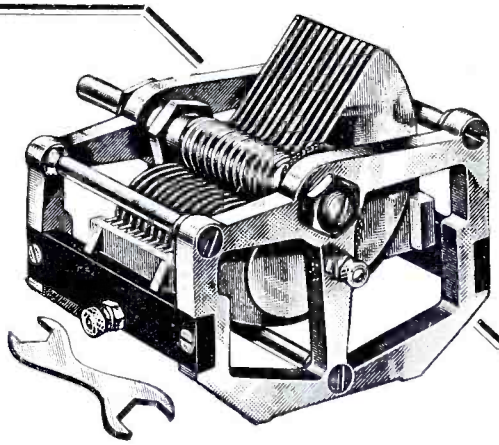
ACME RADIO WIRE NEEDS

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Are You Rich Enough To Afford Poor Parts?

Why Risk Your Money?

Do You Buy for Experience or Satisfaction?



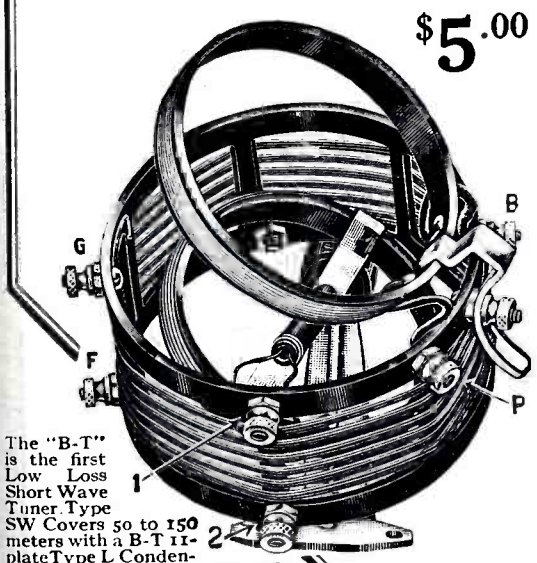
150 m.m.f. 7 plate $4.25
250 m.m.f. 11 " 4.50
520 m.m.f. 23 " 5.00
800 m.m.f. 35 " 6.50

If you want to know where B-T Products stand, ask the man who is using them.

We began production this Fall with unfilled orders greater than total shipments for September, October, November and December of 1923,—although not 10% of our jobbers had seem samples of our new products. THAT'S CONFIDENCE!

It means that users have been satisfied — that reputation counts—and that fair treatment is remembered.

It means low sales resistances and more value in the product itself.



The "B-T" is the first Low Loss Short Wave Tuner. Type SW Covers 50 to 150 meters with a B-T 11-plate Type L Condenser. Type B covers 200 to 565 meters—no taps in either Case, and the price is $5.00.

It means added desire to safeguard our leadership—to put out only products that will do credit to our name and to limit production to what we can put out right.

If you want value received, let your judgment be your guide—and get busy.

Bremer-Tully Mfg. Co.,
534 S. Canal St. Chicago

Western Electric *and* BAKELITE

In each of these Western Electric Telephone Head Sets is a molded Bakelite terminal block.

The use of Bakelite by this company, with its years of experience in the manufacture of electrical communication apparatus, is evidence of its value as an insulating material.

Bakelite dials, panels, variometers and other parts are standard radio equipment. Mechanically strong, unaffected by atmospheric changes, and beautiful in appearance, they may be depended upon to render years of good service.

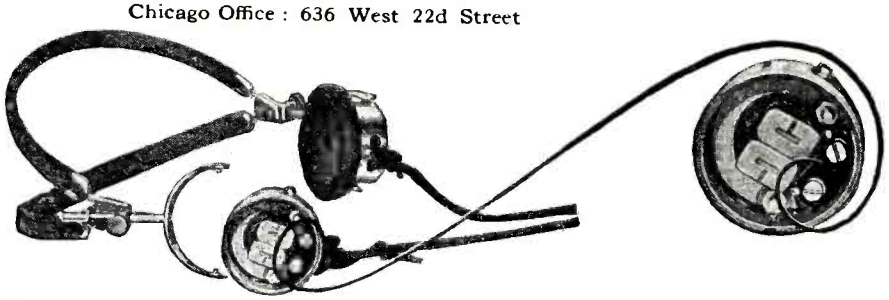
Send for our Booklet K.

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 10c to cover the cost, and we will send you this map. Address Map Department.

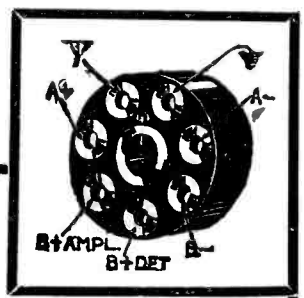
BAKELITE CORPORATION
247 Park Avenue, New York, N. Y.
Chicago Office : 636 West 22d Street

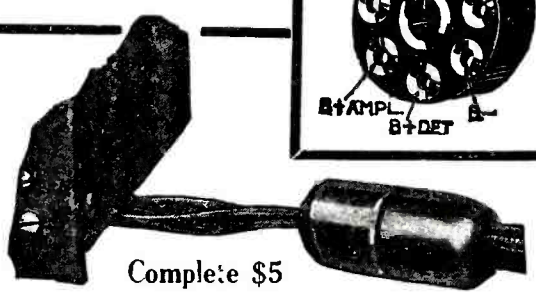
BAKELITE
Condensite
REDMANOL
are the registered Trade Marks for the Phenol Resin Products manufactured under patents owned by
BAKELITE CORPORATION



THE MATERIAL OF A THOUSAND USES

Jones Multi-Plugs are supplied for panel or bracket mounting. Also (as illustrated below) with seven leads coded for attaching to binding posts of any set.





Complete $5

One Pull

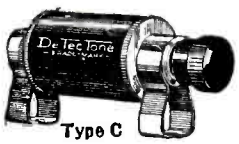
on the Jones MULTI-PLUG instantly disconnects antenna, ground, A and B batteries from your set! One push reconnects! Long cable permits placing batteries out of way—in basement, closet or elsewhere. All leads coded.

Jones MULTI-PLUG

Can't be plugged in wrong. Prevents burning out tubes or shorting batteries. 100 percent foolproof. Enables anyone to connect your set with safety. Standard on Zenith, WorkRite and many other leading sets. Jones Multi-Plugs, complete for panel mounting, $4; for bracket mounting, $4.50. Binding Post type, $5.00. Carried by all jobbers. If your dealer isn't supplied, state his name when ordering. Folder free.

Pat. Applied For

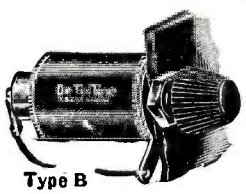
HOWARD B. JONES
616 S. Canal St. Chicago



Type C

Highest Praise for DE-TEC-TONE

Not only those who "build their own" but manufacturers, too, highly praise the de-tec-tone for its consistent performance. Use DE-TEC-TONE on either crystal or reflex sets. Operates unfailingly. Insures greater selectivity, more volume and greater D.X.


Type B

At dealers or direct. Type "C" above $1.50. Type "B" below $1.60. JOBBERS: discounts and literature on request.

PYRAMID PRODUCTS CO.
117 N. Dearborn St. Chicago

RADIO TUBE EXCHANGE

We Repair All Standard Makes of Tubes, Including

W.D. 11 or 12
U. V. 199 or C. 299
C. 11 or 12
U.V. 201A or C. 301A
D.V. 1 or D.V. 2
U.V. 200 or 201
C. 300 or 301

$2.00

U.V. 202 Repaired, $3.00
All tubes guaranteed to do the work.

RADIO TUBE EXCHANGE
200 BROADWAY, NEW YORK
All Mail Orders Given Prompt Attention. Orders Sent Parcel Post C. O. D.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

BRISTOL

One Stage Power Amplifier

Needs No "C" Battery

Give Your Loud Speaker a Chance

Loud Speakers will not give best results unless there is sufficient amplification.

It is not necessary to rebuild your set to secure the required amplification—here is a One Stage Unit which can be added to any good audio receiving set of one or two stages. In fact, any desired amplification can be had by connecting several Bristol One Stage Power Amplifiers together.

This amplifier has been carefully worked out to avoid the distortions of speech and music which are apt to mar the performance of an amplifier with improper grid control and transformers of inferior design. When used with loud speakers of the better class, and particularly with the Bristol Audiophone, music and speech are reproduced without any distortion that the ear can detect.

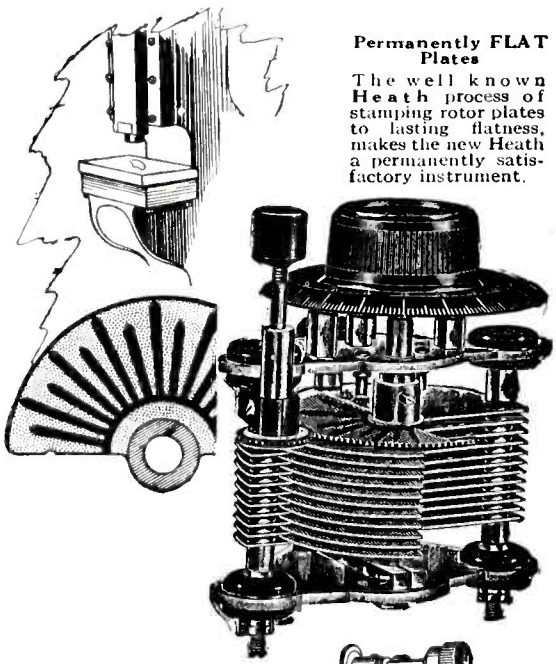
Write for Bulletin No. 3011-L.

Made by

THE BRISTOL COMPANY

WATERBURY, CONN.

HEATH Radiant

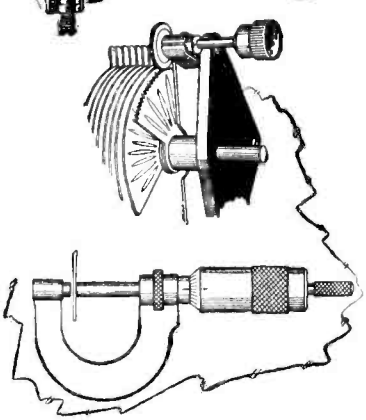


Permanently FLAT Plates

The well known Heath process of stamping rotor plates to lasting flatness, makes the new Heath a permanently satisfactory instrument.

Micrometer Geared Vernier

Ordinary adjustments reduced by separate geared adjustment to hair-breadth distinction. We guarantee the Heath Vernier Condenser to be more highly selective than any condenser employing a vernier which actuates ALL of the plates.



NON-DIELECTRIC Condensers

Dielectric losses reduced to insignificant minimum as required by the latest circuits. ALL Metal—only enough dielectric material to properly insulate rotor from stator elements. Smooth, true-running shaft, like the jewel movement in a watch. Contacts independent of bearings—pigtail connections insures NO LOST EFFICIENCY. Equivalent series resistance of only 0.1 ohm and a phase difference of less than one minute.

PRICES FOR VERNIER CONDENSERS

	With Dial	Without Dial
No. 12 AV 12 Plate	$5.00	$4.35
No. 24 AV 24 Plate	5.50	4.85
No. 44 AV 44 Plate	6.50	5.85

Plain types in all sizes

Ask for Heath Sockets and Dials

HEATH RADIO & ELECTRIC MFG. COMPANY

204 FIRST ST., NEWARK, N. J.

Exclusive Canadian Distributors
Marconi Wireless Telegraph Co., Ltd., Montreal, Canada.

In She Comes!

TIP your whisker to almost any point of an NAA Meter tested crystal and the full flow of the impulse instantly hits your phones, clean, clear, steady.

Reason—no guess work in the test;—every, EVERY crystal meter-tested singly by specially made electrical instruments to a point away beyond normal sensitivity. In addition, the Newman-Stern mounting is new—patents pending—cold assembly, provides for refilling, and avoids damage to crystal by hot alloy; recessed for protection.

Perfect for Reflex

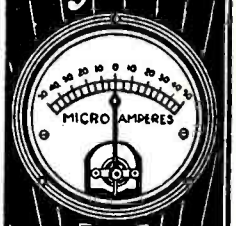
At all good jobbers and dealers, in neat turned wood box, 60c. If dealer can't supply, order direct and send dealer's name.

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

New NAA Meter Tested Crystals



Nuggets of Sensitiveness

Stage This 3 Act Play Do This

I Go to a studio and hear an artist sing.

II Listen to the same voice thru a metal speaker.

III Listen to the same voice thru our Die Cast Wood "Clearspeaker." You will think yourself back in the studio again.

Only wood can reproduce—exactly as the artist sings, and as the piano plays. If your dealer cannot supply you, order direct.

COMPRESSED WOOD CORPORATION
Formerly American Art Mache Co.
351 Austin Ave. Chicago, Ill.

Die-Cast Wood
$15

WALNART

Trouble-proof" Radio Products include: Tube Sockets, "B" Battery and Inductance Switches, Lettered Binding Posts, Variable Condensers (plain and Vernier), Vernier Adjusters, Dials, Variable Grid Resistances, "The Dialog," etc. At dealers, or write for booklet.

WALNART ELECTRIC MFG. CO., CHICAGO

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.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Of Course It's a CROSLEY
Better-Costs Less Radio

To combine the two most desirable things in radio—distant, clear reception at the lowest possible price—there is only one receiver for you. That is a Crosley.

