Popular Radio

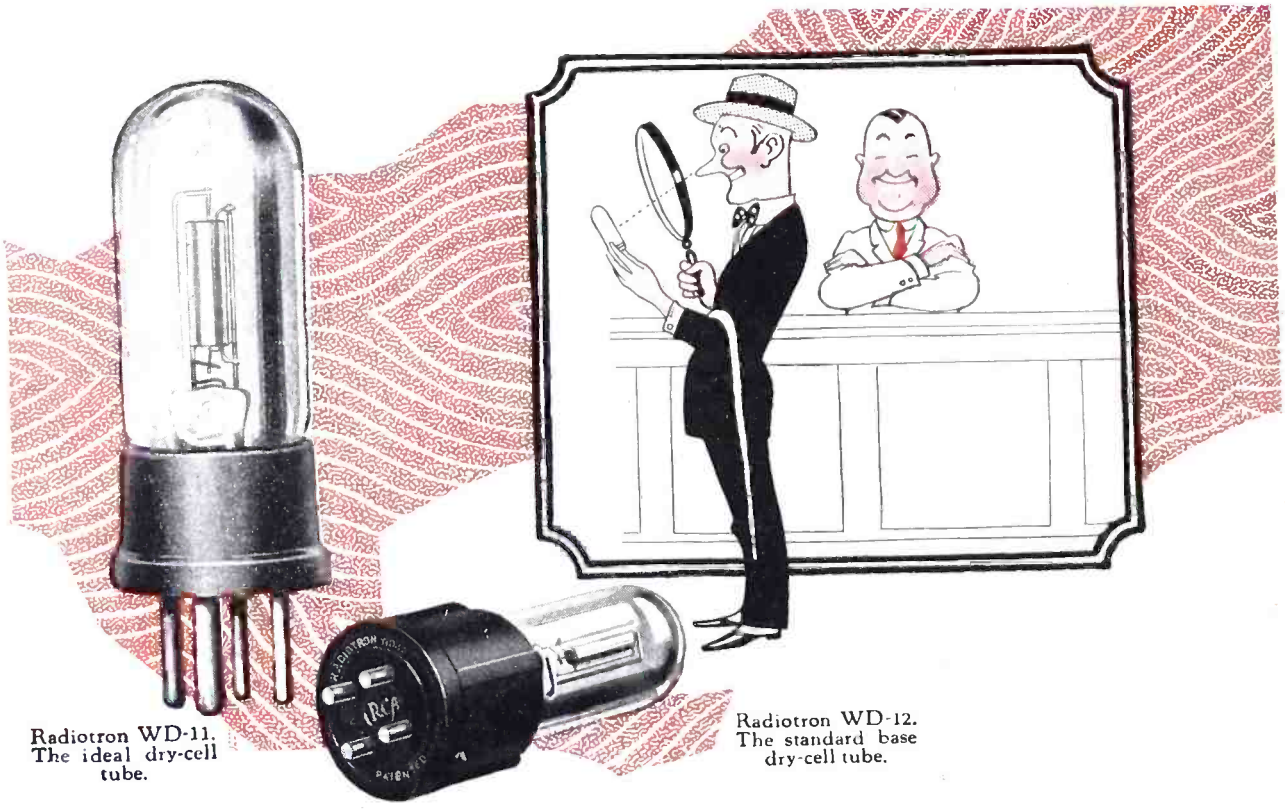
Edited by KENDALL BANNING

25¢

FEBRUARY 1925

In this Issue—

How to Build a 4-tube Reflex Receiver with the New Sodion Detector



Radiotron WD-11. The ideal dry-cell tube.

Radiotron WD-12. The standard base dry-cell tube.

For *Distance* — the *tube* is important

Radiotrons WD-11 and WD-12 are the same except for the base.

Radiotron WD-12 has a standard navy type base. Use it to change your set to dry battery operation. Ask your dealer today

Radio reception is not only a question of power, but of sensitivity to weak signals—and *clear* amplification. Radiotrons WD-11 and WD-12 are sensitive to the extremely feeble signals from distant stations—are silent in operation—and economical. They are famous for radio frequency amplification as for audio frequency—and detection. Get *genuine* WD-11's or WD-12's. Look for the name Radiotron and the RCA mark.

This symbol of quality is your protection

Radio Corporation of America

Sales Offices:

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Radiotron

REG. U. S. PAT. OFF.

LET the others have their card games — Grandpa settles down to real amusement — at the radio.

His dependable Brandes Headset shuts out the babble. Its *Matched Tone* gives him each word clearly — with identical tone and equal volume for both ears.

Grandpa's in a world of his own — and the game continues undisturbed. Everybody's happy!

When you choose a radio set be sure it's equipped with a Brandes. When you buy a headset alone — hear 'em all — and choose a Brandes.

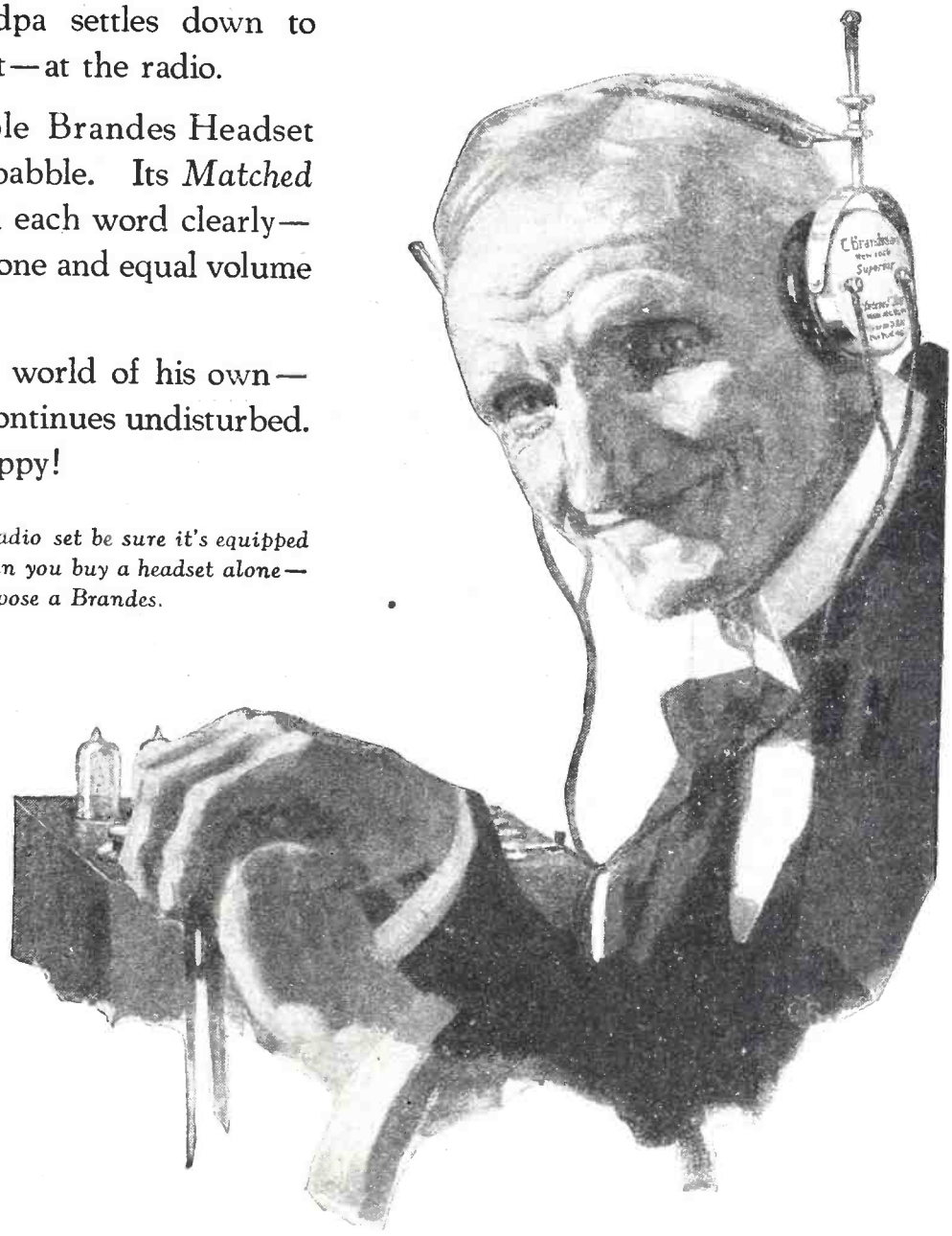

Table-Talker $10.00 [50 cents additional west of the Rockies]. In Canada . $12.50.

Superior *Matched Tone* Headset $6.00. In Canada . . $7.00.

Brandes

The name to know in Radio

POPULAR RADIO

EDITED *by* KENDALL BANNING

CONTENTS *for* FEBRUARY, 1925

(*Cover design by Frank B. Masters*)

VOLUME VII — FEBRUARY, 1925 — NUMBER 2

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.

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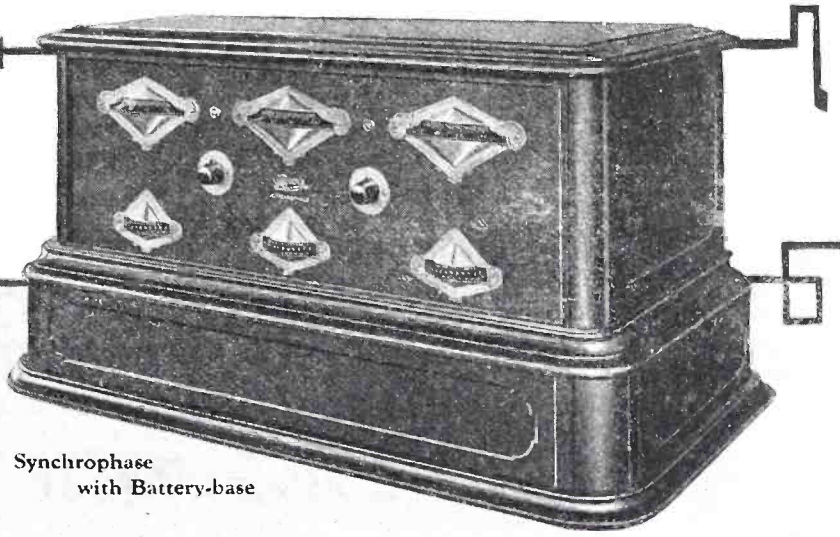
LAURENCE M. COCKADAY, *Technical Editor*

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



Synchrophase
with Battery-base

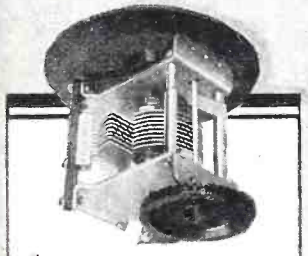
It Is Written:
"A slight deviation leads to a great error."

There are no deviations, however slight, in the making of a Synchrophase; each is a masterpiece.

Doctor Grebe

The GREBE SYNCHROPHASE

TRADE MARK



Synchrophase Secrets
No. 2 The S-L-F Condenser
(Straight line frequency)

This ingenious device eliminates the crowding of low wave stations toward the lower end of the dials; the settings for the various broadcast stations being spaced at *equal* intervals around the dials. The circuits are so arranged that the settings for a given station are identical on all three dials.

The S-L-F Condenser makes the Synchrophase a receiver that is unrivalled in its simplicity and ease of dependable operation.

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

INTO this masterpiece of design and craftsmanship are built the knowledge and experience gained during fifteen years by the manufacturer who stands pre-eminent in the industry.

Binocular coils give the Synchrophase a degree of selectivity found in no other receiver. Two stages of balanced tuned radio frequency—the result of exhaustive research—are responsible for its unsurpassed sensitivity. Its thorough ease of operation is made possible by the S-L-F condensers and a volume control giving an unbroken range of six variations of audio amplification.

To see the Synchrophase is to appreciate its charm; to operate it, is to realize its true excellence.

Ask your dealer, or write us for literature.

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

All Grebe apparatus is covered by patents granted and pending.

THIS COMPANY OWNS AND OPERATES STATION WAHG.

PAGES WITH THE EDITOR

THERE is at least one manufacturer of radio apparatus who has a definite answer to the question, "Who will pay the broadcasting bills" —and who comes right out in meeting and says so! His name is Duryea Bensel, and his office is at 872 Broadway, New York.

* * *

"THE manufacturers should pay the broadcasting bill," he states frankly, "and the sooner they get around to it the better it will be for all concerned.

* * *

"SUPPOSE broadcasting should stop; what will the manufacturer do? To my way of thinking there is only one logical way to handle the situation and I believe all manufacturers will be in accord.

* * *

"WHAT profit we manufacturers have made (and a good many of us have made great fortunes), we owe to broadcast programs. It is only right that we should help pay for the privilege to continue to make more fortunes.