During the past twelve months Crosley made and sold more sets than any manufacturer in the world, we believe. This is self-evident proof of Crosley Quality and Crosley Performance.

From the one tube Armstrong Regenerative Receiver Crosley 50 at $14.50, the lowest priced regenerative set on the market, to the three tube Armstrong Regenerative and Reflex Trirdyn Regular at $65—in special mahogany cabinet $75—Crosley Receivers, each in its own class, assure you as good or better reception than any other instrument of the same number of tubes. At the same time they are the least expensive sets ever offered to the public.

The Trirdyn Regular has especially come through the summer with flying colors. The combination of one stage of tuned radio frequency, with regenerative detector and reflexed amplification, has proven beyond a doubt that the features of selectivity, volume and ease of operation can be obtained with three tubes better than heretofore has been possible with five tubes. We believe no other receiver combines these features so well incorporated in the Trirdyn.

Before you buy—Compare Your choice will be a Crosley
For sale by good dealers everywhere
Send for complete catalog

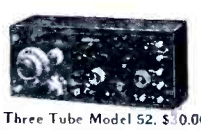
THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., President
1116 Alfred Street **Cincinnati, O.**

Crosley Regenerative receivers are licensed under Armstrong U. S. Patent 1,113,149. Prices West of Rockies—add 10%
Crosley Owns and Operates Broadcasting Station WLW

Crosley Head Phones Better—Cost Less $3.75

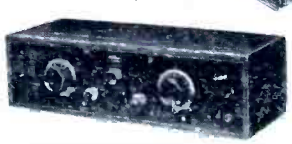
Crosley One Tube Model 50, $14.50
With tube and Crosley Phones $22.25

Crosley Two Tube Model 51, $18.50
With tubes and Crosley Phones $30.25



Crosley Three Tube Model 52, $30.00
With tubes and Crosley Phones $45.75

Crosley Two Tube Model 51-P, $25.00
With tubes and Crosley Phones $36.75



Crosley Trirdyn Regular, $65.00
With tubes and Crosley Phones $80.75

Crosley Trirdyn Special, $75.00
With tubes and Crosley Phones $90.75

Mail This Coupon At Once

The Crosley Radio Corp'n.
1116 Alfred St.
Cincinnati, O.
Mail me, free of charge, your catalog of Crosley receivers and parts with booklet entitled "The Simplicity of Radio."

Name_____

Address_____

"Gets the Absolute Limit Out of Any Set"

"Your Superspeaker is my biggest help in closing the sale of any complete set" writes in a successful amateur builder. "It gets the absolute limit out of any set in tone, volume and distance."

Here's a frank, simple statement. It rings true. Grasp its full significance!

'The absolute limit of any set'! That's what every devotee of radio wants with all his heart. And The Superspeaker is the way for him to get it—without extra batteries and with an original method of adjustment that never deteriorates.

The owner of a Superspeaker-equipped set always welcomes every form of competitive test. Comparison always confirms the pride in its performance.

Here is the reproducing instrument you need for 100% performance.

Get a Superspeaker and reach out!

JEWETT RADIO & PHONOGRAPH CO.
5668 Twelfth St., Detroit, Mich.

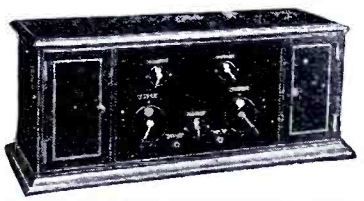
JEWETT Quality Products

The Superspeaker

You'll be Proud of This Michigan Four

"America's Most Beautiful Set"

Michigan "de Luxe" 4 tube receiver. 1 stage R.F. amplification. Built-in adjustable loud speaker. Solid mahogany case. "America's most beautiful set" M R C 4, $150



3 tube receiver in handsome case with inlaid panel door, and compartments for batteries, head phones, etc. M R C 3, $87.50

1 Tube Regenerative Detector and 2 stages of amplification. The set we never could catch up on orders for last year. M R C 12, $57.00

Michigan two stage amplifier. Will operate any loud speaker. Gives any degree of volume desired without distoration. Can be used with any receiving set. M R C 11, $30.00

2 tube Regenerative long distance wonder. M R C 2, $32.50

THE art of Chippendale, the grace of Louis XIV, the sturdiness of the Jacobian period have been combined in this wonderful Michigan four cabinet. And in the radio receiving set itself, all the latest development in good construction and design have been incorporated. One stage of radio frequency, a detector, and two stages of amplification, give you distance—selectivity and unusual volume.

A built-in loud speaker, with adjustable feature of exceptional mellow tone quality is part of the set.

Also compartment with ample room for batteries. The set operates equally as well on Standard Six Volt or Dry cell tubes.

The beautiful mahogany cabinet with inlaid drop panel gives you a set that cannot be surpassed for beauty and service.

Write for Illustrated Folder
Ask Your Dealer for Demonstration

Other models and types to meet all requirements from $32.50 up.

Licensed under U. S. Patent 1,113,149-letter pending 807,388

MICHIGAN RADIO CORPORATION

33 Pearl Street Grand Rapids, Michigan

ELECTRAD

Parts of Guaranteed Dependability

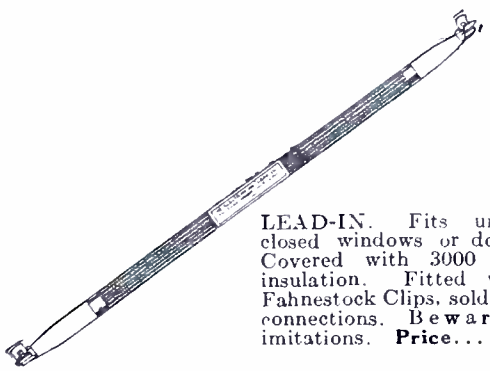
CERTIFIED LEAK. The most dependable grid leak made. Absolutely correctly calibrated. Each one tested and permanently set. **Price** **50c**

VARIOHM. A scientific variable grid leak. Any resistance from ¼ to 30 megohms by turning the knob. Guaranteed to increase your distance. **Price 75c. Mounted** **$1.00**

AUDIOHM. Just try one across the secondary of your transformer. **$1.50** with adjustable bracket.

LIGHTNING ARRESTER. If fire should occur, you can't collect insurance if you haven't a lightning arrester. Get an Electrad. Model passed by the National Board of Fire Underwriters. **Price** **50c**

LAMP SOCKET ANTENNA. Simplest, and most effective antenna. **Price** **75c**



LEAD-IN. Fits under closed windows or doors. Covered with 3000 volt insulation. Fitted with Fahnestock Clips, soldered connections. Beware of imitations. **Price**....**40c**

DON'T take chances. Insist on getting Electrad parts and protect yourself by using them. They are the trade-marked products of one of the oldest and largest radio laboratories.

Electrad parts are precise, scientific instruments for radio reception, the finest product of skilled craftsmen.

They cost no more, frequently less. If your dealer cannot supply you send us his name and the purchase price indicated and we will see that you are supplied.

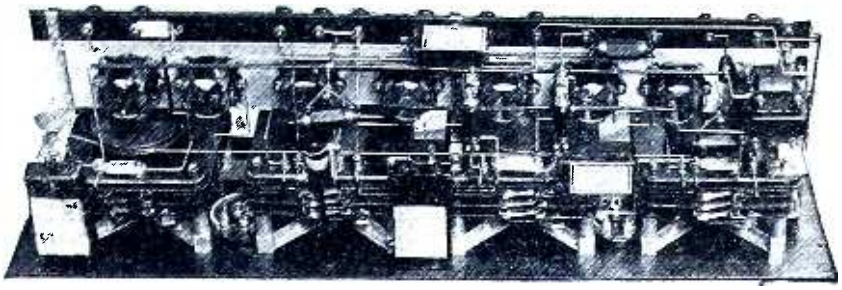
ELECTRAD, Inc.

428 Broadway, New York

Makers of

Hydrogrounds, Glass Grid Leaks, Variable Grid Leak and Condenser Combined, Grid Leak Mountings, Aerial Outfits, Fixed Resistance Units, Indorarial, Resistance Coupled Amplifier Kits, Verni Tuner.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



The rumored Telos Kit now ready

with refinements and features of amazing interest

Already they're building new Telos sets—the experienced fans who first discovered the amazing results Telos gets. And the very ones, who from the beginning said Telos was everything they wanted a set to be—they are the ones who are now most surprised at the lengths to which the Telomonic principle of tuned R.F. has been carried.

Three stages of Telos tuned R.F.! Two stages of reflexed resistance coupled amplification. Six drycell tubes (U. V. 199's or D. V. 3's) consuming only 6 to 8 milliamperes at 90 volts.

The most distance, the most volume, for the least upkeep! Unicontrol (Pat. app. for), the clever device whereby all dials turn simultaneously for rough tuning, then separately for the finer adjustments.

These are just a few hints of the surprises in store for you in the Telos Kit. And you can do other things with it, too. In the Kit you'll find the most detailed instructions for using 6 volt tubes if you prefer. You'll find how to use transformer A.F. in place of resistance-coupled. You'll find all sorts of interesting combinations. Yet the essential Telos instruments for these variations of the Telomonic circuit are *all* in the Kit.

There's not a quarter enough room on this page even to list all the things you get in the Kit and all the interesting experiments you can try with them. But you *can* follow the example of thousands of experienced fans — and send the coupon below to-day!

Telos Radio

Danziger-Jones, Inc.,
Dept. A, 25 Waverly Place,
New York, N. Y.

Your new Telos Kit sounds good!

I want to know all about it at once.

Name .....

Address .....

.....

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Election Returns via the ECHOPHONE "F5"

Know how the States are "going." Get first hand, the returns from each state as they are radiocast by the leading stations of the country!

The Echophone "F5", the last word in radio receivers brings in any of the better known stations whether 2 or 2000 miles away. Employs a combined radio and audio frequency circuit and may be operated from either an indoor, outdoor or loop aerial.

Loud speaker reception of distant stations surpasses in clearness of tone that of any other 5 tube loop operated set.

For those who want a powerful but more modest outfit the Echophone "V3," a three tube regenerative at $50 is an exceptional value.

Your dealer will gladly demonstrate either of these models. Send for our descriptive folder. Address

Used with loop or outdoor aerial

$110.00

Without tubes and batteries.

The Armac Radio Company, Agents, 1120 N. Ashland Ave., Chicago, Ill.

Manufactured by THE RADIO SHOP
1120 N. Ashland Ave., Chicago, Ill.
Long Beach, Cal.; Sunnyvale, Cal.

ECHOPHONE

Storage Battery Results at Dry Cell Cost

Where Noted Experimenters Find

HARD-TO-GET PARTS

4-CIRCUIT TUNER WITH RESISTANCE COUPLED AMPLIFIER

Precision Cockaday Coil Set	Set $5.50
Cardwell Variable Condenser .0005 Mfd	5.00
Cardwell Variable Condenser .00035 Mfd	4.75
Accuratune Micrometer Control Dials	3.50
N. Y. Mica Fixed Condenser .00025 Mfd	.35
Amplex Gridenser	1.25
Bradleyleak	1.85
Benjamen Cleratone Sockets	1.00
Amsco "Dubl-Wunde" Combination Potentiometer and Rheostat	1.50
No. 1-A Amperites with mountings	1.10
Improved Double Circuit Jacks	1.00
Improved Single Circuit Jacks	.80
Precise A.-F. Amplifying Transformer 285-A	5.00
Bradleyohms No. 25	2.00
Electrad Certified Grid Leaks	.50
Electrad Certified Grid Leak Mounting	.25
N. Y. Mica Fixed Condensers .005 Mfd	each .60
Amsco Switch Lever	.30
Improved Filament Battery Switch	1.00

POPULAR RADIO PORTABLE RECEIVER

Marion Loop Antenna with Plug Attachments	6.00
National Variable Vernier Condensers	5.75

CRAIG TUNED RADIO FREQUENCY RECEIVER

Parts for Craig Coupler and R. F. Transformer	$3.25
41-Plate Cardwell Condenser	6.00
21-Plate Cardwell Condenser	5.00
11-Plate Cardwell Condenser	4.25

COCKADAY DISTORTIONLESS AMPLIFIER

1 Pr. Como Push and Pull Transformers	pair 12.50
1 Amertran Transformer	7.00
30 in. Lengths Celatsite Wire	.25
Quinby Radio Frames	each 1.00
Special Guaranteed Electric Soldering Iron for Radio Use	**$2.50**
Amsco 26-Plate Vernier Condensers with Dials	$4.50
Complete Set of Parts for Constructing Fixed Coupler for Craig Reflex Receiver	3.00

Write for Special Discounts on Complete Kits

Agents for
General Instrument Low Loss Condensers
Lopez Low Loss Tuners

Try us on any radio parts you have been unable to secure.

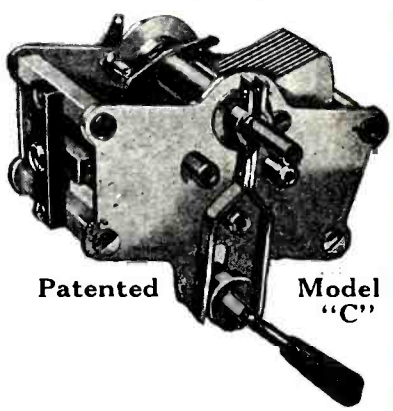
MORISON Electrical Supply Co. Inc

C.O.D. Mail orders will be shipped promptly

Wholesale *Retail*

15 East 40th Street New York City

"Just Be Sure It's a Hammarlund"



Patented **Model "C"**

1. Clock spring pig-tail
2. Ball bearing rotor shaft
3. Cut back plates for easy tuning on low waves
4. Strongest construction
5. Losses too small to measure
6. Soldered brass plates
7. Micrometer vernier
8. Takes any size dial

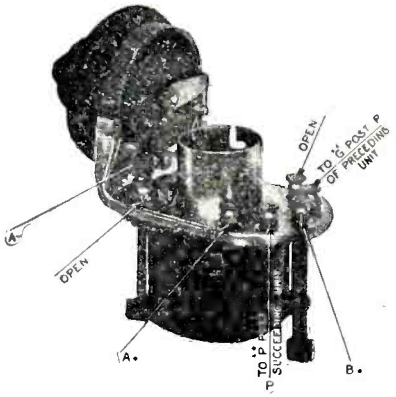
HAMMARLUND CONDENSER

Write for New and Interesting Folder

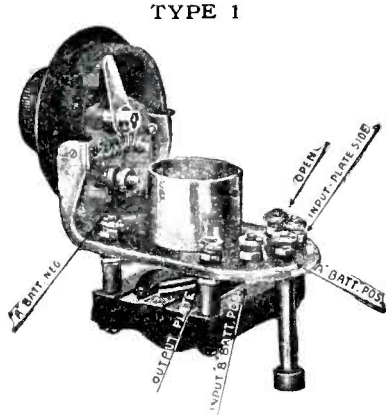
HAMMARLUND MFG. CO.

424-438 W. 33rd Street **New York**

Canadian Representatives
RADIO LIMITED, Montreal, Que.



TYPE 1



TYPE B

ANNOUNCING the Superadio Radio Frequency Amplifier Unit

One complete stage Non-oscillating Tuned Radio Frequency Amplification using the new Superadio Type X Transformer. No special spacing of coils or neutralizing condensers required. Unit consists of new Superadio low-loss straight line Condenser—Type X Transformer—socket and 8 or 30 ohm Rheostat.

	List
Type 1-RF Unit	$8.50
Type 2-R.F.U.	9.00

For last stage with grid-leak and condenser

Two Type 1-R.F. Units—One Type 2-R.F. Unit and two A. F. Amplifier Units constitute a complete Non-oscillating Tuned Radio Frequency Receiver, the equivalent of a five tube Neutrodyne Receiver.

"SUPERADIO" Audio Amplifier Unit

An unbeatable combination for faithful Audio Amplification. One complete stage of Audio Amplification in one unit.

Transformer already wired. May be used in any set.
Transformer shell type ratio 4 to 1. Rheostat 6 or 30 ohms.

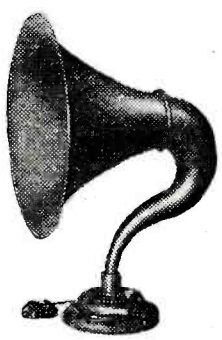
LIST PRICES

Type B for use without C battery	$7.00
Type C for use with or without C battery	$7.00

Manufactured by
DeWITT - LaFRANCE COMPANY, Inc.
54 WASHBURN AVENUE
CAMBRIDGE, MASSACHUSETTS

TRIMM
RADIO MANUFACTURING COMPANY
24 So. Clinton St.
CHICAGO
U.S.A.

Concert Model Speaker



The Concert Model No. 80 is especially designed for reproducing the enormous volume received from high-powered Super-Sets, without sacrificing the marvelous fidelity of tone and clearness for which Trimm Quality Reproducers are justly famous. An external adjustment, easily accessible, provides instant control of tone and volume.

$25

Professional Headset

$7.50

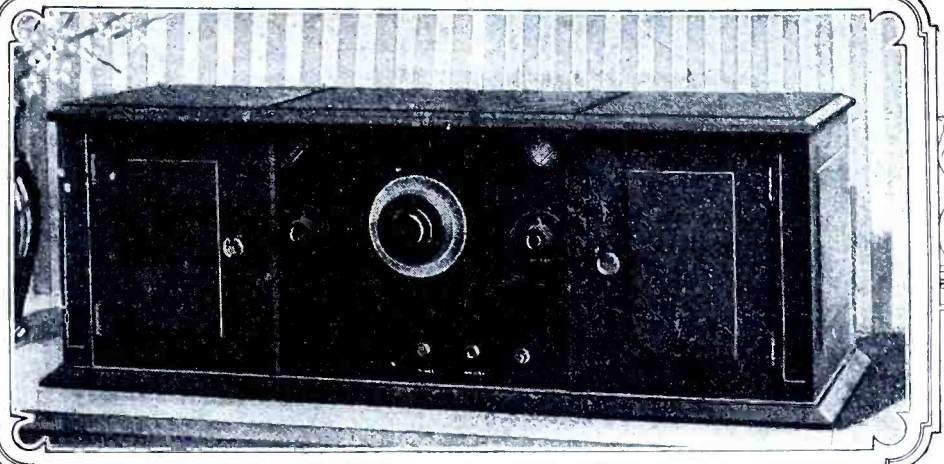
Trimm Headsets Proved Superior

Dr. Donald B. MacMillan, the noted Arctic explorer and the Wm. Hale Thompson expedition which is setting out to explore the un-mapped, far South Sea Islands, chose the Trimm "Professional" Headset after exhaustive tests proved it to be the most sensitive available. The "Professional" at $7.50 and the "Dependable" at $5.00 are two headset values unequalled in Radio.

Trimm Radio Manufacturing Co.

24 South Clinton Street Dept. B Chicago, Illinois

Member Radio Manufacturers' Association



The Ultimate Radio Receiver
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.

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.

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 Amplification, reception of music has been transferred into the realms of higher musical expression.

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.

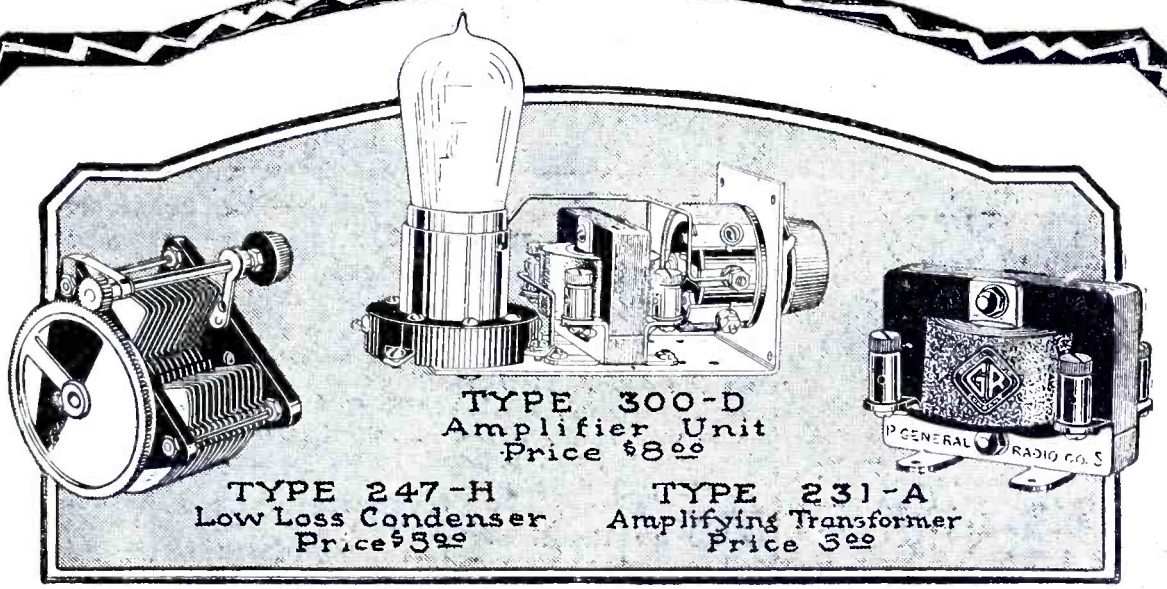
TRADE BRANDOLA MARK

Any Dealer will be glad to demonstrate the "BRANDOLA" for you—

List Price	$125
West of Rockies	135
Canada	165

The Brandola

The J. F. Brandeis Corp. 39 Oxford St. Newark, N. J.



General Radio Parts

Give Super-Reception

Selectivity, distance, clarity, and *volume* are the qualities that constitute *good reception* and are what you may expect from your set if you build with *GENERAL RADIO* parts.

For over a decade *GENERAL RADIO* Condensers have been the *universal favorites* because of their *low losses* and over-all efficiency.

Since 1917 *GENERAL RADIO Amplifying* transformers have been the leaders—not only in an historical sense but in *undistorted amplification.*

The type 300D is an amplifying unit designed for the convenience of amateur set builders. It combines the advantages of an efficient transformer, rheostat, and socket. Compactly assembled and ready for easy installation.

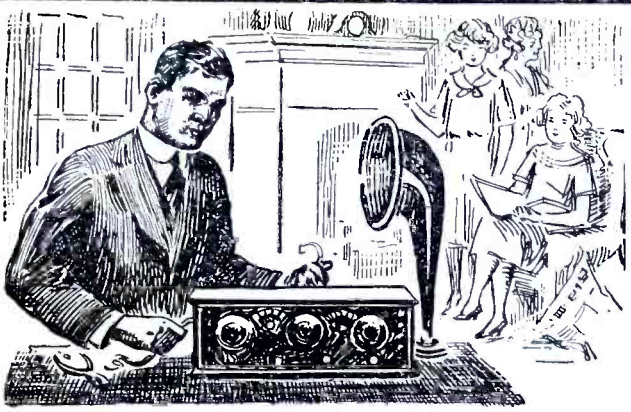
Whatever your circuit—build with *GENERAL RADIO* parts—for *Super-Reception.*

GENERAL RADIO Co

Cambridge, Mass.

Ask Your Dealer or Write
for Our New Radio Catalog

Be A Master OF THE Air



Pleasant Home Study

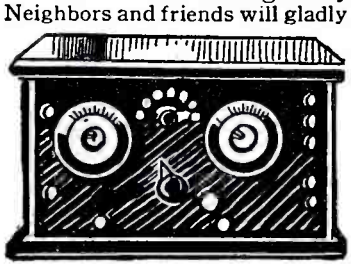
During the next few months you can, by devoting a few hours each week in pleasant home study, qualify yourself to get into the biggest paying field of all time. My practical, understandable course of instruction enables you to be a Master of the Air. Every problem in radio becomes an open book to you. *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 .....

Electrola

A Five Tube Tuned Radio Frequency Set that is unsurpassed when it comes to real long distance reception. Brings in even those stations furthest away with pleasing tone quality and volume.

The Electrola is highly efficient—no neutralizing condensers or loss producing potentiometers to cause trouble. It is non-oscillating—non-radiating.

Operating cost is extremely low. Only 5 milliamperes of plate current and 3 volts filament potential required.

Price $125

Ask your dealer or write to us for interesting literature.

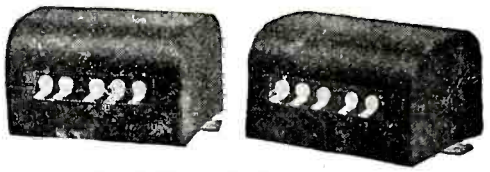
The American Specialty Co., Inc.
Bridgeport, Conn.

"The Golden Rule Receiver."

"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."

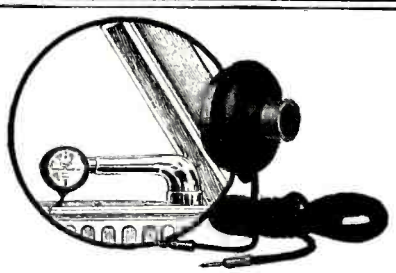
R. J. Robbins, *New York Sun:* "After consideration of several well-known makes of push pull transformers which are available "COMO DUPLEX" was selected as most satisfactory."

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



Make Your Own LOUDSPEAKER!

BRING your radio set up to the minute! Simply attach this little device to your phonograph in place of the sound box, and you've a loudspeaker of wonderfully clear, mellow, natural tone that will make all the other boys envy you. Only $7.50 gives you the N & K Imported Phono Unit, made in Europe by the makers of famous N & K Imported phones and N & K Imported Loudspeaker. Instantly attached to any standard phonograph. No screws necessary. Radio dealers allow responsible customers to try it in their homes *free for five days.* Ask your dealer. If he is not yet supplied, write us.

TH. GOLDSCHMIDT CORPORATION
Dept. P11, 15 William St., New York
41 Common St., Montreal, P. Q.