* * *

"LET the manufacturers put aside one percent of their net earnings and distribute it among the necessary stations in the U. S. to assure the buying public the best talent the world produces.

* * *

"Two years ago we tried to start this idea but there was no co-operation. I believe that POPULAR RADIO can pave the way to bring together the manufacturers to discuss the proposition. We will gladly contribute one percent of our net earnings and I am sure all other manufacturers will do the same."

* * *

THERE is Mr. Bensel's proposition in a nutshell. The Editor wants to know what other manufacturers think about it. Upon their opinions will be based such action (if any) that the desires and needs of the radio fans and of the radio industry may justify POPULAR RADIO in taking.

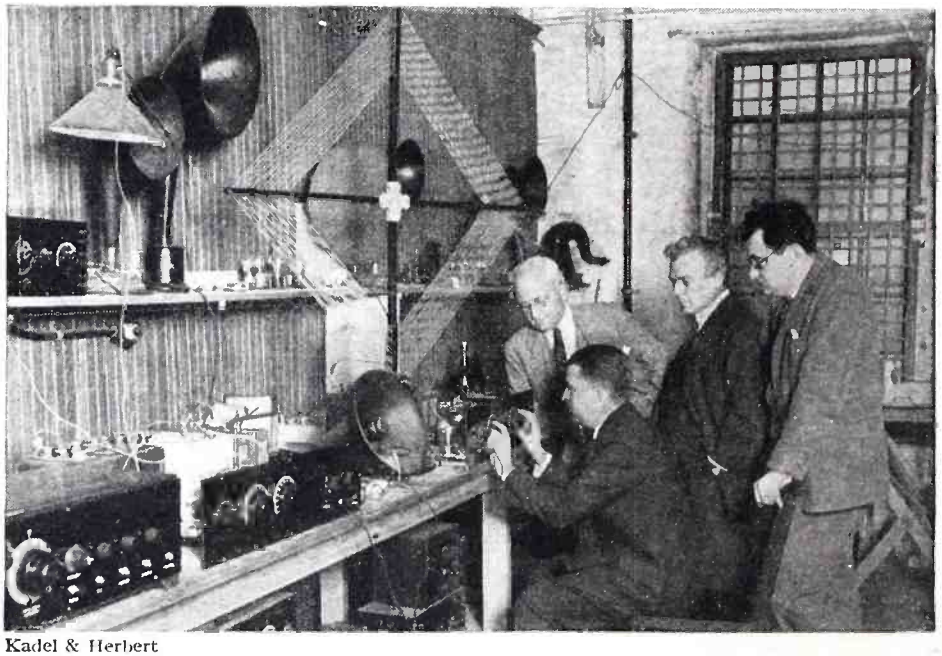
* * *

THE article by Mr. Sylvan Harris that is published on pages 129-134 of this number of POPULAR RADIO embodies such new and important observations about condensers that the author has been invited to prepare, in collaboration, another contribution on the same subject for the February issue of the "Proceedings of the Institute of Radio Engineers."

* * *

"YOUR excellent publication is a splendid medium for real radio news; among radio engineers as well as among the fans it is held in the highest regard," writes Mr. Don C. Wilkerson, an engineer of Washington, D. C., who is engaged in research work in radio for the United States Government. Among the readers of POPULAR RADIO, indeed, are the fore-

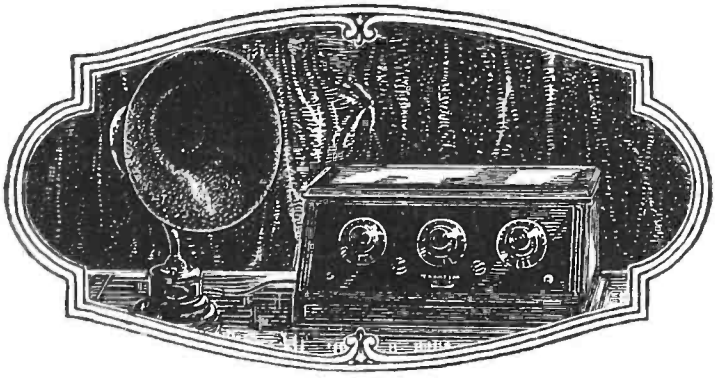
(*Continued on page* 6)



Kadel & Herbert

LAURENCE COCKADAY DEMONSTRATES HIS 8-TUBE SUPERHETERODYNE REFLEX RECEIVER

This remarkable set—the very latest word in receivers of its type—was described in detail in POPULAR RADIO *for January. The above snapshot was made in the* POPULAR RADIO LABORATORY *during the transatlantic tests, in the presence of (left to right) Mr. Douglas H. Cooke, the Editor and Raymond Francis Yates. Among the foreign stations logged were 2BD, Aberdeen; 5NO, Newcastle; 2PY, Plymouth; ESP, Paris and 2LO, London.*



"Experience is the Vital Factor in Excellence"

THOMPSON RADIO

THE Thompson Organization is unique among radio manufacturers in having a background of 15 years experience in designing, developing and manufacturing intricate and delicate radio apparatus for the armies, navies and commercial institutions of the world.

Licensed by Independent Radio Manufacturers, Inc. NEUTRODYNE Pat. March 21 1922 and April 1 1924. Patents Pats. Nos. 1450,080 and 1,485,328 Other Patents Pending

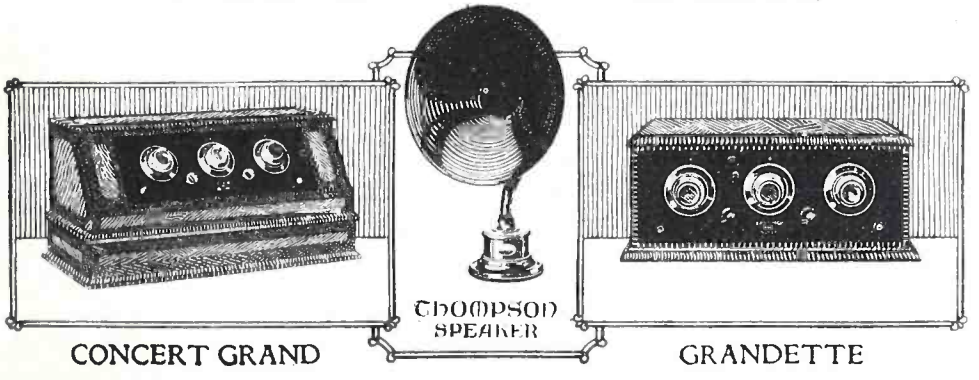
During this time its research laboratories have perfected developments which have contributed largely to the advancement of the radio industry.

This wide experience, now available in the Thompson apparatus, means Receivers and Speakers that embody the latest and best practice in Radio Engineering. A critical investigation of each model will disclose outstanding features of genuine excellence — in artistic appearance, naturalness of tone, simplicity of operation.

Thompson Receiving sets range in price from $125 to $180. The Thompson Speaker is now $28.

Write for attractive literature and name of Thompson dealer near you.

R. E. THOMPSON MANUFACTURING CO.
30 CHURCH STREET NEW YORK, N. Y.



(*Continued from page 4*)

most scientists of the world. And they not only read it but *contribute* to it! A glance over our list of authors is a veritable "Who's Who in Science."

* * *

THE recent feats of transmitting pictures and letters (and more recently pictures in color, as described on pages 125-128 of this issue), make the predictions of Major General Charles McK. Saltzman, Chief Signal Officer of the Army, particularly significant. These predictions were made by General Saltzman in POPULAR RADIO for September, 1924; recently in his annual report, General Saltzman pointed out the military value of the latest developments in radio as follows:

* * *

"MECHANICAL transmitters with higher speed qualities are becoming stabilized and American invention seems to be making further and rapid progress in associating photography with radio, which bids fair to revolutionize fundamental methods of transmission. Military messages of the future, particularly in active operations, may contain diagrams and sketches or even entire sheets of maps, all transmitted as part of the same message, and in a method by which detection or listening in will be reduced to a very low minimum."

* * *

"FIRST, I wish to say that I enjoy POPULAR RADIO more than any other radio magazine. Your editorial policy causes your readers to feel that the articles in POPULAR RADIO are authoritative, and they instill confidence."

—JAMES O. BRUEN, *Kansas City, Mo.*

* * *

No editorial policy initiated by POPULAR RADIO ever met with such determined opposition in the beginning nor met with such universal endorsement in the end, as the policy of furnishing the specific names of radio parts in our "how-to-build" articles. Here is a typical letter of approval from a Canadian reader:

* * *

"THE policy of POPULAR RADIO in not hesitating to recommend parts by name which are being used with success in your circuits, greatly appeals to us by reason of our distance from the manufacturing sources, and our inability in consequence to examine many of the parts which appear in advertising literature. We take pleasure in stating that in no one case have we been disappointed with any recommendation that has appeared, and our hope is that your present policy may long continue."

—*Walter W. Ballinger, Director, Thomas Ballinger & Co., Ltd., Wellington, N. F.*

* * *

AND here is another friendly greeting—from a trapper in the great open spaces of the north country:

"I have not been a reader of POPULAR RADIO long and have missed several copies—but I can truthfully say it is the most favored of the radio publications received among the trappers and miners. POPULAR RADIO covers the field so thoroughly that I do not feel the need of any other radio publications."

—E. H. JOHNSON, *Whitehorse, Yukon Territory, Canada*

* * *

WHEN the world and his wife read with amazement on the front pages of their newspapers a short time ago of the transmission of pictures by radio by means of the Jenkins apparatus, they were merely reading a newspaper description of a development that was originally described in POPULAR RADIO for April, 1923—one year and eight months before!

* * *

"I WAS formerly a subscriber of POPULAR RADIO," confesses Roscoe Bloss of Dunningville, Mich., "but thought I would try another and cheaper magazine on radio. But nowhere could I find one to compare with POPULAR RADIO, and to prove it—well, here's my subscription!"

* * *

ON page 638 of POPULAR RADIO for December appeared a picture of Lieut. Franklin L. Nash holding a radio transmitter of his own design. At least, the Editor assumed that it was a picture of Lieut. Nash because that was the information that came to him with the photograph. But the information was wrong.

* * *

"As I served as a Captain in the Signal Corps at Camp Alfred Vail, N. J., with this officer," writes S. D. Ashford, the senior Signal Engineer of the Interstate Commerce Commission, "it was not difficult to recognize him as Lieut. *Rash*—not Nash" So the error is hereby corrected.

* * *

"I WANT to express my sincere appreciation and to tell you of the pleasure I get from reading POPULAR RADIO," writes Dr. R. Robinson Duff of Chicago. "I have followed it practically from its inception and I want to add my little bit in congratulating you on the splendid magazine which you are placing before the radio public. Please accept my subscription for the coming year."

* * *

"I HAVE had POPULAR RADIO since it was published, and for real information on radio it has any other publication beat forty-'leven different ways."

—HERMAN RADLOFF, *Sleepy Eye, Minn.*

* * *

IN the next number of POPULAR RADIO—for March—will appear another constructional article by Laurence M. Cockaday, "How to Build the Improved DX Regenerative Receiver." Unless you are a regular subscriber, ask your newsdealer to reserve a copy for you.

Kendall Banning

Editor, POPULAR RADIO

The Practical Way to Buy Radio

That button identifies the Ozarka Factory Representative in your city. It is your assurance of complete radio satisfaction.

THE automobile is a success today because of the service station. Little things sometimes go wrong with the best of cars—exasperating to the owner but very easily corrected by the trained mechanic.

The same condition is true of radio instruments. No matter what anyone tells you, the most perfectly constructed radio instrument sometimes requires service.

The pleasure you derive from radio depends not only on the quality of your instrument, but on the quality of the service you can secure on that particular make of instrument.

Ozarka Radio instruments are sold only by direct factory representatives — men who have been thoroughly trained on our instrument *and no other*.

The Ozarka Representative knows every part, every wire of the Ozarka. In fact he completely assembles his own instruments. His training on installations, aerials, ground connections, operation and service comes directly under our own engineers who designed and perfected the Ozarka circuit.

This method of training men for radio sales and service is not an untried idea. It was originated by Ozarka, Incorporated, two years ago. Today nearly 3070 men are delivering this service. More are right now going thru their training. The sign of the long distance goose is your protection. The Ozarka representative will gladly set up an instrument in your home without any obligation on your part. He will set it side by side with all others for beauty, distance, volume, tone and ease of operation.

He won't tell you he has the best—he'll let *you* prove it by your own operating, and his complete installed price will be much lower than other instruments of similar high quality. The Ozarka four-tube model for loud speaker operation sells for only $39.50. Our illustrated book No. 200 describes the Ozarka instrument fully. A copy is yours for the asking. Please mention the name of your county.

More Ozarka Representatives Wanted

RADIO under the Ozarka Plan offers an exceptional opportunity to the right kind of men. 3070 Ozarka Factory Representatives have been trained under our plan to sell, install and service the Ozarka Radio Instrument.