N&K *Imported*

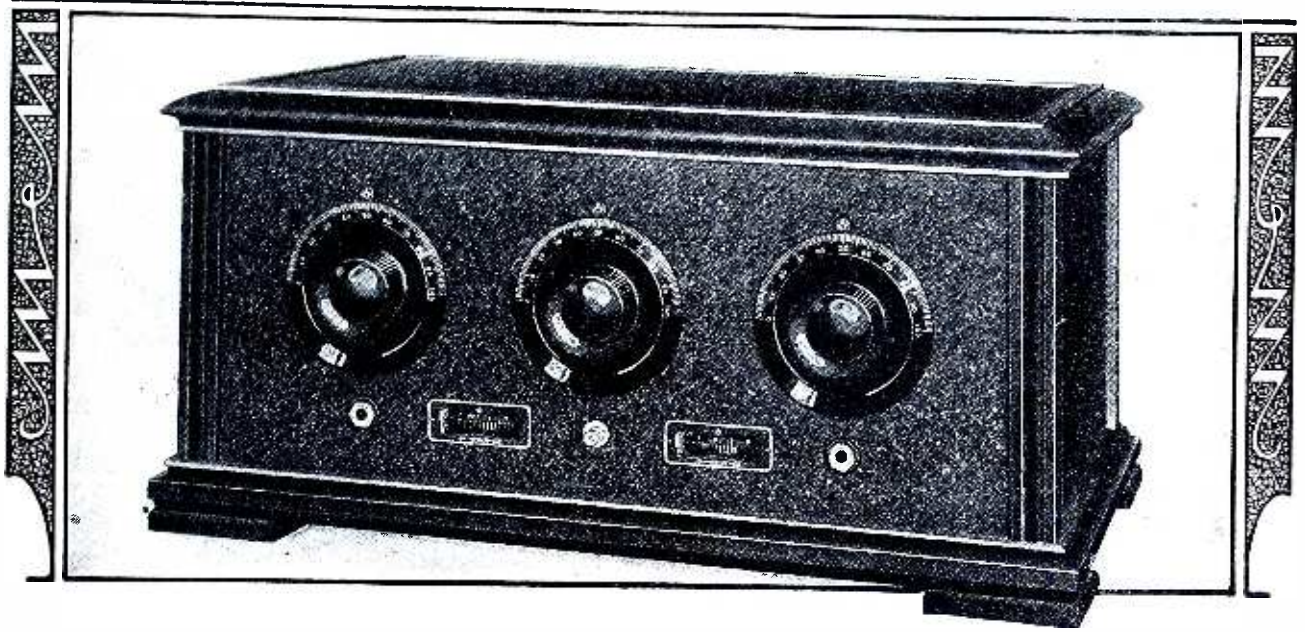
PHONO-UNIT

Descriptive Folder Free on Request

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

EISEMANN

ELECTRICAL EQUIPMENT



The Measure *of* True Worth

SPECIFICATIONS

Circuit: Two stages of tuned radio frequency amplification, detector and two stages of audio frequency amplification. Non-oscillating.

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.

Wave lengths: 200 to 600 meters, with uniform efficiency of reception.

Aerial: 75 to 125 feet, single wire.

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.

EFFICIENT performance, attractive appearance and moderate price are the three basic elements that comprise value in a receiving set, as in any other article. Trick names and catch phrases, used to designate circuits, mean little and often confuse the buyer. All three essentials are combined in the Type 6-D Receiver.

Performance: Extraordinary selectivity widens the choice of programs. In close proximity to powerful stations, the sharpness of tuning is marked. Far distant points are received with unusual clarity and volume. Tuning is very simple. The three dials are closely matched at all wave lengths, and settings are easily memorized.

Appearance: The substantial mahogany cabinet, with distinctive lines and high finish, is a fitting addition to the living room or library. The symmetrical panel layout and interior construction bear the imprint of advanced thought and skilled workmanship.

Price: $125.00, without tubes and batteries, creates a new standard of value.

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

Cannon-Ball Headset

$3.50

Cannon-Ball is the Headset that is giving radio enthusiasts the service they desire. It is made by Camco craftsmen who have been making headsets for over eight years —craftsmen who specialize on headsets and loud speakers.

Examine Cannon-Ball. The careful workmanship and beautiful finish of the entire set will impress you. Slip the phones on your ears. Comfortable? You bet—weighs only ten ounces complete with headband and cord. And when you attach Cannon-Ball to your radio set, the clearness of the reproduction of all tones will please you. "Radio as you like it," will be your comment when you invite a friend to "listen in."

We know that radio enthusiasts are recommending Cannon-Ball Headsets to their friends. To us it means larger production. And to you it means a quality headset at a fair price.

Like other folks, you'll invest your money wisely—Camco Cannon-Ball, $3.50; Camco Grand, $4.75, and the

CAMCO
Loud Speaker

$9.50

Truly a friend of the family. Horn, one piece brown molded fibre; Base, ornamental casting finished with black checked varnish, enclosed bottom, soft rubber feet; Height, 22 inches; Bell, 10 inches in diameter; Cord, black mercerized cotton, 5 feet long. Complete with a Camco permanent adjustment Loud Speaker unit. A quality speaker at a fair price—$9.50. West of Rockies, $10.50.

DEALERS: Ask your jobber about Camco products or write for complete details. All Camco products are backed by a liberal, money-back guarantee.

CANNON & MILLER CO., Inc.
SPRINGWATER, N. Y.

Kelford

A Transformer of Rare Achievement

The Kelford audio transformer is an instrument of rare achievement. It brings out every word or musical note broadcasted—no matter how high or low—or how distant the station may be—as clearly and distinctly as when transmitted through the Microphone. Not a bit of distortion, howling, or squealing, so prevalent in other transformers.

Write for complete literature on our entire line of quality radio apparatus. Also prices.

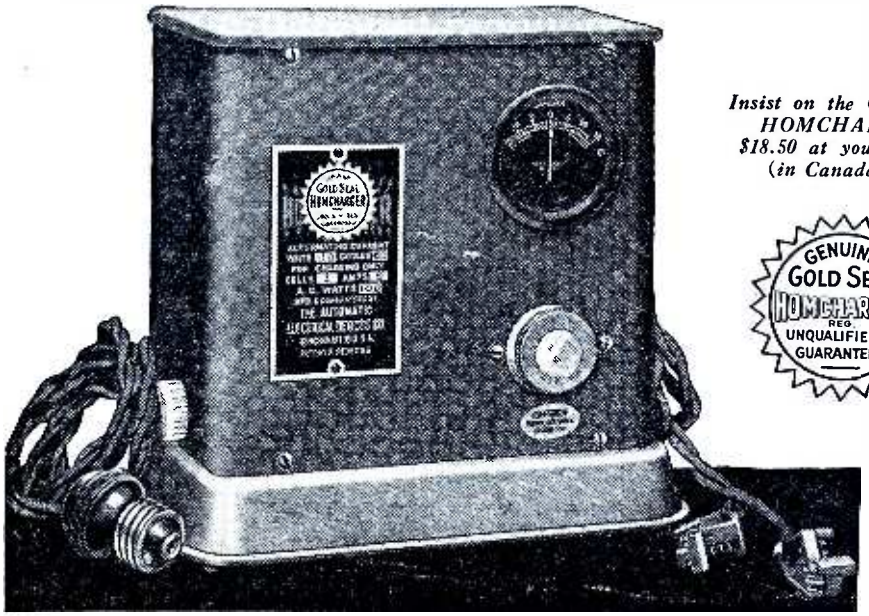
The American Specialty Co.
Holland Ave. Bridgeport, Conn.

This Money Saving Offer Limited to Twenty Days

UNTIL November 10, 1924, we will accept $4.70 as payment in full for two one year subscriptions for POPULAR RADIO. The primary object of this very low price is to secure *new subscribers* for POPULAR RADIO. We have in the past discovered that our old readers are, as well, loyal friends, and to permit them to take advantage of this money-saving opportunity, we will accept one renewal order and one new subscription for $4.70. The renewal will, of course, be entered as an extension of the present subscription while the new order may begin with any issue desired.

The cash saving is obvious. It will also be apparent that any subscriptions on this basis will not include premiums or other inducements. And inasmuch as the time limit will be strictly observed, we cannot too strongly urge you to forward your order and remittance promptly.

POPULAR RADIO, Dept. 117, 627 W. 43d St., N. Y. City



Insist on the Gold Seal HOMCHARGER $18.50 at your dealer (in Canada $26)

You needn't have "battery trouble"

TWO things will make your enjoyment of radio free from battery trouble. First, any good storage battery. Second that excellent, simple, automatic charger—the new silent Gold Seal Homcharger.

Insist on the GOLD SEAL — LOOK FOR IT

Such a combination means minimum care and maximum results, with no trouble at all. Then you can use your set all you want. If the battery becomes weak right in the middle of a program, screw the Homcharger plug in any lamp-socket, snap two spring clips over the battery terminals, and go right on listening at full power. Leave the Homcharger connected overnight, and in the morning the battery is charged again.

Everybody says this is the handsomest charger ever seen. The Gold Seal Homcharger is finished in mahogany-red and gold. It has rubber feet and so cannot mar polished floors, tables or cabinets. Safe—approved by the Fire Insurance Underwriters. Can't injure anything.

When buying a set, get storage battery tubes. They give most volume, and in many cases better results in distance too. Make sure the battery you buy is charged, then you can listen in for a week to a month before you buy your Gold Seal Homcharger. Price only $18.50 complete; $26 in Canada. Absolutely guaranteed.

FREE! Ask your dealer or send direct 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.

Insist on the Gold Seal Homcharger—ask your dealer.

The AUTOMATIC ELECTRICAL DEVICES CO.

Under the same management as the Kodel Mfg. Co.

132 W. Third Street Cincinnati, Ohio

Largest Manufacturers of Vibrating Rectifiers in the World

14 Gold Seal HOMCHARGER Features

1—Simple; needs no care.

2—Efficient; costs about 5c to charge the average battery, much less than bulb or liquid types of charger.

3—Quick; brings battery up to full charge overnight.

4—Tapers charge; cannot injure the battery.

5—Clean; no bulbs to break, no liquids to spill or produce fumes.

6—Dependable; adjusted and sealed at factory.

7—Lasts forever; only one moving part, the Tungsten contact, which can be replaced at $1 after many thousands of hours of use.

8—Fool-proof; charges automatically, no matter which clip is attached to which battery terminal.

9—Safe; approved by Fire Insurance Underwriters. No danger of shock or fire.

10—Beautiful; sturdy metal case finished in mahogany-red and gold.

11—Universal; made in types for all voltages of alternating and direct current. Charges all radio "A" and "B" batteries, and automobile batteries.

12—Quiet; its faint hum cannot be heard in next room.

13—Unqualifiedly guaranteed.

14—Popular price—sold everywhere for $18.50; in Canada $26. Complete, no extras to buy.

Guglielmo Marconi, as he appears today. Signor Marconi is Honorary Chairman of the Radio Institute of America

Write for information today

Success for You —in RADIO

The big men in radio today started—almost all of them—as radio operators. Very many of them are graduates of the Radio Institute (or Marconi Institute, as it was formerly called).

The demand for trained radio men today is too great to fill. Beginners are needed—and positions are open all the way up the ladder to the top. Train now. Radio is swiftly growing. And the opportunities grow with it.

Study at home

You can start now—at home—from the very beginnings of electricity—with the same guidance and instruction that has built the reputation of the Radio Institute. In a few months you can be fitted for your Government operator's license—and your first job.

The Radio Institute is under the auspices of the Radio Corporation of America, which places more men in radio than any other organization in the world—and gives preference to our graduates. Your opportunity is limited only by your ability.

Radio Institute of America
(Formerly Marconi Institute)
Established 1909
322A Broadway, New York City

Indicate by a cross X the course you are interested in:

Radio Institute of America,
322A Broadway, New York.

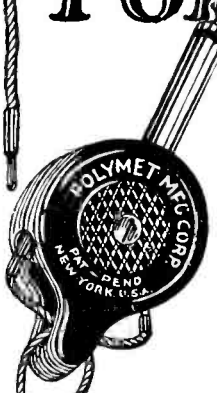
Please send me full information about radio opportunities today, and your *Complete Radio Course.*

Name.....

Address.....

.....

Poly Plug



Positive contact always maintained

The tension slot is the reason—a feature found only in Poly Plug. Permits the phone cords to be pulled and jarred without disturbing the contact a bit. The plug you have been waiting for. It's genuine Bakelite, too.

At your dealers otherwise send purchase price direct for plug **75c** *"Worth It"*

Polymet Mfg. Corp.
74 Lafayette St. New York

40c
each in any value from ¼ to 10

FRESHMAN SUPERIOR

You can depend upon them to remain accurate at all times

Made of high resistance material impregnated throughout (not coated paper). Unaffected by climatic conditions. Will not deteriorate. Clamped between solid knurled ferrules assuring rigid construction and firm contact at all times.

At your dealer's, otherwise send purchase price and you will be supplied postpaid.

Chas. Freshman Co., Inc., 106-7th Ave., N. Y.