The man we want is now employed—he has held his present position for some time—he is not a "floater" jumping from job to job. He feels certain that there must be some way whereby he can better his condition—he is not afraid to try.

He may not be a salesman, but he can talk convincingly on something that he knows perfectly, and firmly believes in. He may not have much money, but he is not "broke." He is mechanically inclined—he is willing to give Ozarka his spare time in study in his own home under our engineering department.

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

The Ozarka Plan is fully described in a large illustrated book. A copy will be sent to men who are willing to tell us fully about themselves. Unlike any book you have ever read, the Ozarka book is a true story of life, of men, of why they fail, and how they succeed. It is founded on the principle that nothing is impossible to the man who is determined and willing to try.

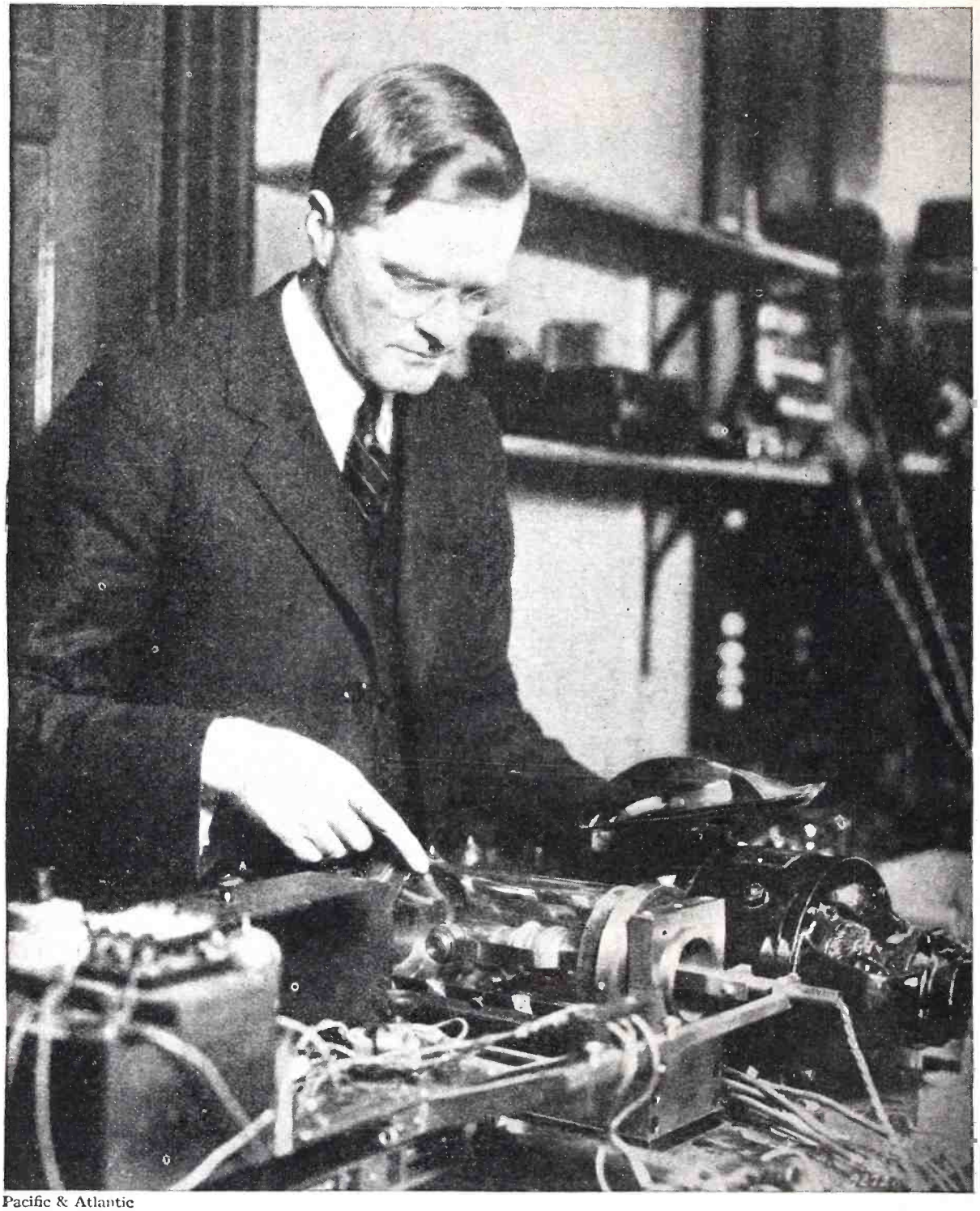
In territory not now covered, the right man is wanted. The investment in money is small, but the investment in time and study is considerable. If you are determined and willing to put forth the necessary effort to obtain a splendid profitable business of your own, write and say "Send me your Ozarka Plan Book No. 100." It may be the turning point in your life. Don't fail to mention the name of your county.

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

To THE EDITORS OF POPULAR RADIO:

I must pass to you a word of congratulation upon your success in building up a first-rate radio journal. POPULAR RADIO *is a credit both to radio and to journalism.*

—DONALD MCNICOL, A. I. E. E.



Pacific & Atlantic

The Machine that Sends Pictures Across the Ocean

When the portrait of President Coolidge was flashed through the ether in London and received in New York on Sunday, November 30, 1924, a new record was made in the annals of radio. Above is shown the transmitting apparatus with its inventor, Capt. Richard H. Ranger—whose description of his machine will shortly appear in POPULAR RADIO.

Popular Radio

VOLUME VII FEBRUARY, 1925 NUMBER 2

How to Get on a Radio Program

So many requests have come to POPULAR RADIO from aspiring broadcast artists for advice about "getting on the ether" that a first-hand investigation was made to get the real, inside facts. Here they are

By JAMES H. COLLINS

HOW can you get on the radio program?

The simplest thing in the world, Brother—or Sister. All you need is "the goods." And latch strings hang out at practically every broadcasting station—every one that I have been able to investigate among the hundreds scattered over the United States. And it isn't necessary to go to a great musical center like New York or Chicago if you happen to live in what theatrical people call "the sticks," because there are opportunities at your local station, and if you make a place for yourself on the program, your performance will travel far.

How must you go about getting on the radio program—call at the station personally or apply by letter?

What sort of performers are the broadcasting directors looking for?

What are the restrictions—what is taboo?

Are any tests or rehearsals necessary?

Are performers paid by the station—or must the performer pay to appear?

Hundreds of inquiries like this come to the editor of POPULAR RADIO from musicians, singers, lecturers and other artists—including press agents, who are certainly artists in their line.

"Write an article and answer them," directed the editor.

So I put on my hat and went out to call upon the folks who directed the programs at the big stations in and around New York.

Are you an artist with "temperament," sensitively shrinking from contact with uncomprehending business men? Do you hesitate about offering your talent because you think the programs are directed by engineers and electricians?

Know then, right at the start, that you will deal with fellow artists, because most of the program directors are musicians, in many cases professionals. More than one regularly steps into his own program to fill gaps. There has been an influx of artists and their agents from the phonograph field, particularly, into radio.

You can start things with a letter, or by calling upon a program director himself. Many artists telephone—a good way, too. And the response will be not only cordial but in most cases you get the feeling that the director or his assistants have been expecting to hear from you and are sincerely anxious—even eager—to find out whether you have them there same "goods!"

"What! I thought the broadcasting stations had waiting lists with hundreds of artists, and were turning thousands away!" you may say.

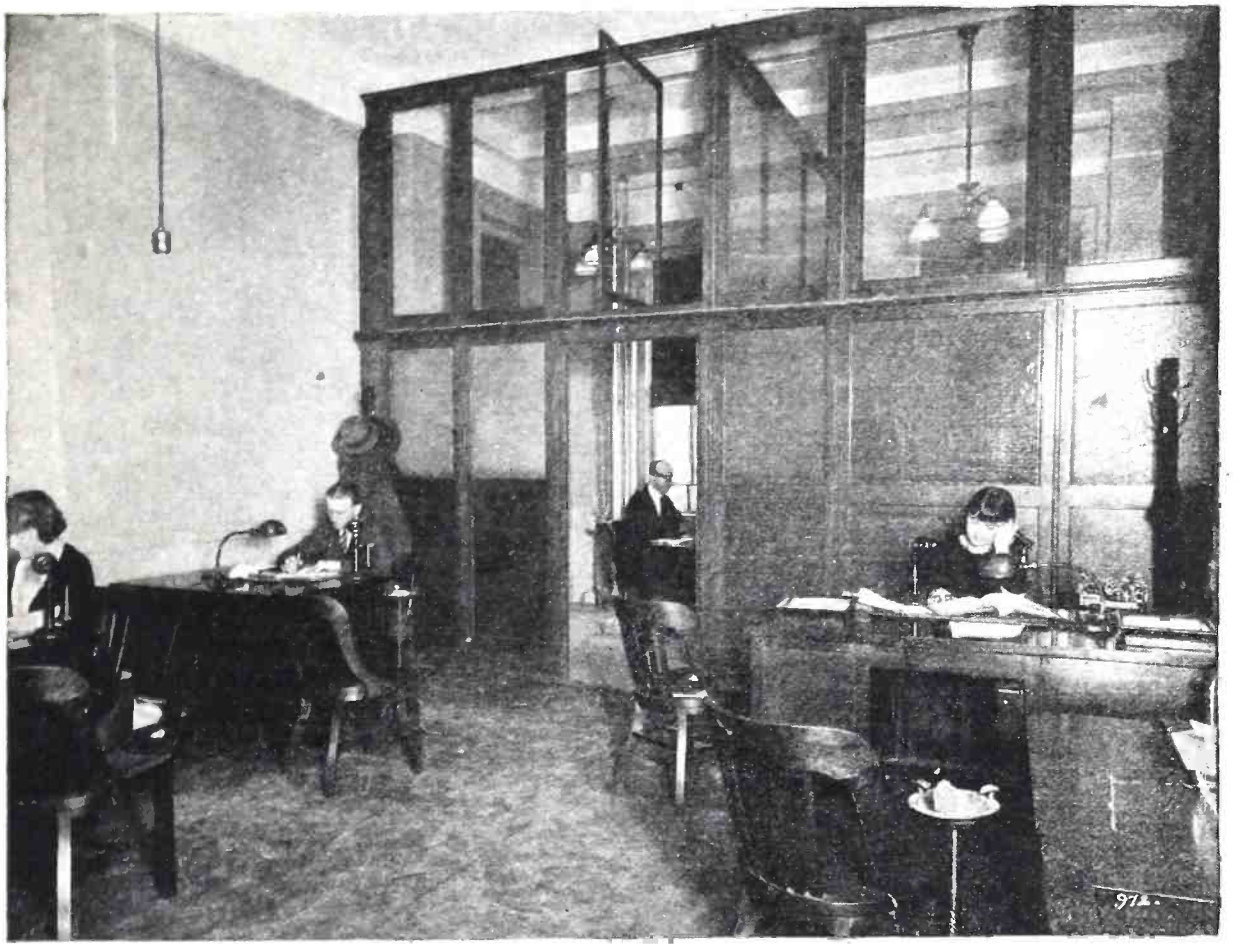
Yep—that's right. But they're not turning away anybody with the goods!

Many apply, but not so many qualify by demonstrating program ability. For radio gives opportunity to thousands of amateur performers and students who are not yet able to land paid engagements, and who may never be able to do so, and naturally many of them must study and practice further to make their place on the programs. But the demand for radio talent is so great that anybody with ability is certain to get a hearing.

"What tests or rehearsals are required of the artist?" I asked directors in and around New York, and also fired a volley of questions at some of the distant stations. We will imagine that a composite program director is answering for all of them, because, while the requirements differ at various stations, the same general trend is found in all.

"We ask a few questions about the applicant's artistic experience," said this imaginary director, "and if it is satisfactory and the inquiry has been made by letter or telephone, he is invited to come in for a hearing. He sings, plays or speaks into a live microphone under distance conditions, and the director not only determines the quality of his performance, but finds out where to place him with relation to the microphone and the accompanist. Rehearsals before a dead microphone may follow, so the artist who has demonstrated program quality may grow accustomed to broadcasting conditions. If the applicant is a speaker, most stations require the submission of a typewritten copy of his talk beforehand, and read it in order to be certain that there are no objectionable features. If his talk is technical—say, something like popular science or everyday health hints that take a medical slant—it may be submitted to authorities in that particular field, who pass upon its accuracy and the professional standing of the speaker. A well-known speaker, however, will usually be given his own head, because upon that same head, not the station, will fall any criticism aroused by his talk.

"If a singer or an instrumentalist is well known, tests and rehearsals are usually not required, but we advise him or her to take them. For example, imagine our joyous feeling if an artist like Mme. Galli-Curci telephoned in and expressed a desire to sing from our station! We'd put her on the program immediately, before she changed her mind, and require no preliminary hearing. But even an artist of her standing, singing in the microphone for the first time, would gain by a rehearsal beforehand, and by the director's suggestions. As a matter of fact, when Galli-Curci made her first phonograph records she was so concerned with the artistic shortcomings apparent to her own ear that she made a profound study of the phonograph as a medium and mastered it, and it is characteristic of great artists that they study the technical requirements of radio beforehand and practice to master the microphone. Mary Pickford and Douglas Fairbanks had a microphone installed



Radio Corporation of Ameri a

WHERE THE APPLICANTS ARE RECEIVED

This is the office of the broadcasting director of one of the big stations (WJZ)—the place with which you must communicate as an initial step toward the microphone. Here appointments are made with aspirants who make phone inquiries and here is where the programs are planned.

in their hotel room several days before talking by radio the first time."

"What kind of program numbers are you looking for?"

"Why, look over the programs for a week, and use your imagination!" said the director. "We want good soloists and ensembles, vocal and instrumental, educational talks, household suggestions, children's entertainment, symphony and dance orchestras, monologues, organ recitals—there's absolutely no limit if the entertainment can be broadcast. The theatrical manager makes up his vaudeville or moving picture program for a week, and it is repeated several times a day for seven days. But the radio program director gives about fifty hours of entertainment weekly, never repeating a number, so he wants quantity and variety as well as quality. Entertainment must come up to the standard of the station. That standard is high, and constantly growing higher. And he welcomes good novelties, numbers with a really original idea. One of the big eastern stations has a radio gymnasium class at seven every morning, with an instructor and music. That was a real idea. Another eastern station has a children's hour from nine to ten every Sunday morning, with clowns, and talks by comic-strip artists and characters—it is an advertising feature for a string of newspapers, but it was a real idea."

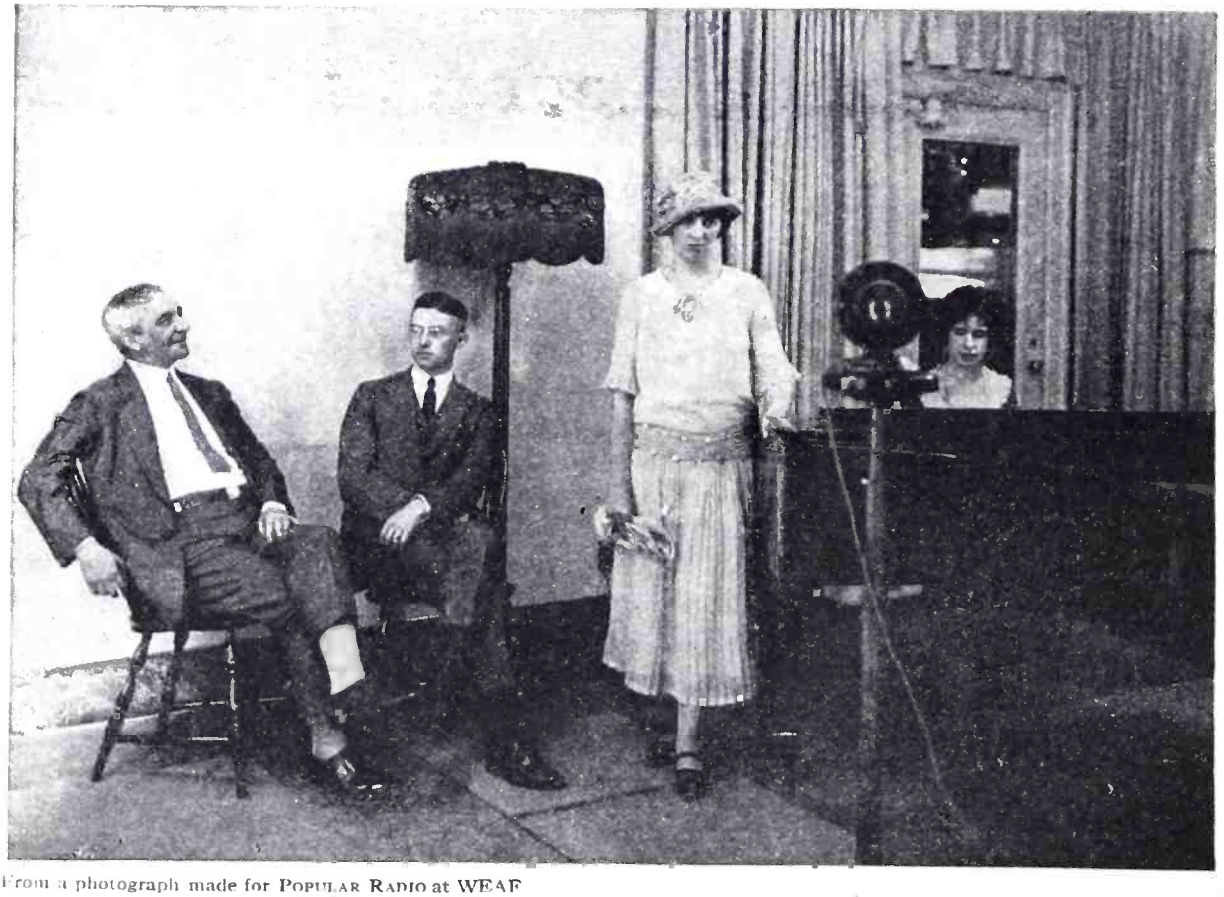
"Some of the radio critics complain that there are too many soprano and baritone soloists on the air."

"They do outnumber other artists—and yet we do not find too many good ones! Some directors think there are too many soloists of all kinds, and are making up their programs with vocal and instrumental ensembles, orchestra numbers, talks and other material."

"The radio critics are ridiculing the instructive talk too—will that be eliminated as well?"

"We like criticism. Sometimes it cuts pretty deep, but it keeps us on our toes.

"A good many of the radio speakers have been dull because they talk on business or technical subjects, and are not practised speakers. If the talk was about banking or life insurance, we got somebody who was an authority in his line, and his speaking ability came second. Then, there has been considerable publicity seeking in such talks—the expert telling the radio public how to simplify its income tax return, probably turned out to be a professional accountant who sought income tax clients in that way. But look over the good programs and you will see that these numbers are decreasing, and the radio critics have nothing but praise for the kind of talks we are broadcasting nowadays. Instead of going to the First National Bank for a speaker, we go to the Zoo, or Aquarium, or Museum of Natural History, or Art Institute, and get specialists who can talk entertainingly about head hunters, gorillas, white Indians, or Egyptian tombs. And we are right on the heels of the man or woman who has done something to get into the day's news—a man like Lieutenant Maugham who eats breakfast in



From a photograph made for POPULAR RADIO at WEAF

A TRY-OUT BEFORE A "DEAD" MICROPHONE

In the presence of the director, the artist "does her stuff" under regular conditions although she has no audience because the "mike" to which she sings is not connected for broadcasting. (The interested spectator at the left is the author of this article.)

Westinghouse

A REHEARSAL BY TELEPHONE

To obviate a 200-mile trip to the station from which she was to broadcast (KDKA), this vocalist followed the orchestra at the other end of the telephone line and sang to its accompaniment while the station director listened over the wire.

New York and supper in San Francisco, keeping pace with the sun in his airplane."

"I hear that good humorous numbers are very scarce."

"That's true, for the reason that good humorous phonograph records are scarce. Some stations broadcast vaudeville numbers direct from the stage. In vaudeville, funny acts are plentiful, but few get over on the air, because the fun must be seen as well as heard. Drop the curtain between the vaudeville audience and the stage, and give your funny act, and see how many laughs you get, and you will understand the difficulties in the way of radio humor. We have just a little more flexibility than the phonograph records, because our acts can be longer. A ten-inch phonograph record plays between three and three and a half minutes—just long enough to cook a soft-boiled egg. In that short time the humorist must raise twenty or thirty laughs. We can give him more time, and a little more scope for his personality, but he must still work through the single sense of hearing. That's why good radio humor is scarce. It is also hard to get clean high-class humor—so much of it is of the slapstick kind, and borders on the vulgar."

"That brings up the question of what is taboo."

"For the speaker, everything likely to arouse religious or political controversy, offend good taste, be unfit for children to hear or not in keeping with the character we maintain for the station. Among the speakers, too, anything in the nature

of concealed advertising—paid publicity agents are constantly trying to use our facilities for their own ends, and we also have the enthusiast anxious to speak by radio for his particular cause or movement. The world is full of propaganda and controversy, but we manage to eliminate it by requiring speakers to submit a written talk beforehand and holding them to it on the air. In music, we put the ban on suggestive songs, as well as compositions not up to a certain artistic standard. Also certain compositions that are rather overdone by radio artists. We'd be glad to have John McCormack sing 'Mother Machree,' or Rachmaninoff play his famous 'Prelude,' but when the unknown artist makes such frequently played compositions prominent on his or her program, we advise other selections for the sake of variety—and it may be that the unknown artist will play something else better."

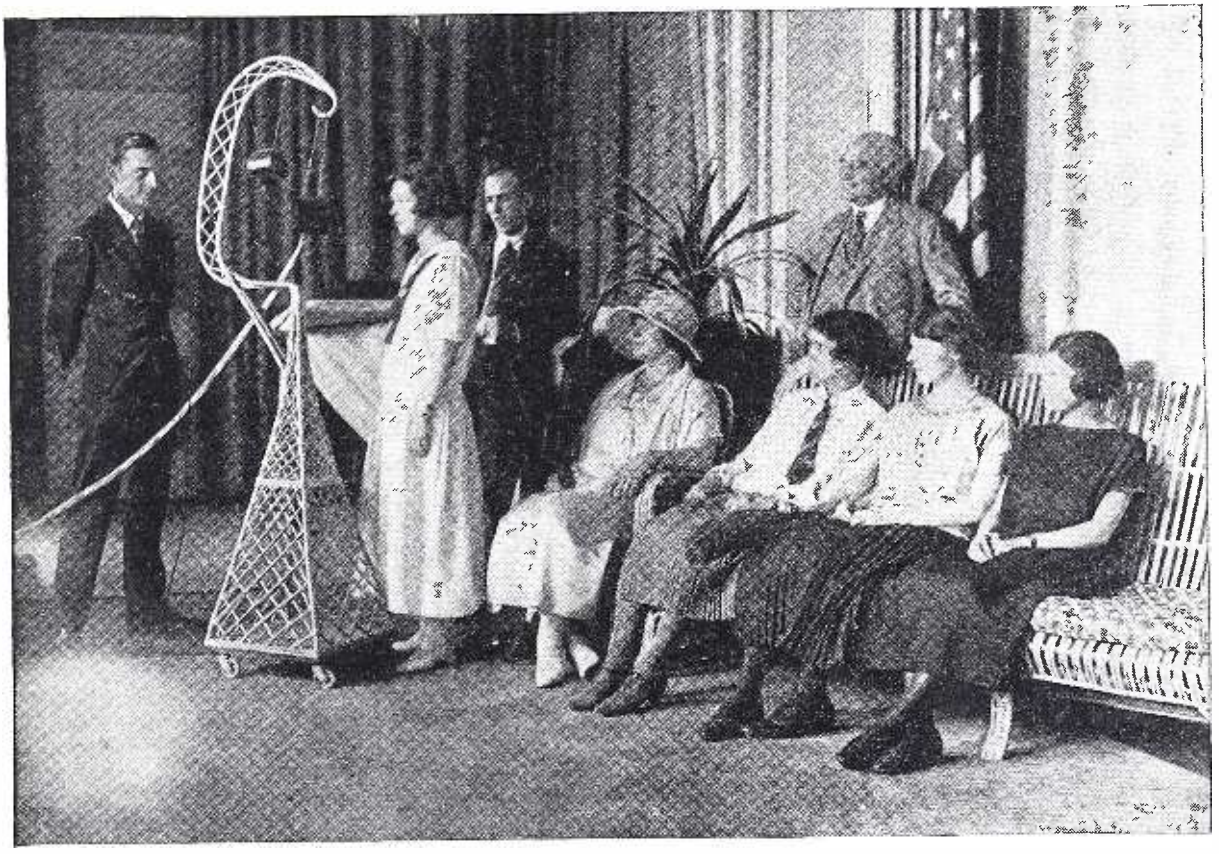
He had other practical suggestions to make to people ambitious to get on the air—little sidelights growing out of his program experience.

For instance, it occurred to me that if sopranos and baritones are too abundant, and solo numbers are becoming unpopular, that the superfluous baritone and soprano might join hands with a contralto and a basso, forming a vocal quartette. The director said that would be fine from his standpoint, but if you look at it as an artist—not so good. One poor singer in a quartette would spoil three good voices. Or a good soprano might get into bad company all around, the other three singers being poor. Then, even if all four were good, it takes months of practice to create ensemble quality, either vocal or instrumental. When they have it, the directors welcome them, but creating this quality is strictly the artists' risk, and can be attained only by careful selection of fellow artists and many months of practice together.