FAHNESTOCK CLIPS

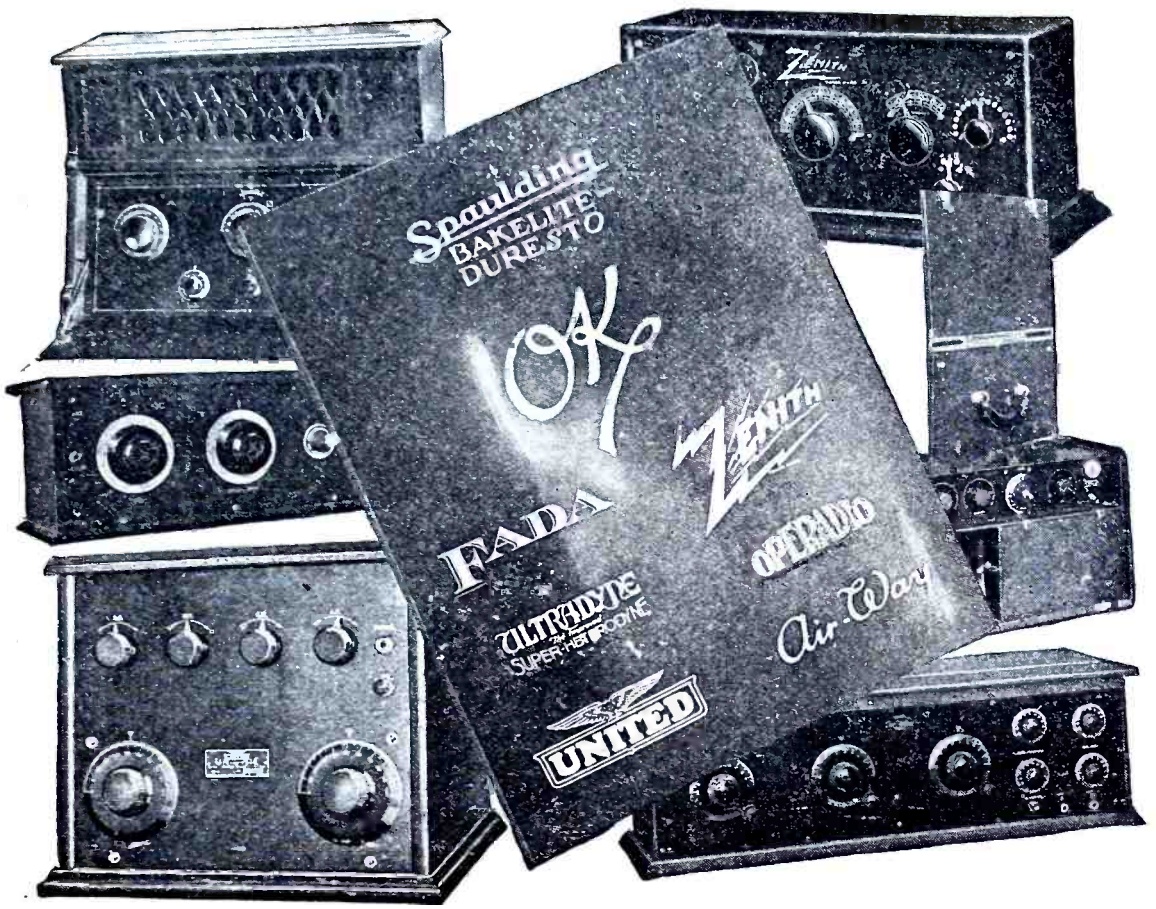
"Popular Wherever Radio Is Used"

14 Sizes in Beautiful Display Case.

Dealers write for big money-making proposition.

FAHNESTOCK ELECTRIC CO.

Long Island City, L. I.



Adopted by Leading Manufacturers

THE unqualified endorsement of these leading radio manufacturers is in itself the greatest recommendation of Spaulding Bakelite-Duresto quality.

These men know bakelite. They know quality depends solely upon manufacture. They know by actual experience that Spaulding Bakelite-Duresto panels possess high dielectric properties and great strength; that it drills, saws, engraves without chipping; that it will not warp; that it retains an everlasting lustre.

For efficiency and lasting beauty, you should use Bakelite-Duresto. Your dealer can furnish standard sizes, individually packed, special sizes to order. Look for Bakelite-Duresto panels on the sets you buy.

Write nearest office for descriptive circular

SPAULDING FIBRE COMPANY, Inc., TONAWANDA, N. Y.

SPAULDING FIBRE COMPANY

Manufacturers

who desire to build quality into their products and who insist on speed and economy in their plants should write our nearest office for complete information on Spaulding Bakelite-Duresto.

Factory: Tonawanda, N. Y.
Sales Offices: Warehouses

484 Broome St., N. Y. C.
659 W. Lake St., Chicago.
141 N. Fourth St., Phila.
15 Elkins St., Boston.
310 E. Fourth Street, Los Angeles.
171 Second Street, San Francisco.
509 First Nat'l Bank Bldg., Milwaukee.

Spaulding
BAKELITE-DURESTO
Panels - Sheets - Tubes & Rods

PYREX *All-Weather* Insulators

Using leaky antenna insulators to collect radio energy is like using a sieve to collect rain water.

You Can't Get Distance With Leaky Insulators!

PYREX is the ideal material for broadcast reception antenna insulators.

It has a continuous uniform structure that does not rely on a glazed surface for its insulating properties.

PYREX has a super-smooth surface to prevent the collection of soot and dust, and to allow rain to wash them off thoroughly. It does not absorb water, nor retain any surface moisture.

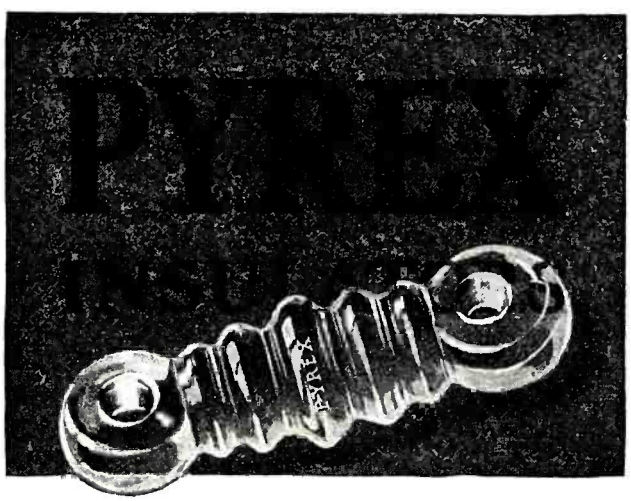
PYREX Antenna Insulators have an exceptionally low phase angle difference, which does not change appreciably with various wave lengths.

The United States Navy, Coast Guard, and other Government Departments use PYREX for the insulation of antennae.

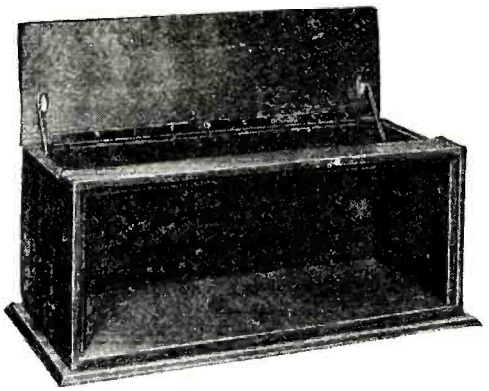
Insist on PYREX Broadcast Antenna Insulators to insure your set giving its best results. Retail at 45c.

Inquiries from jobbers invited

CORNING GLASS WORKS
Industrial Division
CORNING - - - NEW YORK



UTILITY SUPPLY COMPANY



From Factory to User

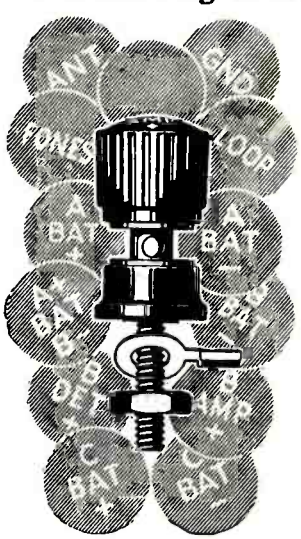
High Grade Radio Cabinets, sturdy built and fine looking. Built from select genuine black walnut or birch. Elegantly finished. Tops on all cabinets hinged. Fronts of cabinets are rabbeted to take panel. Walnut cabinets have continuous piano hinges and lid holders. Birch cabinets have regular hinges. (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.

Establishing a New Standard!



The New and Improved

"READ'EM" BINDING POSTS

"The Knobs Can't Come Off"

NEW MARKINGS FULFILL EVERY DEMAND

The Utmost in Quality and Appearance at the Lowest Price

15c.

At Your Dealers or sent Postpaid.

THE MARSHALL-GERKEN CO.
Toledo, Ohio

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

MU-RAD MA 20

Turn your switch and get Cuba or Seattle

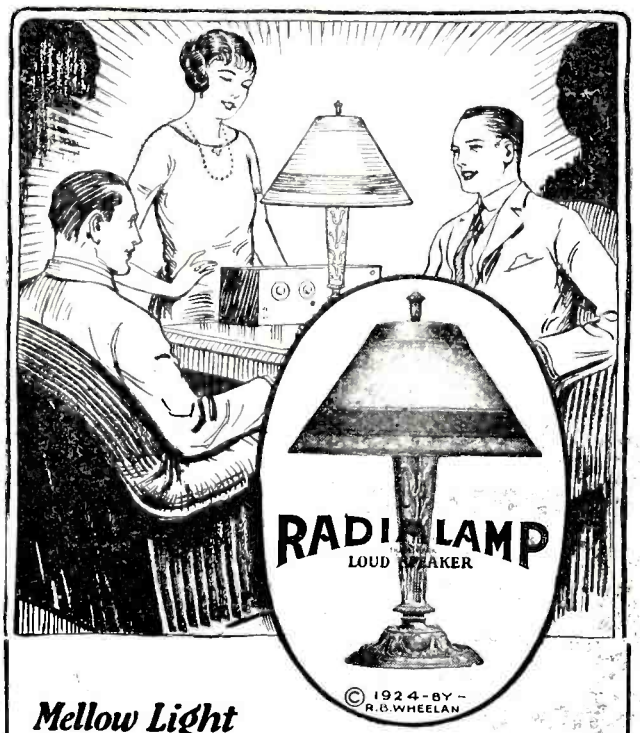
It is no trouble at all for a person in Dallas, Texas, to pick up either Seattle or Cuba with a Mu-Rad MA-20! Mr. K. H. Wiggett in Sherbrooke, Quebec, got Los Angeles "and heard them perfectly."

The amazing thing is, the Mu-Rad MA-20 does this without any batteries. Just hook it up to your electric light socket and you are in touch with the continent.

The Mu-Rad is so easy to operate! It will select stations with such rare delicacy that even a person with no knowledge of radio whatever may get any desired program that is in the air quickly and easily.

As for tone quality, the Mu-Rad must be heard to be believed. Get prepared for the Christmas programs. Write for literature on Mu-Rad Receivers and proof of the amazing results owners get. Address Dept. B.

MU-RAD
LABORATORIES, INC.
Asbury Park, New Jersey



Mellow Light
Beautiful Music

Amazing Radialamp a Perfect Loud Speaker

"WHERE does all the beautiful music come from," your friends will ask, never suspecting the magnificent lamp on the table. The beautiful parchment shade thru which streams a mellow golden light is in reality the most perfect Radio Loud Speaker yet produced. There is no metallic harshness—the tone is clarified by the heat from the electric lights and amplified by the parchment. The result is the most flawless reproduction of voice and instrument yet achieved. You can attach the wonderful new *Radialamp* to any socket as a light—to any radio set as a loud speaker. It doesn't even need to be in the same room with the radio set—you can put the *Radialamp* anywhere in the house and connect it to your receiving set by a long wire. Step into the nearest dealer today and see this remarkable lamp—but if he hasn't one—you can get full information by mailing this coupon.

RADIOLAMP CO.

Dept. 311 334 Fifth Ave., New York

Radiolamp Co., Dept. 311, 334 Fifth Ave., New York

Please send me at once complete information about RADIALAMP loud speaker.

Name .....

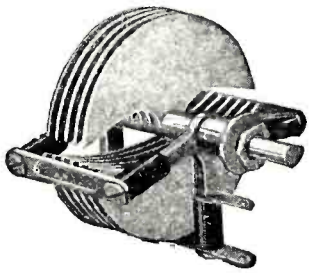
Address .....

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

RADIALAMP
TRADE MARK
LOUD SPEAKER

(Mfd. under U. S. Pats. No. 1,185,987, 1,272,843. Other patents pending.)

Premier "CROFOOT" Vario Condenser



"Look for the Condenser with the Red Stripe"

1 to 74 Tuning Ratio!

So great a ratio in a standard variable condenser is no accident. It is the result of careful engineering, radically different design and painstaking manufacture.

These facts are convincing evidence of superiority. "CROFOOT" has the lowest minimum capacity yet attained, therefore the greatest tuning ratio and widest tuning range. Extremely low phase angle loss, low insulation leakage and low skin resistance. Made entirely from brass and hard rubber, semi-straight line construction. All plates soldered. Grounded rotor. Lacquered rotor and stator plates. One hole mounting.

Min. Capacity	Max. Capacity	Tuning Ratio	List Price
.000005 M. F.	.0001 M. F.	1 to 19	$2.75
.000006 M. F.	.00025 M. F.	1 to 42	3.25
.000007 M. F.	.00035 M. F.	1 to 53	3.50
.000007 M. F.	.0005 M. F.	1 to 74	3.75

Complete with "E-Z-Toon" Vernier Dial 75 cents additional

Write for Free Bulletin No. 94 showing complete line of Premier Quality Radio Parts. Ask your dealer if he has Premier free hook ups. If not, send his name and receive a set free.