He said some interesting things about music teachers on the radio program. The individual instructor, vocal and instrumental, as well as the school and conservatory director, quickly saw the advertising possibilities in radio and are among the applicants.

He doesn't care a catwhisker whether you are a teacher or not, nor worry about any possible advertising you may get by a radio appearance. It is what you can do as an artist that he considers. Not every teacher, however capable, is also an artist. Many of the successful radio artists are also teachers, as that is a secondary occupation. Music teachers figure on the radio program in another way—they may not be artists themselves, but they seek a hearing for pupils who, if successful in getting on the program, give the teacher indirect advertising. Especially if the pupil is a child prodigy. There was a regular epidemic of child pianists, violinists and other marvels in New York about a year ago, but they are not now so often on the air. The radio public grew tired of prodigies. Making an actual appearance, their childish "cuteness" helps out musical ability, but on the air something is lacking. However, the good child prodigy is still welcome. Musical schools and conservatories frequently give pupils' programs lasting an hour or more, but these are being carefully restricted to institutions whose pupils really have ability, the publicity-seeking school being eliminated.

So far as I have been able to find out, no broadcasting station in the country—and that includes Canada—pays the artist or makes any charge. Some stations pay orchestras that play regularly, just as they pay their regular accompanists, announcers and other employees, but the artist's performance is voluntary. One great eastern station charges ten dollars a minute for the broadcasting of publicity talks and acts, but the artists in this case are engaged on salary by the business concern doing such advertising, and are usually well-paid pro-



Pacific & Atlantic

TESTING AMATEURS AT STATION WNYC

These young women were weeded out of several would-be broadcast artists. They will be booked if their radio tests prove satisfactory.

fessional performers, because, unless the advertising stunt is entertaining in itself, people tune out and listen to something else. This station has many more numbers by volunteer artists on its programs, and they are, of course, charged nothing for appearance.

"Then what does the artist get out of it?" I asked, finally. "At last accounts, there were more than five hundred commercial broadcasting stations throughout the country, and the programs more than half volunteer numbers —talks, instrumental recitals, vocal recitals, reading, bedtime stories, lectures, sports talks and the like. Allow only five volunteer numbers on the daily program of each station, and count them all as soloists—no duets, quartettes or ensembles. Between fifteen thousand and twenty thousand performers at least, are appearing weekly, the programs are constantly changing, and there is a waiting list. What is there in it for the artist?"

First, publicity that makes reputation and leads to paid engagements or permanent positions.

It is a common experience for artists to receive letters offering engagements at home musicales, club and lodge entertainments, as well as opportunity to become stage professionals. Something in the performer's ability or personality makes an impression on the "cash customer" in the ether, and it often happens that a telephone call offering an engagement comes in before the performer leaves the studio. The dance orchestra is hired for dances, the organist gets a movie position, the monologist is invited to a phonograph tryout.

Wonderful things are happening in American music nowadays. Fifteen years ago, exceptional talent and hard study might land the musician in a

From a photograph made at WGY

HOW THE QUALITY OF VOICE REPRODUCTION IS DETERMINED

The singer may have a good voice, but she must learn to control it properly to meet conditions if she is to get the best effect over the ether. The man behind the door at the right listens to her voice through the headphones connected with a transmitter in the studio.

narrow professional field. There were opera, recitals, orchestra and chorus, and that was about all. The native artist suffered under the handicap of being an American. If the world of professional music was not controlled by foreigners, the snobbish American musical public, made up of highbrows, looked down upon native talent. Besides ability and work, the artist needed money to pay managers and agents, and for advertising in the musical press which was pretty close to blackmail.

The moving pictures changed all that. There are at least ten thousand picture theatres in the United States that employ artists, and the demand is so great that even the amateur may secure paid engagements while he or she is studying. No agents, critics or other interlopers stand in the way—the moving-picture manager's door is open to anyone who wishes to ask for a tryout. And now, on top of these new opportunities, comes radio, offering a greater audience, a hearing and a chance to make a reputation. No more highbrow prejudice to be overcome, and no traveling to a few big cities where the world of music centers. The radio audience is "just folks," it is everywhere, and the broadcasting station and the opportunity may be right around the corner, even if the aspiring artist lives a thousand miles from New York, Chicago, or San Francisco.

Besides the publicity of the ether, radio artists get that of the printed word. When the program director accepts you after the tryout, he hands you a blank to be filled out for the publicity department. You tell who you have studied with, where you have performed before, what musical organizations you

belong to, and so on, also listing the selections to be broadcast, with the time required for each number. This is turned in with a photograph of yourself, and the publicity department sends press notices to the newspapers. Even if none of the "write-ups" are published, your name will appear in printed programs published by several hundred papers for a local station, and several thousand for one of the big stations. If you perform at a station operated by a newspaper—and there are more than half a hundred of them—the publicity generally runs several days, with a preliminary notice the day before you appear, a picture and sketch on "the day," and a review the day after. It may also be your luck to have one of the "collumnists" praise your performance. And if enough listeners write in, the program director will invite you to appear again and again—many popular artists become fixtures on the programs.

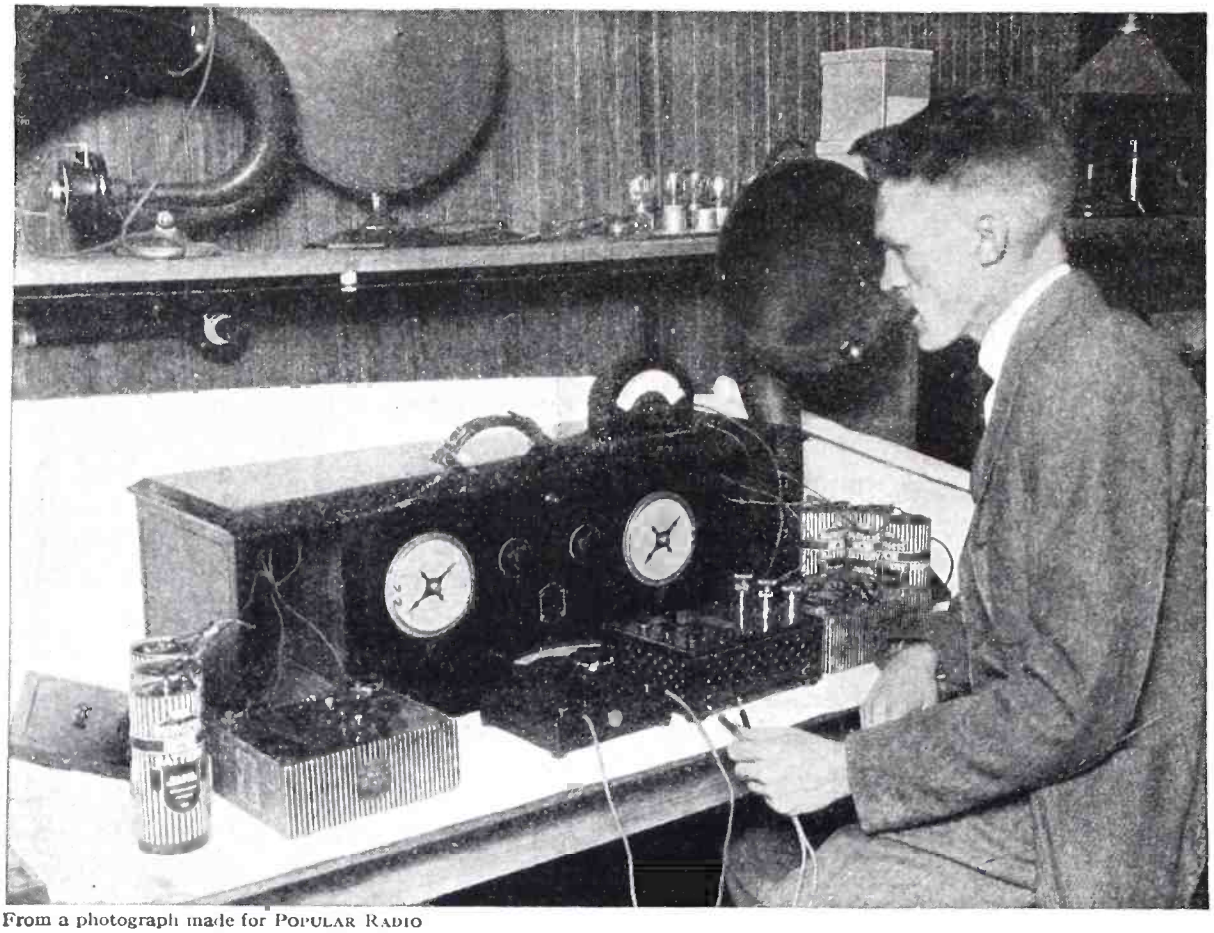
It may be that you care nothing for paid engagements or a professional career. Very well—but how about reputation or social prestige? Many amateur artists who have sung or played only for friends, find through the radio program a new circle of friends running into the millions, and to be known and appreciated is their kind of reward.

Finally, there is the incentive of doing something for the cause of music. When Theodore Thomas and Dr. Leopold Damrosch were struggling to establish symphony orchestras in the United States, less than fifty years ago, they had to sweeten their programs with "popular" numbers. Real musical appreciation in America was limited to a few cities with German colonies. Gradually the symphony orchestra created its public until today there are good orchestras in most of our large cities. The phonograph and player piano created a wider public for good music, and the moving-picture theatre helped further. Radio is reaching out still more widely. Eventually, it will reach everybody. But, for the present, its most interesting developments are found in the local stations. Again and again, the past three or four years, a new station has been opened in some community far from the big musical centers. In the beginning, the program director had a hard job. It was necessary to hunt for performers and urge them to appear, and the programs were often pretty thin in quality and length. But before long the director had a waiting list, because radio creates artists just as it creates appreciative listeners, and as the latter develop in musical taste, so the station's artists develop in ability and new ones appear.

Getting on to the radio program is, therefore, getting into the greatest of all musical and educational movements.

How to Build the Improved DX Regenerative Receiver

THE real DX regenerative receiver described in the January, 1923, issue of POPULAR RADIO still has so many friends and users that the editors receive frequent inquiries about further improvements of this receiver. To meet the readers' demands the laboratory has developed a new set, including a distortionless amplifier, which will be described in the next issue. The improved DX regenerative receiver is low in cost and high in efficiency.



From a photograph made for POPULAR RADIO

THE "SUPER" UNDER TEST

This picture shows the Radiola Superheterodyne with the dry batteries removed from the compartments at both ends of the cabinet and meters used for the test. The ammeter on top of the cabinet is not a regular part of the set.

HOW TO GET THE MOST OUT OF YOUR READY-MADE RECEIVER

No. 2: THE RADIOLA SUPERHETERODYNE

¶ *This series of articles explain the theory, operation, equipment and care of the various makes of standard receiving sets.*

The series will not indorse the product of any manufacturer, nor make comparisons between receivers of different types or makes. The receivers included in this series will be selected by the readers of POPULAR RADIO, from whom suggestions are invited.

By S. GORDON TAYLOR

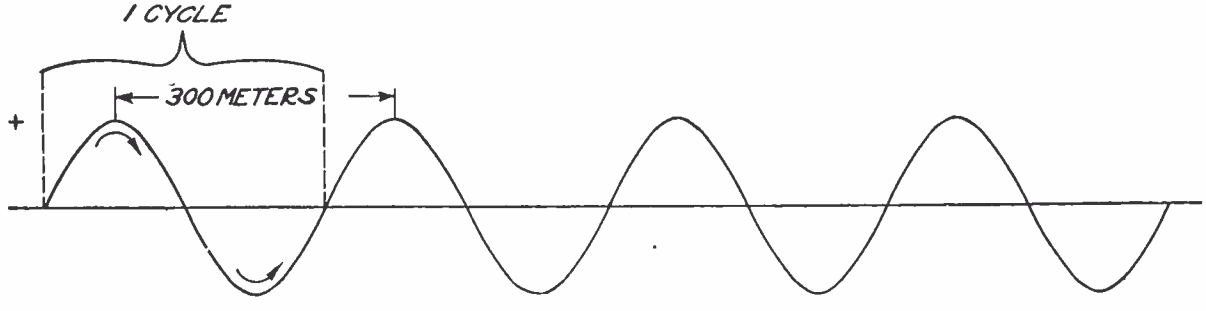
THE theory of the superheterodyne is really simple if one has a fairly thorough understanding of radio. Even to the layman the general principle of the superheterodyne is not difficult to comprehend. The actual working out of the principle is another matter. This article will therefore not present a too technical explanation. It will cover the superheterodyne principle broadly.

Explanation of the Superheterodyne Theory

It is, of course, understood that radio transmission is measured in terms of wavelength or frequency. A signal transmitted by radio travels at the rate of 187,000 miles per second. If the signal is transmitted by a broadcasting station on a wavelength of 300 meters, it means that 300 meters is the distance between the peaks of the waves. The transmitted energy is in the form of an alternating ether wave, as represented graphically in Figure 1. The station transmitting on 300 meters is transmitting a wave alternating at the rate of 1,000,000 times per second, which means that if a curve similar to that shown in Figure 1 was drawn representing the entire second it would have 1,000,000 peaks. Inasmuch as radio energy travels 187,000 miles during this second, the wavelength is obtained by changing the miles into meters and dividing the number of meters by the frequency of 1,000,000. This is the way that the wavelength of a transmitting station is determined. In describing the superheterodyne, the term frequency, as explained above, will sometimes be used, rather than wavelengths. The fact that the higher the frequency the lower will be the wavelength should be borne in mind throughout.

Radio-frequency amplification on the lower wavelengths, such as the wavelengths used by broadcasting stations, is comparatively inefficient. On the higher wavelengths from 2,000 meters up it is much more efficient, and it is on this fact that the value of the superheterodyne rests. If a superheterodyne receiver is tuned to receive signals from a broadcasting station transmitting on 300 meters, the signals from this station are received at 300 meters and through the action of the oscillator the signals are boosted to a higher wavelength in order that they may be more efficiently amplified. Amplification then takes place in what is known as the intermediate-frequency amplifier. This intermediate amplifier is designed to amplify signals at one particular wavelength. In some superheterodynes they may be tuned to as low as 2,000 meters, while in other cases they may be five or even ten thousand meters.

Reverting to terms of frequencies, the functioning of the oscillator is readily explained. The signal coming in on 300 meters has a frequency of 1,000,000 cycles, or 1,000 kilocycles. Assuming that the superheterodyne intermediate-frequency amplifier is designed for 3,000 meters (100 kilocycles) it is necessary to reduce the frequency of the signal from 1,000 to 100 kilocycles. The oscillator of the superheterodyne will have to be tuned in such a way as to make up this difference. In this case the variable condenser which controls the oscillator must be set so that this circuit will oscillate at a frequency of 900 kilocycles. This frequency subtracted from the frequency of the incoming signal results in the signal being passed on to the intermediate amplifier



WHAT WAVELENGTH MEANS

FIGURE 1: *The measurements from the peaks or top of waves give wavelength which is measured theoretically. Wavelength depends upon frequency or cycles of change of a radio wave. A cycle is indicated above by the dotted lines.*

at a frequency of 100 kilocycles. The signal is then amplified by the intermediate-frequency amplifier functioning as would any other radio-frequency amplifier.

If the oscillator circuit is so adjusted that it is oscillating at a frequency of 1,100 kilocycles the result will be the same. In other words, the frequency of 100 kilocycles which is passed on to the intermediate amplifier may result from having the oscillator tuned at 100 kilocycles higher than the incoming wave or 100 kilocycles lower. It is for this reason that it is possible to tune in a given station at two points on the oscillator dial (Station Selector Dial No. 2.) That is, the same station can be tuned in at two different dial settings with practically the same volume. As a matter of fact, it is often possible to tune in stations on more than two settings, but the explanation of this phenomena is not important, and is too complicated for discussion here. Suffice it to say that this condition results from other harmonics.

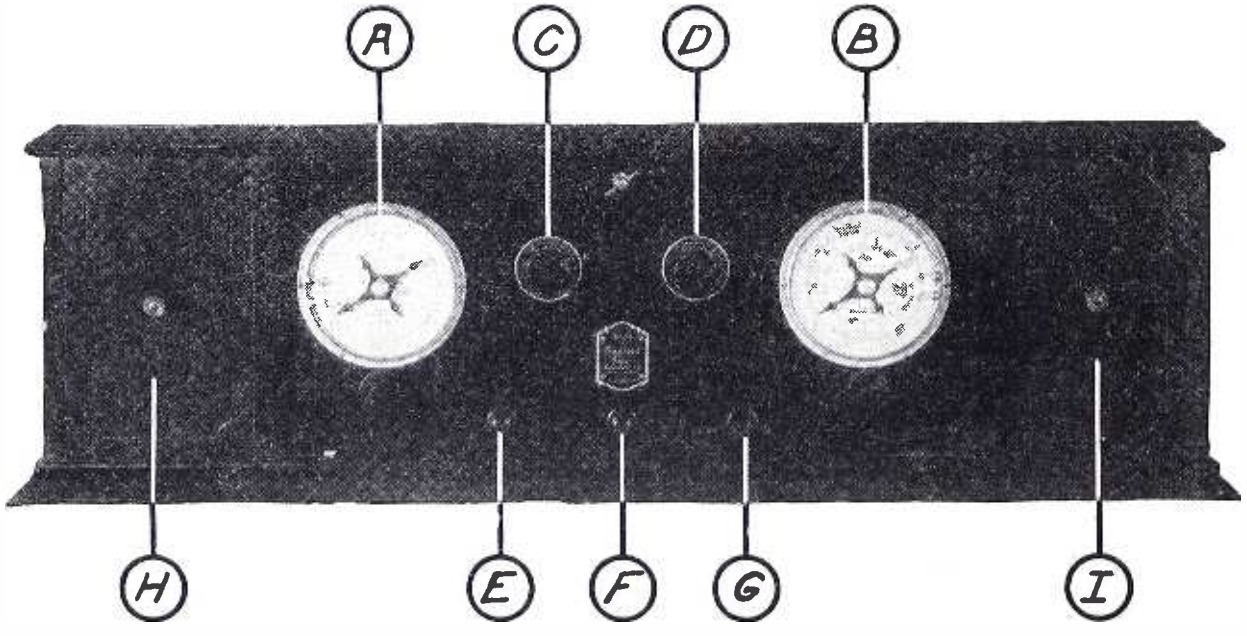
The receiver taken for the subject of this article is the *Radiola Superheterodyne, as* shown in Figure 2. The main points of interest to be considered will be the care and operation of the receiver.

How to Construct the Superheterodyne

This receiver is entirely self-contained, with the exception of the loudspeaker. It requires no outside wires for antenna and no outside batteries. A loop antenna is built within the cabinet and compartments are provided at either end of the receiver for the necessary "A" and "B" batteries. Arrangements are also made whereby a separate loop antenna may be connected to the receiver if desired. By this method somewhat better results can be obtained on more distant stations. This connection is accomplished as shown in Figure 3. For ordinary use an external loop is not necessary. The use of an outdoor antenna with this receiver is not recommended.

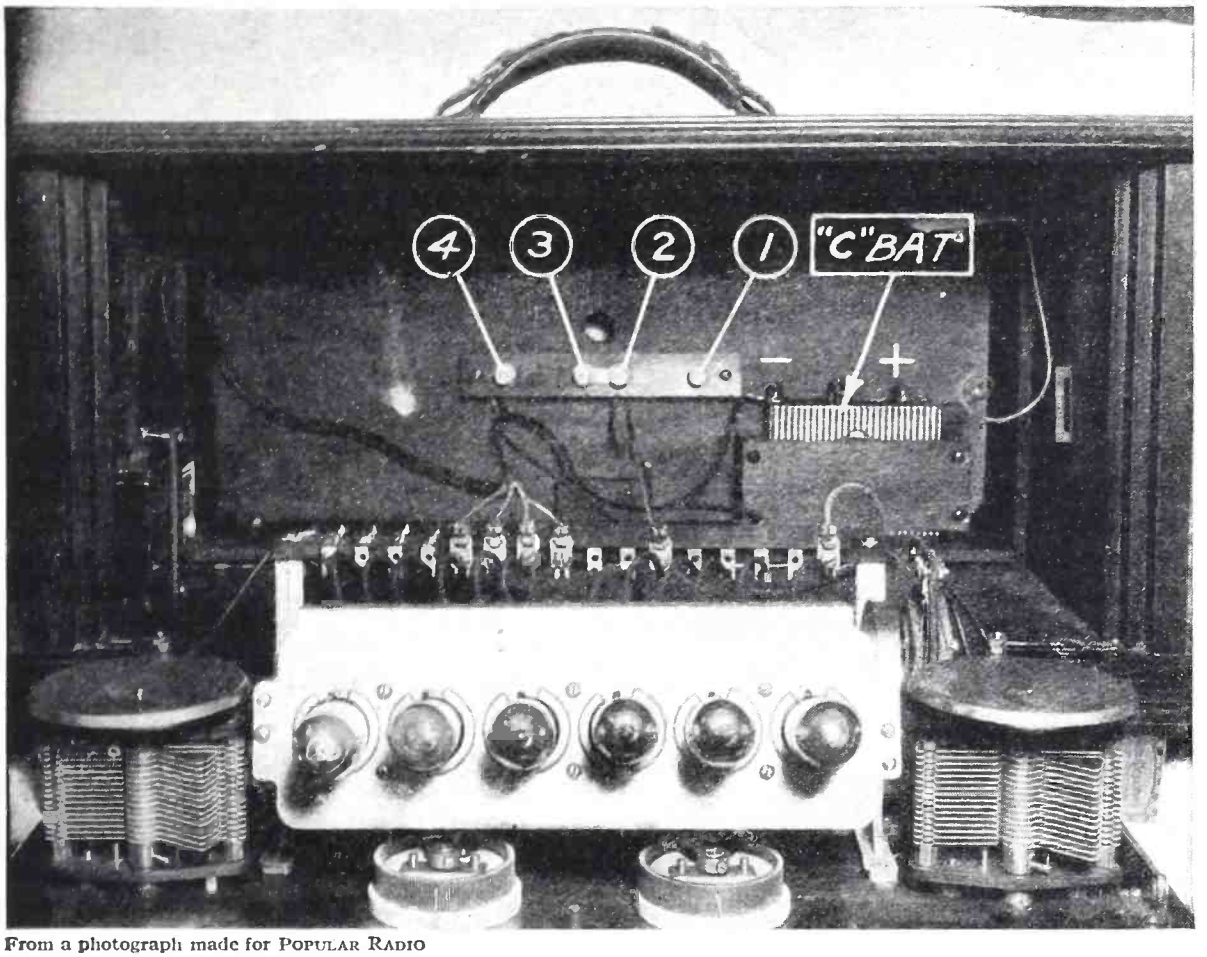
Try Out Tubes Before Buying the Set

The tube equipment consists of six UV-199 Radiotrons which are mounted as shown in Figure 4. In this connection



FRONT VIEW OF THE RADIOLA SUPERHETERODYNE

FIGURE 2: *The letters on the illustration indicate the following: A—station selector No. 1. B—station selector No. 2. C—battery regulator. D—volume control. E—amplification control switch. F—battery cut-off switch. G—loudspeaker jack. H and I—battery compartments.*



From a photograph made for POPULAR RADIO

THE CONNECTION FOR THE SEPARATE LOOP ANTENNA

FIGURE 3: *This illustration shows the binding post connections on the back of the cabinet to hook in the loop that is contained in the back part of the case. Note that the binding posts 2 and 3 are connected together. To use an external loop, remove the metal connector between these posts and fasten your leads from the loop to posts 2 and 4.*

it will be found advisable to try changing around the tubes until they are all in positions that give the best results. Usually this is done before the receiver is purchased. The fourth tube from the left-hand end is the most important, and the most critical. In shifting tubes around it is a good practice to make sure that each of the six tubes is tried in this fourth socket.

While every effort is made in the manufacture of vacuum tubes to make them as nearly alike as possible, it will be found that different tubes of the same type may have different characteristics. It is this fact that makes the shifting around of tubes necessary for best results in any radio receiver and particularly in the superheterodyne type.

How to Select and Care for Batteries

Three types of batteries are used, these being known in radio parlance as "A," "B" and "C" batteries. The "A" battery consists of six ordinary dry cells connected in series-parallel, as shown in Figure 5, so as to provide 4½ volts for the operation of the filaments of the tubes. The "B" battery consists of two large-sized 45-volt radio "B" batteries connected in series so as to provide a total of 90 volts for the plate supply. The "C" battery is a small 4½-volt battery made especially for radio work. The purpose of this "C" battery cannot well be explained without going into the entire theory of not only this particular type of receiver, but also the theory of the vacuum tube. It is enough to say that it aids in

the operation of the receiver by making the tube function at highest efficiency.