Premier Electric Company
3807 RAVENSWOOD AVE., CHICAGO

MAKERS OF

PREMIER
Quality Radio Parts

Big Dealer-discounts

It lists and illustrates absolutely dependable, guaranteed sets and parts. Give your customers what they want—when they want it; but buy it so that you can make a good profit. We're supplying hundreds of radio dealers satisfactorily every day. Write for catalog and discounts sheet. **You'll be astonished at the prices quoted.**

Ask for catalog No. 9

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

An even better "A" battery and at a much lower price

IF you are one of the thousands who have come to rely on the famous six-volt Exide "A" Battery, you will not recognize the new one when you first see it—but you will know it when you hook it up to your set, for it has the same old rugged power, the same constant efficiency, and the same long life.

You will say of this new battery: "Handsome is *and* handsome does." The composition case (including handles) is moulded in one piece. Beautifully stippled and finished in glossy black, it is an ornament to any room.

Broad inter-cell connectors fit close to the top of the battery. Offset terminal posts make it very easy to hook up. Filling plugs require but a quarter turn to remove. This new Exide is made in five sizes—50, 75, 100, 125, 150 ampere hour capacity.

A complete line of radio batteries

If you use low-voltage tubes you have your choice of those sturdy midgets, the Exide two- and four-volt "A" batteries, weighing but five and six pounds respectively.

In addition to the compact 24-volt Exide rubber case "B" battery of 4000 milliampere hour capacity there is the new Exide for those who desire visibility as well as capacity. This "B" battery is assembled in glass jars and is made in 24 and 48 volt size. Larger plates and greater space for the electrolyte give a capacity of 6000 milliampere hours.

The new Exide six-volt "A" Battery in one-piece case.
Price, **$14.60** *up, f. o. b. Philadelphia*

The Exide Rectifier enables you to recharge your "B" battery from your house current at a cost that is insignificant.

Ask to see the Exide line at any Exide Service Station or Radio Dealer.

Prices Exide Radio Batteries

Battery	*Capacity*	*Voltage*	*Price F.O.B. Philadelphia*	*Battery*	*Capacity*	*Voltage*	*Price F.O.B. Philadelphia*
3-LXL-5	50 A.H.	6	$14.60	1-KZR-5	24 A.H.	2	$ 5.40
3-LXL-7	75 A.H.	6	16.90	2-KZR-3	12 A.H.	4	7.30
3-LXL-9	100 A.H.	6	19.15	12-RB-2	4000 M.A.H.	24	10.00
3-LXL-11	125 A.H	6	22.10	12-LR-2	6000 M.A.H.	24	12.00
3-LXL-13	150 A.H.	6	25.00	24-LR-2	6000 M.A.H.	48	23.30

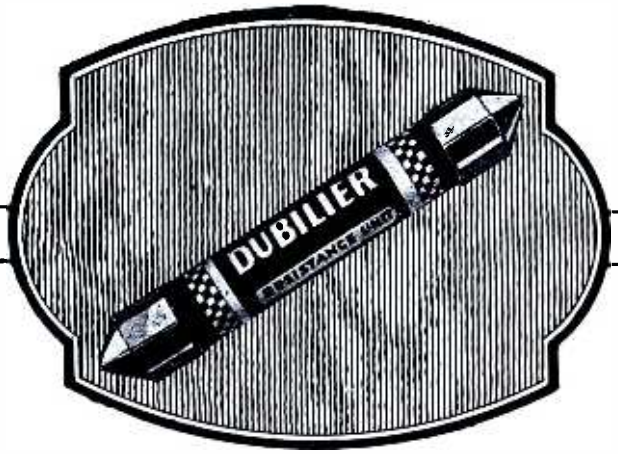
Exide Rectifier $2.00

For better radio reception use storage batteries

Exide
RADIO BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA

In Canada, Exide Batteries of Canada, Limited, 153 Dufferin Street, Toronto



PRICE 50c
Furnished in following Resistance values:
.5 .75 1. 1.5 2. 2.5 3. 4. 5. {megohms

The RESISTANCE UNIT
—*Accurate and Efficient*
A new Dubilier Product

The Dubilier engineers have perfected a resistance unit that is at once efficient, accurate *and constant.*

A good resistance unit will not change in resistance value with age. If it is marked 2 megohms it should have that same value to within commercial tolerance, after months of use.

It is easy to design a resistance unit but it has taken us years to produce one that is right—quiet, efficient and constant.

You will find that the Dubilier Resistance Unit greatly increases the range and efficiency of your set.

For a descriptive folder address 45-49 West 4th St., New York

Dubilier
CONDENSER AND RADIO CORPORATION

MAR-CO RADIO PRODUCTS CONDENSERS

MAR-CO CONDENSERS

43	plate	$6.50
23	"	5.50
17	"	5.00
11	"	4.50

without dials.

Choose the safe—and leak-proof way!

Specify MAR-CO whenever you buy radio instruments.

MARTIN-COPELAND COMPANY
Providence, R. I.

The name "MAR-CO" on the carton—and one good look at the construction—is enough for those who know a *good* condenser when they see it!

A FRANK STATEMENT

and Explanation to the Radio Public

From C. H. Thordarson, *President*
Thordarson Electric Manufacturing Co.

HERETOFORE, Thordarson Super Transformers have been mainly obtainable only by the manufacturers of quality radio sets. Fans, the world over, have of course noted the use of our transformers in a preponderance of leading makes of receivers.

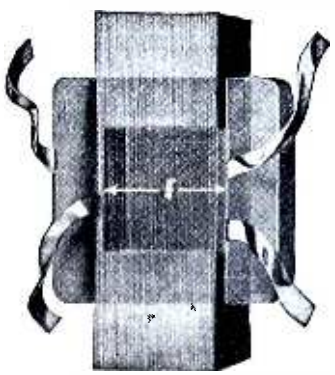
Quite rightly they concluded that Thordarson transformers must be decidedly superior. And so they sought to buy the same transformers for replacing unsatisfactory types and for use in home-built sets.

Despite the fact that we lead the field in number of transformers produced, dealers were unable many times to supply Thordarsons to these customers. This led to some feeling that we might be purposely restraining the general sale of our product.

The truth is that the tremendous gains in sales enjoyed by the makers who standardize on Thordarsons, took nearly all we could turn out even though our production was continually multiplied.

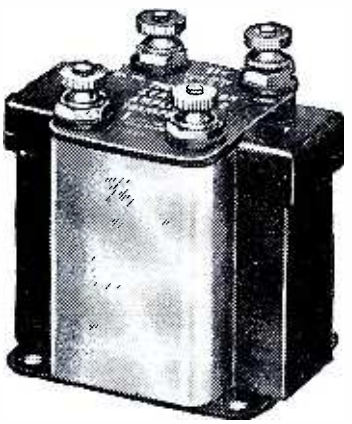
Not until last summer were we able finally to increase the capacity of our immense six-story factory sufficiently to provide for supplying the needs of the general public in addition to the larger wants of more and more set builders.

From now on, however, you should experience little if any difficulty in being able to buy Thordarson transformers. My aim is to build enough Thordarsons this season to permit every store to handle them.



The Exclusive
THORDARSON SQUARE COIL LEAK-PROOF CONSTRUCTION

The Thordarson-made layer-wound SQUARE coil fits snugly around the square core. Coil can't turn—no open circuits due to layers slipping. No air spaces between coil and core (exclusive Thordarson feature!)—no lost energy, no lost volume (especially on low notes), no leaks from primary to cause howls in set. (Thordarsons are quiet, even on the third stage!) Over-size core (¾" cross section) provides 50% larger magnetic circuit—minimizes core losses, prevents over-saturation. Broad ribbon leads locked in the coil give short, direct and *more durable* connections to the patented inner-locked terminal posts—no tangled or broken wires inside case (exclusive!) Each Thordarson transformer comes completely protected, shielded and tightly *clamped* in a stout case. No rivets or screws through the special silicon steel core to cause short circuits or eddy current losses between the laminations (exclusive!) Do you wonder that Thordarson leads the field in output and produces *more* transformers for *more* makers of quality sets than *all* competitors combined?



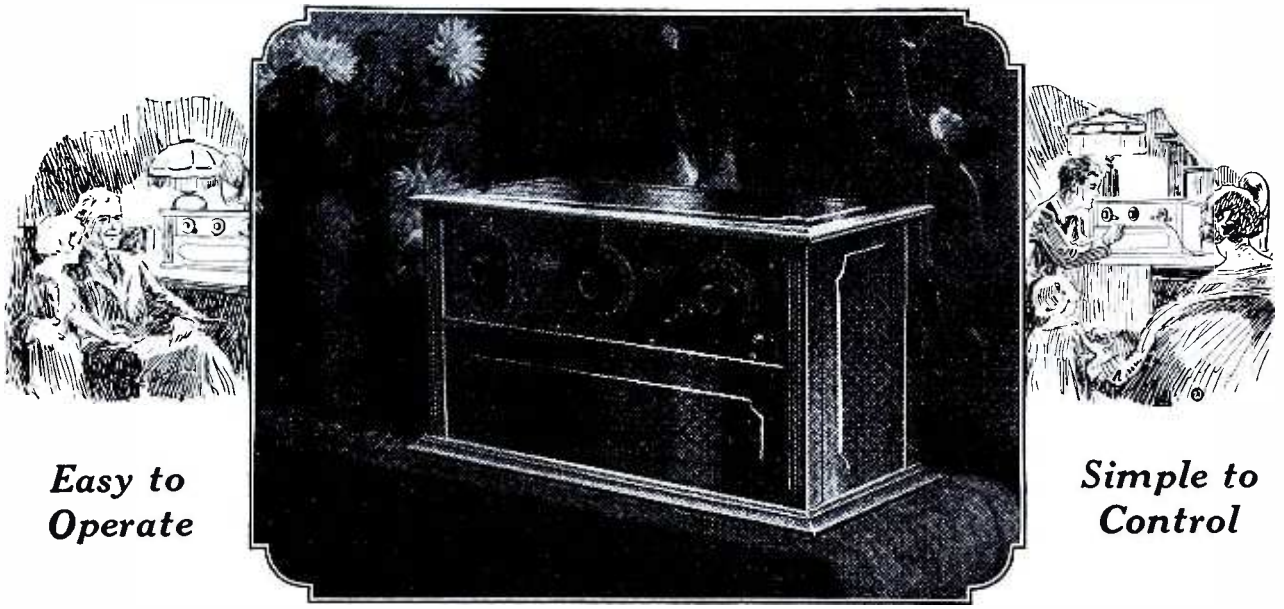
Thordarson "Super" Audio Frequency Transformers enjoy wider use because of the *even* volume and freedom from distortion with which they amplify over the *entire* musical scale and thereby make a good radio set a true musical instrument. *Unconditionally guaranteed.* Three ratios: 2-1, $5; 3½-1, $4; 6-1, $4.50. Thordarson Power Amplifying Transformers, which equal our audio frequency types in tonal purity, are $13 the pair. Write for latest bulletins.

Six floors 100,000 sq. ft.

Devoted to Transformers

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

THORDARSON
Super
AMPLIFYING TRANSFORMERS
Standard on the majority of quality sets



Easy to Operate

Simple to Control

WHEN you own a Radiodyne you can tune in on broadcast programs without wasting time tinkering. The Radiodyne shuts out interference from nearby stations. By simply adjusting the dials as indicated on the Radiodyne chart you can select the stations you wish to hear. All batteries are enclosed in the beautiful two-tone mahogany cabinet.

Uses a 25 Foot Lamp Coil for Summer Reception

WL RADIODYNE

Wife Gets Good Results After Two Minutes Instruction

"We are getting constant reception this summer from stations 500 to 1000 miles away on loud speaker with a 25 foot length of lamp coil. I got Los Angeles, San Francisco and Cuba."
Bernard S. Slay, Minneapolis, Minn.

"I gave my wife two minutes instruction and left her alone with the Radiodyne. When I came back she said that signals had been roaring in all evening and had a log to prove it."
Robert S. Rose, Marquette, Mich.

Write for illustrated folder which describes the Radiodyne in detail. If you buy a radio before you have a demonstration of the Radiodyne you will surely regret it.

WESTERN COIL & ELECTRICAL CO.

308 Fifth St. **Racine, Wis.**

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

What good is a good battery *neglected?*

TODAY you might buy the best battery in the world. And yet within a week or two would come the chance to neglect it.

Harm follows when batteries need recharging—and don't GET it. When you have to send your battery away for recharging, the temptation is to drain it for every last bit of juice it contains. This ruins batteries. It costs you clearness, volume and distance. It spoils many pleasant evenings by the battery quitting suddenly through your trying to get just one more night on the air.

The Unitron Battery Charger makes this all unnecessary. Charging costs only about a cent an hour. Attached to your battery over night once a week, it keeps your set performing perfectly all the time.

It is quiet. You can't hear it three feet away. It requires no adjustment of any kind and it is simpler to operate than the simplest radio set. The Unitron is fully guaranteed, and mail orders receive especially careful attention.

Send for the Story:
"MORE STATIONS ON THE SPEAKER"

Forest Electric Company

Pioneer Manufacturers of Industrial Current Rectifiers

New and Wilsey Streets, Newark, N. J.