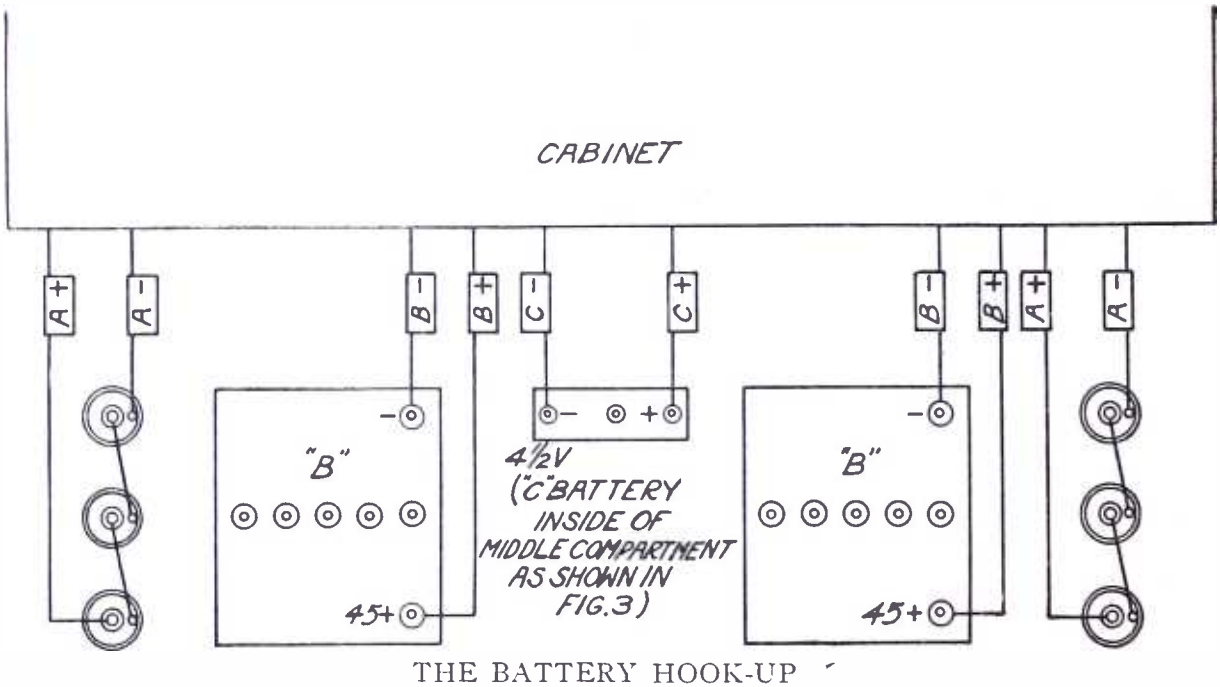
The proper way to connect the batteries is shown in detail in Figure 5.

The life of the battery equipment is something in which the owner of a receiver is vitally interested inasmuch as replacement of worn-out batteries represents practically the entire cost of upkeep. The life of the batteries depends, of course, on the amount of service the receiver is called on to deliver. Following is a brief tabulation of the estimated approximate life of the "B" batteries when used at different rates per day. These figures, of course, are only approximate, but will at least give the owner a good idea as to how long he may expect his batteries to last.

The "A" batteries should give somewhere in the neighborhood of 150 hours service before their replacement becomes necessary. The life of the "C" battery is greater than that of either the "A" or "B" batteries, as there is practically no current consumption here. A "C" battery should last for a year or more.

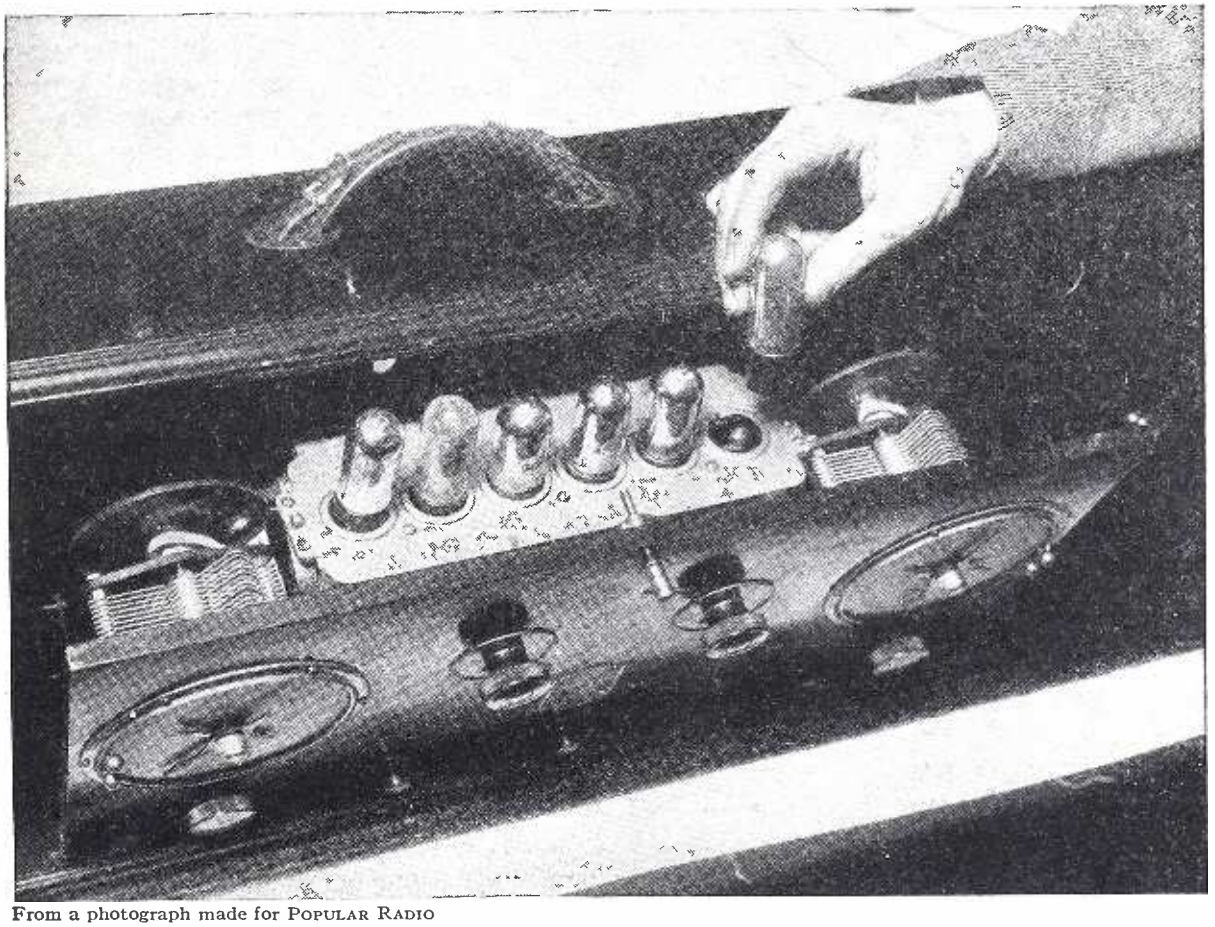
The best means of keeping a check on batteries to determine their condition is by means of a voltmeter. When a voltmeter registers less than 35 volts when connected across the terminals of a 45-volt "B" battery, it is an indication that the battery is too far run down for further efficient service. In the case of the "A" battery a voltage of 3.5 necessitates replacement. The proper working voltage of new batteries is 4.5. Incidentally, the voltage of the "A" battery should always be measured with the receiver in operation, as an "A" battery which is almost run down will show a higher voltage if it is standing idle, and a measurement taken under this condition would be misleading. The "C" battery should not be allowed to drop to less than 4 volts.

If one does not have a voltmeter, the condition of the batteries may be determined by the action of the receiver. The dial marked "Battery Setting" will give an indication of the condition of the "A" battery. When the "A" battery is new, good results will be obtained when this dial is set somewhere between "Off" and 10. As the battery runs down, however, it will be found that a higher setting of this dial becomes necessary. When a point is reached where it is necessary to



THE BATTERY HOOK-UP

FIGURE 5: *This diagram shows how to connect battery renewals. The battery leads are all marked with tags in this set. Check up before using the set with new batteries to make sure your positive and negative battery terminals attach to positive (+) and negative (—) posts in the cabinet.*



From a photograph made for POPULAR RADIO

HOW TO GET AT THE TUBES

FIGURE 4: *The front panel is unlocked by means of a catch at the top, center of the cabinet. The panel hangs out as shown above. To remove a tube, press it down and turn it to the left. To replace one, press it into the socket and twist it to the right.*

turn the pointer almost all the way around, it is time to replace the "A" battery.

It is somewhat more difficult to judge the condition of the "B" battery. The best plan is to listen to the click in the loudspeaker as the plug is inserted in the loudspeaker jack. When the batteries are fresh the click will be quite noticeable. As the voltage drops, however, this click will become less noticeable or may disappear entirely. Also, the volume of signals on the loudspeaker will drop off materially.

How to Control and Tune the Superheterodyne

Assuming that the loudspeaker plug has been inserted in the jack provided for it and that the "Battery Setting" dial is set in the "Off" position, the button just to the left of the loudspeaker jack should be pulled out. This is the switch that turns on the "A" battery current. The button to the left of this switch is for the purpose of controlling the volume, and when maximum volume is desired should be pushed in as far as it will go. Next, the "Battery Setting" dial is turned very slightly to a position one or two points beyond "Off." This will provide the proper filament voltage for the vacuum tubes. The "Volume Control" dial is then turned in a clock-wise direction until a grating sound is heard. Then it is turned back just below this point. If no grating sound is heard the "Battery Setting" dial should be turned a little farther in a clock-wise direction and the manipulation of the "Volume Control" dial repeated. With these operations completed, the receiver is ready to tune in broadcasting

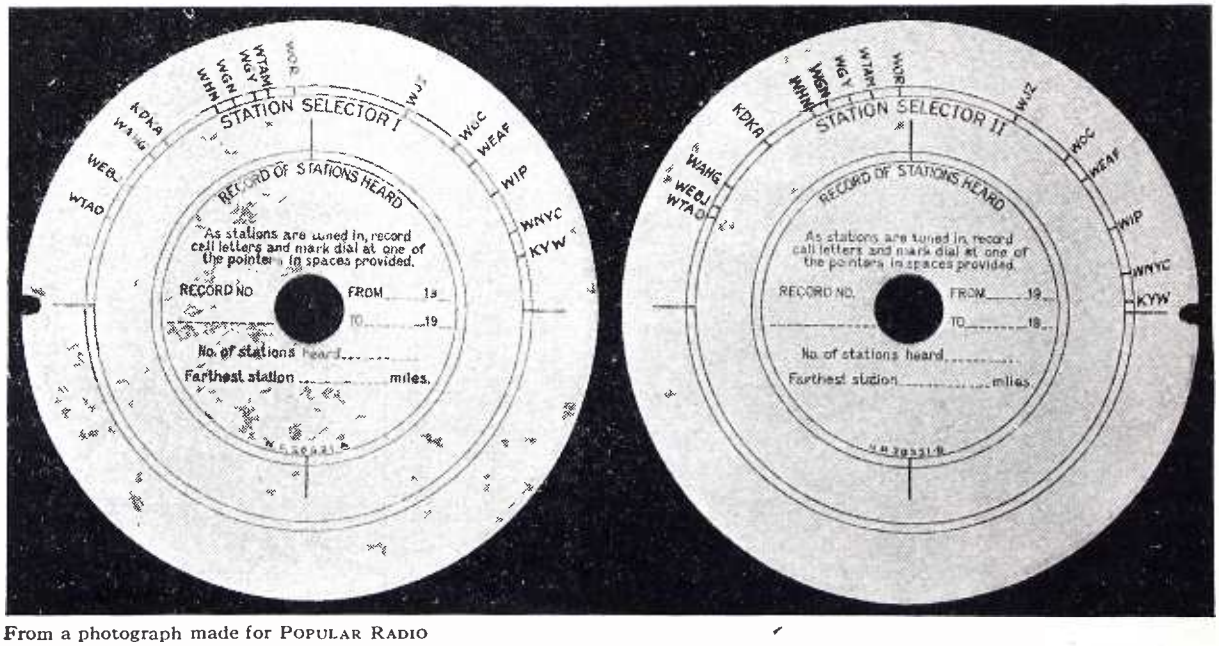
stations. This tuning is accomplished by slowly rotating the knobs under the "Station Selector" dials. These knobs should be so manipulated that the gold heads of the pointers move approximately together. When a signal is heard "Station Selector No. 1" should be adjusted to bring the signal up to the greatest volume. Then "Station Selector No. 2" should be readjusted. This will give the proper settings of these two tuning units. The final adjustment is that of the "Volume Control." It should be turned to either the left or right until a point is found where the signals come in with maximum volume but without distortion.

How to Chart this Receiver

When a station has been tuned in to maximum volume, the call letters should be marked on the paper dials of "Station Selectors" opposite the gold heads of the pointers one and two. As explained previously, it will be found that a given station may be tuned in at two different points on the dial "Station Selector No. 2." On the upper wavelengths these points will be approximately an inch and a half apart, while on the lower wavelengths they will be much closer together. In marking the call letters on the dials it is always advisable to mark the upper setting of the dial No. 2. Then the next station tuned in should be marked in the same way. Once a station has been charted in this manner, it may always be tuned in at the same settings of the "Station Selector" pointers. The adjustments of the "Battery Setting" and "Volume Control" dials will, of course, not always be the same, as they will vary with the condition or voltage of the "A" battery.