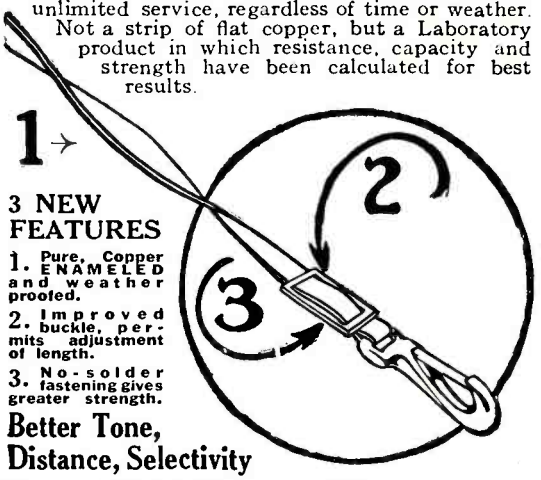
Model 00 **$18**
Charges any type of A battery

Model 0 **$30**
Charges A and B batteries and automobile batteries

Adv. by PICARD-SOHN, INC. N.Y.

The New ACORN Enameled RIBBON AERIAL

Now **enameled** and weather proofed—will give unlimited service, regardless of time or weather. Not a strip of flat copper, but a Laboratory product in which resistance, capacity and strength have been calculated for best results.



3 NEW FEATURES

1. Pure, Copper ENAMELED and weather proofed.
2. Improved buckle, permits adjustment of length.
3. No-solder fastening gives greater strength.

Better Tone, Distance, Selectivity

Thousands of letters from users say their reception has been revolutionized by "ACORN" Enameled Copper Ribbon Aerials. Don't blame your set for poor results. Install this wonder-aerial on our positive guarantee to improve tone, distance and selectivity or **money refunded.**

If your dealer will not supply you, order direct from factory.

50 Ft. $1.75
75 Ft. $2.50
100 Ft. $3.25
150 Ft. $4.75

NEW WINDOW LEAD-IN

No. 1—Triple Insulated, 35c
No. 2—Window Lead-In, 25c

ACORN RADIO MFG. CO.
Dept. 408 307 W. Lake St.
CHICAGO, ILL.

all free! RADIO LIBRARY

JUST SEND A POST CARD

YOU GET absolutely free—the A-K "Library of Latest Radio Literature," written by foremost radio authorities. Contains HUNDREDS of valuable wiring diagrams, HOOK-UPS, illustrations, articles, data, etc.

EXPLAINS in clear, understandable language the popular new circuits: reflex, neutrodyne, phusiform, "nameless," superheterodyne, etc., and how to build sets. Covers long and short wave amplification, push-pull and audio amplifiers. Latest information on multitudes of other radio subjects. **LOG BOOK INCLUDED FREE.** Also our latest Radio Catalog featuring NATIONALLY ADVERTISED lines at attractive savings. Write today—offer limited. Address

ATWOOD-KING, INC.
Dept. M-11 163 W. Washington St., Chicago

ATWOOD KING INC.

WHOLESALE EXCLUSIVELY

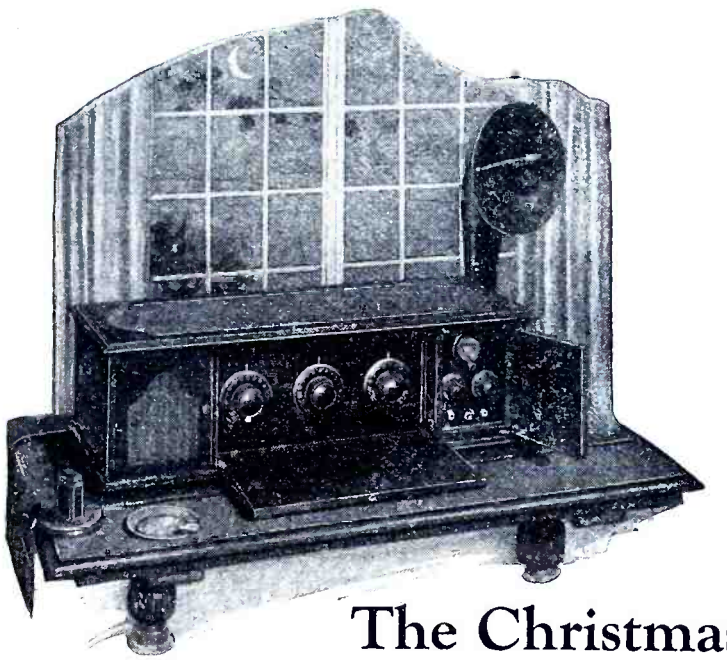
LUDWIG HOMMEL & CO

929 PENN AVENUE — HOMMEL — PITTSBURGH, PA.

carry complete stocks of the most reputable radio apparatus — Prompt deliveries.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

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**

The Christmas Radio Gift!

Select your Christmas Radio Gift for performance and appearance.

The GILFILLAN NEUTRODYNE has wonderful clarity, ample volume and exceptional selective powers. Programs come in from far and near—equally clear—and without interference, howls or squeals.

Parts for GILFILLAN NEUTRODYNE sets are made, assembled and finally inspected in Gilfillan factories. That is why every Gilfillan Neutrodyne set gives the best results in reproduction.

The cabinet is made of selected American walnut in two-tone finish—which will look handsome in the modest or richly furnished home.

A GILFILLAN NEUTRODYNE makes a most beautiful and enjoyable Christmas present. Send for literature to the nearest office.

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

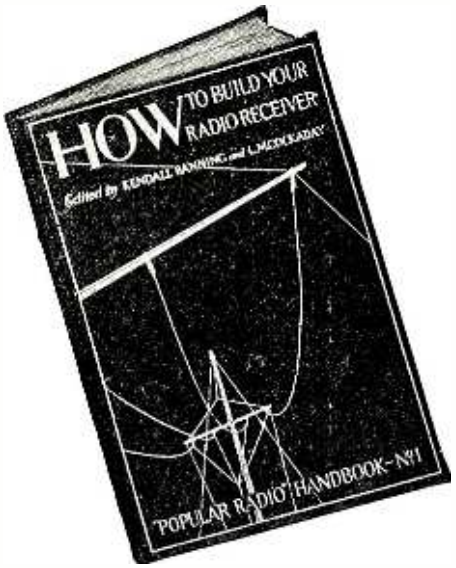
GILFILLAN RADIO CORPORATION
LICENSED BY
Independent Radio Manufacturers Inc
NEUTRODYNE
Reg. U.S. Pat. Off.
Pat. Mar. 27, 1923 and April 4, 1924
Hazeltine Pats. Nos. 1,450,080 - 1,489,228
Other Patents Pending
Reg. U.S. Pat. Off.

For the next 30 days this big 100 page reference book and instruction manual will be given

FREE

WITH

POPULAR RADIO



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. 115,
627 West 43rd Street,
New York City.

Offer expires Nov. 20, 1924.

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

Youth's miracle

Nineteen hundred and twenty. Shivering throngs—eyes straining at frosted chalk-marks. Here and there a boy, snatching the election news out of space.

Nineteen hundred and twenty-four. Radio wings the returns straight from the ballot boxes to millions of firesides.

Four fleeting years, hardly more than a flash in the jumbled centuries, and radio is everywhere. A miracle, wrought by youth. Hundreds of springs of invention, thousands of freshets of young enthusiasm merged into a torrent of interest, swept down Main Street, swirled through Broadway and flooded the country with radio sets. Pioneering, creating interest, spreading knowledge—boys built the radio business. And to-day they are its chief support.

The 500,000 boys, averaging 15½ to 16 years old, who regularly read THE AMERICAN BOY, form a tremendous group of radio buyers. Their keen appetite for radio is sharpened by its authoritative and instructive radio articles. The volume of potential radio sales to these boys is enormous. The sales where their advice is sought and followed run into millions of dollars.

Here, then, is an army of customers for your product. Moreover, an army of salesmen for it—enthusiastic, indefatigable. In either capacity they merit your unstinted effort to win their preference. The proper development of your business and expansion of your market practically demand it. Advertise to boys in their own magazine, THE AMERICAN BOY.

The American Boy
"The Biggest, Brightest, Best Magazine for Boys in All the World"
Detroit Michigan

Copy received by November 10th will appear in the January issue.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

Prices Advance on November 10th

To take advantage of these money saving rates, your order must be postmarked not later than November 10th

Pictorial Review Popular Radio $4.50 Reg. For **$3.85**	***Cosmopolitan *Good Housekeeping Popular Radio** $9.00 Reg. For **$7.60**	**Film Fun Judge Popular Radio** $10.00 Reg. For **$7.85**	**McCall's Popular Radio** $4.00 Reg. For **$3.25**	**Modern Priscilla Popular Radio** $5.00 Reg. For **$3.95**
Peoples Home Journal Pictorial Review Popular Radio $5.50 Reg. For **$4.35**	***Good Housekeeping or *Cosmopolitan *Hearst's International Popular Radio** $9.00 Reg. For **$6.85**	**Live Stories Snappy Stories Popular Radio** $9.00 Reg. For **$7.35**	**Youth's Companion (52 issues) Popular Radio** $5.50 Reg. For **$4.50**	***Judge *Popular Radio** $8.00 Reg. For **$5.50**
Christian Herald Modern Priscilla Popular Radio $7.00 Reg. For **$5.10**	**Today's Housewife McCall's Popular Radio** $5.00 Reg. For **$3.80**	**Success Popular Radio** $5.50 Reg. For **$3.85**	***American Magazine *Woman's Home Companion Popular Radio** $7.00 Reg. For **$5.60**	**Pictorial Review Modern Priscilla Popular Radio** $6.50 Reg. For **$4.95**

POPULAR RADIO is prepared to place all of your subscriptions with the various publishers and will guarantee that the price is as low as you can obtain anywhere.

While we have presented on this page the bargain offers of all the more popular magazines, there are, of course, hundreds of others. If you cannot make a complete choice, we would urge you to submit a list of all the magazines you want and let us quote you the very lowest combination price on them all. You should do this immediately, however, so that the order can be recorded before the thirty day period of special low rates expires.

This is a very favorab'e time to make up neighborhood orders as well as Christmas g ft orders, since new subscriptions placed now can begin with any future issue des red and renewals will start at the expiration of current subscriptions. Magazine combinations can be split and sent to different subscribers unless starred (*).

Submit a complete list for our lowest price quotation or fill in the order coupon below and mail it promptly with your remittance

POPULAR RADIO

627 West 43rd Street, New York City, N. Y.

POPULAR RADIO, Dept. 112,
627 West 43rd Street, New York City.

Enclosed is $..... Please see that yearly subscriptions are at once entered in my name for each of the magazines I have checked in the special bargain club list at the right.

Name.....

Street and Number.....

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

(If not a NEW subscription, please mark R after the name of the magazine, to indicate RENEWAL.)

Prices for Canada and foreign countries will be quoted on request.

Or You Can Make Up Your Own Club of POPULAR RADIO With:

American Boy	$5.00 reg., for...	**$4.35**
American Magazine	5.50 reg., for...	**4.85**
Boy's Life	5.00 reg., for...	**4.10**
Christian Herald (52 issues)	5.00 reg., for...	**3.85**
Collier's (52 issues)	5.00 reg., for...	**4.10**
Cosmopolitan	6.00 reg., for...	**5.35**
Delineator	5.00 reg., for...	**3.85**
Designer	4.50 reg., for...	**3.45**
Film Fun	5.00 reg., for...	**4.10**
Good Housekeeping	6.00 reg., for...	**5.35**
Hearst's International	6.00 reg., for...	**5.35**
House & Garden	6.50 reg., for...	**5.60**
***Judge** (52 issues)	8.00 reg., for...	**5.50**
Live Stories	5.00 reg., for...	**4.10**
McClure's	6.00 reg., for...	**4.85**
National Geographic	6.50 reg., for...	**5.85**
People's Home Journal	4.00 reg., for...	**3.15**
Physical Culture	5.50 reg., for...	**4.60**
Popular Science Monthly	5.50 reg., for...	**4.85**
QST	5.00 reg., for...	**4.20**
Radio	5.50 reg., for...	**4.35**
Radio Broadcast	6.00 reg., for...	**4.85**
Radio Digest (52 issues)	8.00 reg., for...	**6.85**
Radio News	5.50 reg., for...	**4.60**
Radio World (52 issues)	9.00 reg., for...	**7.85**
Scientific American	7.00 reg., for...	**5.60**
Snappy Stories (24 issues)	7.00 reg., for...	**5.60**
Today's Housewife	4.00 reg., for...	**3.00**
Vogue (26 issues)	8.00 reg., for...	**6.85**
Wireless Age	5.50 reg., for...	**4.60**

Must go to one address:

Note: If you wish any TWO or more of these magazines with POPULAR RADIO, simply deduct $2.35 from the bargain club price quoted, then add POPULAR RADIO at $2.35. For example:

Christian Herald...$3.85 less $2.35=	$1.50
Radio ..... 4.35 less 2.35=	2.00
POPULAR RADIO, added at only.....	2.35
Remit this amount	**$5.85**

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

MAGNAVOX

Receiving Sets which establish an authoritative standard of excellence for the daily enjoyment of radio.

LONG identified with the most efficient radio reproducing and amplifying equipment, Magnavox has developed its new Receiving Sets under conditions insuring superior design, precision of manufacture, and a gratifyingly low cost.

Exacting tests prove that the Magnavox Receiver is not only the simplest to operate but one whose daily performance will satisfy the most discriminating.

Magnavox Radio Receivers, Vacuum Tubes, Reproducers, Power Amplifiers, and Combination Sets are sold by reliable dealers everywhere.

MAGNAVOX Patented in U. S. A. and foreign countries

Receiving Set TRF-5

A 5-tube tuned radio frequency receiver encased in handsomely carved cabinet, as illustrated **$125.00**

Reproducer M4

A highly desirable accessory for TRF-5, as illustrated . . . **$25.00**

Receiving Set TRF-50

Same as TRF-5 but larger cabinet with carved doors and built-in Reproducer **$150.00**

THE MAGNAVOX COMPANY, Oakland, California

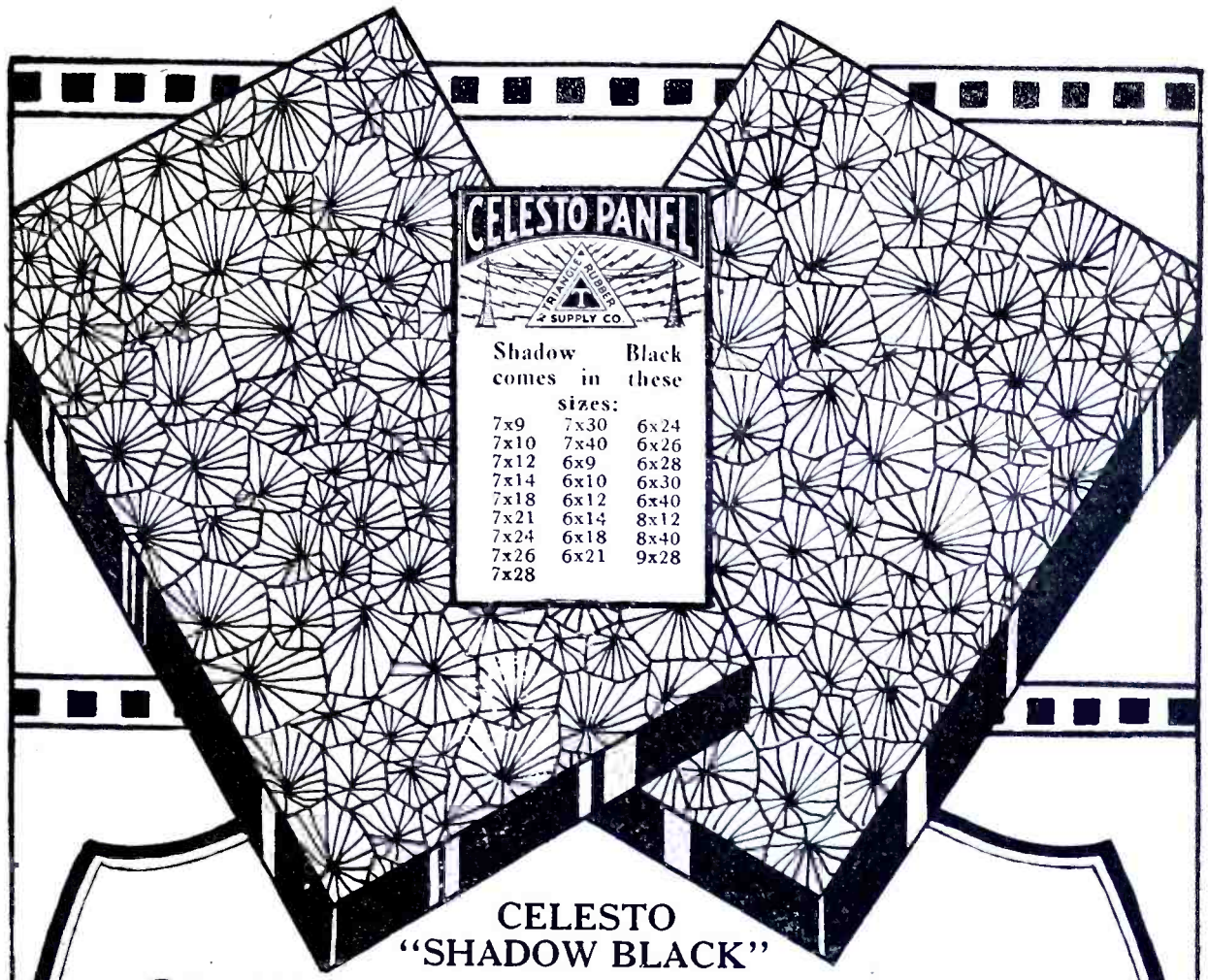
New York: 350 West 31st Street *San Francisco:* 274 Brannan Street

Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

11R

dvertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

All apparatus a



CELESTO "SHADOW BLACK"

CELESTO Shadow Black Panels do not show finger prints or scratches! Think what that one feature alone means in the appearance of your set.

CELESTO Shadow Black Panels are the newest development in their line, the most beautiful panels of all. And they meet the highest requirements of radio work because they are moulded of pure hard rubber

Build your new Cockaday set with a CELESTO Shadow Black Panel. Your dealer can supply one *already drilled.* If he cannot, write us at once.

The following sales offices will gladly serve the trade—

H. M. NOBLE
9 S. Clinton St.
Chicago, Ill.

L. C. KOHN
2019 Farnam St.
Omaha, Neb.

MARSHANK SALES CO.
1240 S. Main St.
Los Angeles, Cal.

J. R. PIERSON
Greensboro, S. C.

HURON SALES CO.
120 Madison Ave.
Detroit, Mich.

RICE-HITT CO.
623 Larkin St.
San Francisco, Cal.

J. L. DAVIS
5600½ Worth St.
Dallas, Tex.

L. DELAHUNT
Waldorf Court
Portland, Ore.

TRIANGLE RUBBER & SUPPLY CO.
68–74 South St. Boston, Mass.

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO I[illegible]

The Whistle! The Kick-Off!

Z-o-o-m-i-n-g High, the ball arcs down the field and drops into eager arms. Around the runner interference rallies. One tackler misses. Another nails him..... The big game is under way..... Next to watching from a stadium seat, the direct radio story gives the utmost in thrill, excitement and satisfaction. ..... Why experiment when Cunningham Tubes are the certain answer to clear Radio reception?

Quality plus Service Since 1915

PATENT NOTICE—Cunningham Tubes are covered by patents dated 2-18-08, 2-18-12, 12-30-18, 10-23-17, 10-23-17 and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

Cunningham 40-page Data Book fully explaining care and operation of Radio Tubes now available by sending 10c in stamps to San Francisco Office.

PRICES THE SAME ON ALL FIVE TYPES

C 301 A
C 300
C 299
C 11
C 12

Cunningham RADIO TUBES

E. T. Cunningham Inc.

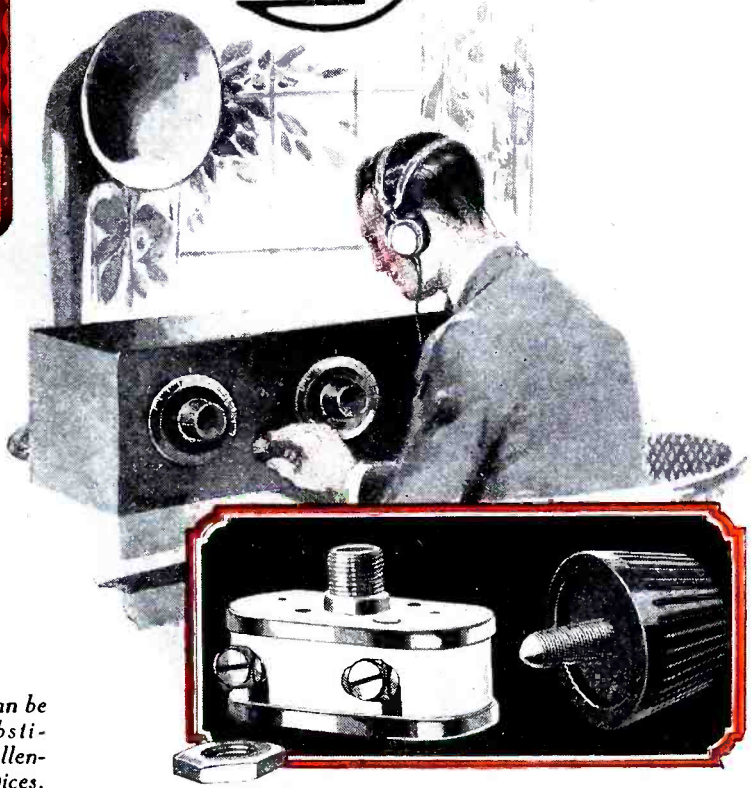
Branch CHICAGO — 182 Second Street, San Francisco HOME OFFICE — Branch NEW YORK

All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

The New Bradleystat

A Remarkable Achievement

Many refinements are embodied in the new Bradleystat. The graphite disc columns are enclosed in a *smaller* container; *two* terminals suffice for ALL tubes; a *new mounting* simplifies installation; the *knob* is of a daintier pattern. And the noiseless, stepless, control of the old Bradleystat remains, unchanged. Such a combination of advantages can be found in no other filament rheostat.



Only One Hole required in Panel

Every radio set can be improved by substituting the new Allen-Bradley radio devices.

Ask your radio dealer about the new Allen-Bradley line.

A DISTINCTLY new and valuable contribution to radio! That is the verdict of all radio engineers and designers who have seen the new Allen-Bradley radio devices and have witnessed their amazing performance. The new "one-hole mounting," which replaces the older clip mounting, makes for marvelous compactness and simplicity of installation. The new Bradleystat, Bradleyleak and Bradleyohm require only a 11/16-inch space behind panel, and the Bradleyometer only 7/8-inch. Thus, the new models can replace inferior wire rheostats and potentiometers without disturbing the arrangement of the set. Our new literature is ready. Send for it, today!

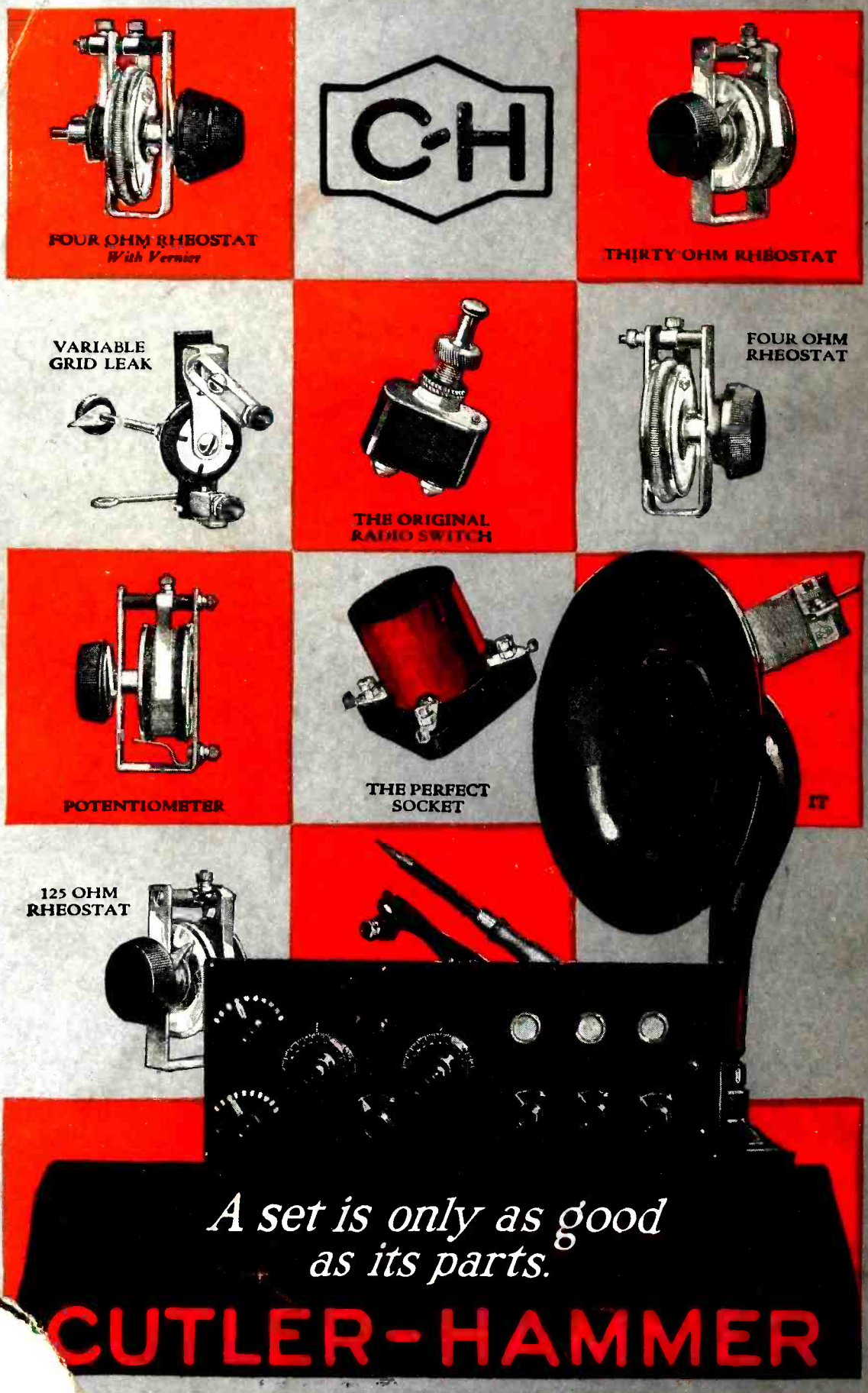
Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Ave. — Milwaukee, Wis.

Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Knoxville, Los Angeles, New York, Philadelphia, Pittsburgh, Saint Louis

PRESS OF WIL



All apparatus a