In Figure 6 will be found reproductions of a pair of dials marked in this manner. These dials comprise a "Chart" made up during the testing of this receiver. If the number of stations logged crowds the call letters, the lower half of the dials may be used with the long black pointer as the indicator; or the space between circles may be utilized.

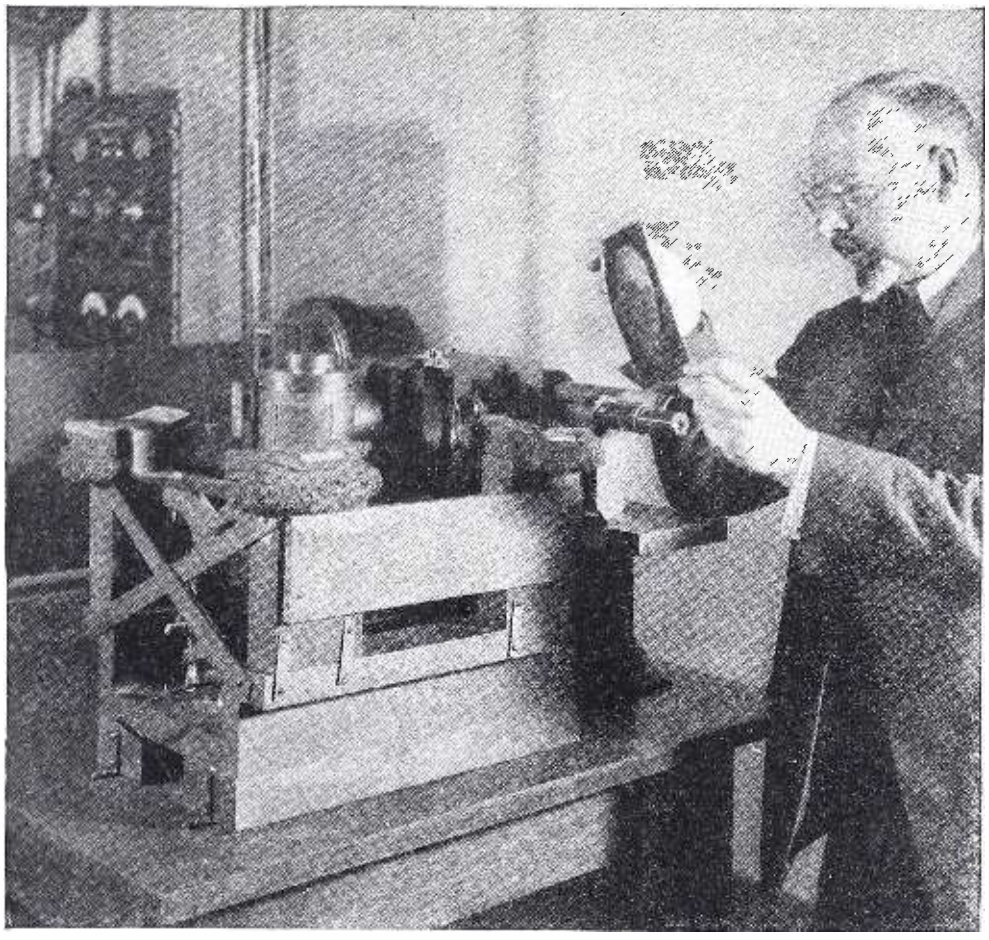
To chart stations as described in this article is a simple matter; once the dials have been marked any station may be tuned in at will. Without trying various places on the dials any member of the family, no matter how inexperienced, can tune the set.



From a photograph made for POPULAR RADIO

A NOVEL METHOD OF CHARTING STATIONS

FIGURE 6: *As stations are tuned in for the first time they are charted on the dials shown above. These are placed on the panel of the set. Stations charted in this manner are easily picked up again at dial settings marked on the circular charts.*



A. T. & T. Co.

THE RECEIVING APPARATUS FOR COLOR PICTURE TRANSMISSION

The unexposed film is just below the hands of Dr. H. E. Ives, the illuminating engineer, who worked on this development. The lense to the left is the "light valve" that controls the light beams thrown on the film from the lamp house at the extreme left.

Color Pictures by Radio

How science is making possible the transmission by wire and radio of a photograph of an object or of a scene in natural tint within the space of a single hour

By R. W. KING

A SHORT time ago announcement was made of the achievement of a simple and practical method of transmitting photographs over telephone lines.

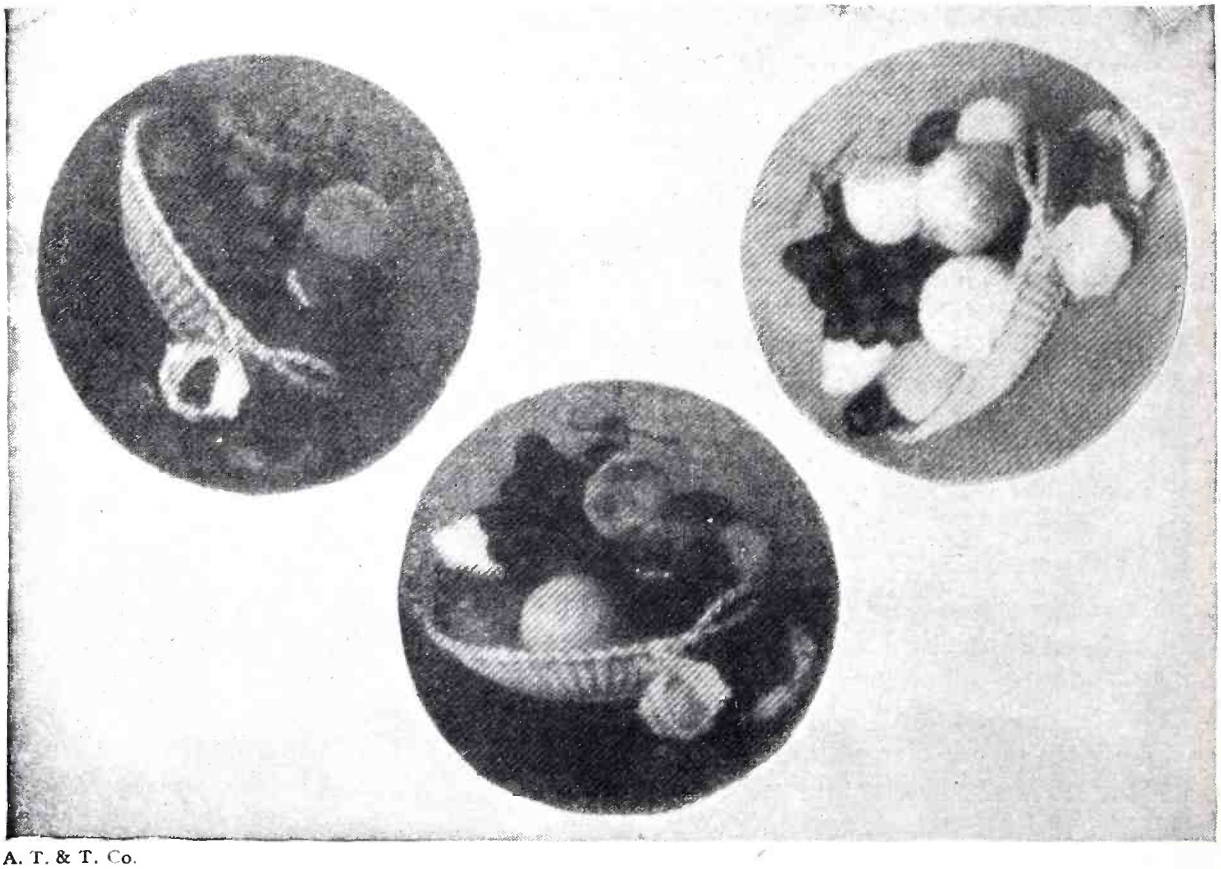
The method as developed by the Bell System engineers is suitable for the transmission of black and white pictures. The original picture in the form of a positive transparency is inserted in the transmitter and is reproduced at the receiving end on another photographic film as a picture composed of fine black lines of varying width. The effect when the picture is held at ordinary viewing distance is that of an ordinary photograph with very perfect rendering of tone. In the course of the demonstration not only ordinary photographs but autograph signatures, fingerprints and printed matter of various sorts were transmitted.

It is obvious that immediately good

black and white photographs can be sent, any other kind of picture which can be recorded as a black and white picture or as a series of such pictures can also be sent. Among such pictures, for instance, are stereoscopic photographs, the component pictures to be used in color lithography, and the three black and white records which are used in the various processes of three-color photography. Actual tests of the system for transmitting colored pictures over great distances show that it is as satisfactory as might be anticipated.

In order to understand all that is involved in transmitting a color photograph over a telephone line, it is necessary to outline the processes of making a color picture by the three-color process. The three-color process depends for its possibility on the fact that all colors may be copied with a high degree of fidelity by the mixture of three colors which are called primary colors. These colors are red, green and blue. Mixing red, green and blue light, as for instance by means of three projection lanterns, each one furnished with a proper colored glass over its lens, enables us to make white light when the three colors are in a given proportion of intensity, and all other colors, including yellow, orange, violet, blue-green, and so on, when the proportion of the three primaries are altered.

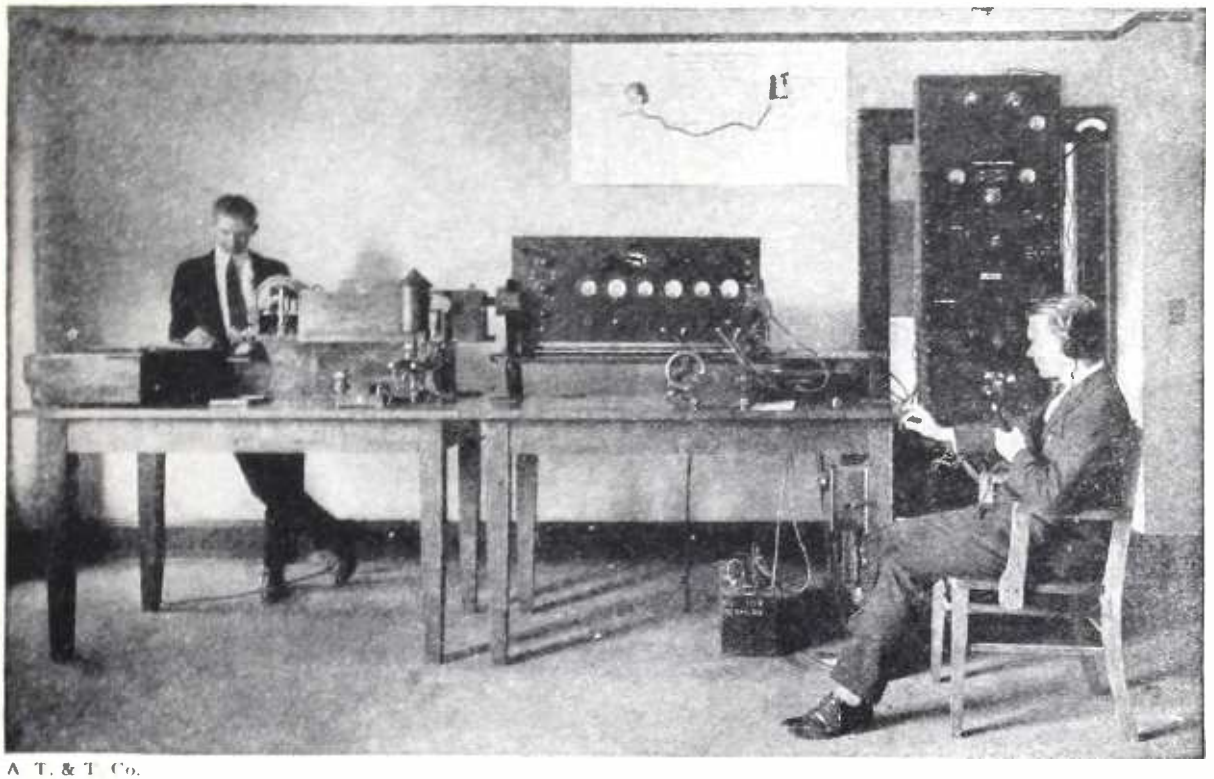
The process of making a three-color photograph then consists in all cases of making three negatives of the original object each through a color filter, as it is called, which in combination with the color sensitiveness of the photographic plate makes a record of the amount of one of the primary colors which will be needed to mix with the



A. T. & T. Co.

THE POSITIVES OF THE THREE KEY-NEGATIVES AS THEY ARE RECEIVED

These negatives serve in the same way as engraved plates for printing in colors; each is a key to the primary colors, yellow, red and blue.



A. T. & T. Co.

THE EYE AT THE SENDING END THAT PICKS OUT THE COLORS

On the extreme left is the synchronous motor for rotating the film which, with the photoelectric cell is under the dark cover just behind the lamp house. The large case with the dials contains the amplifier for enlarging the output of the photoelectric cell.

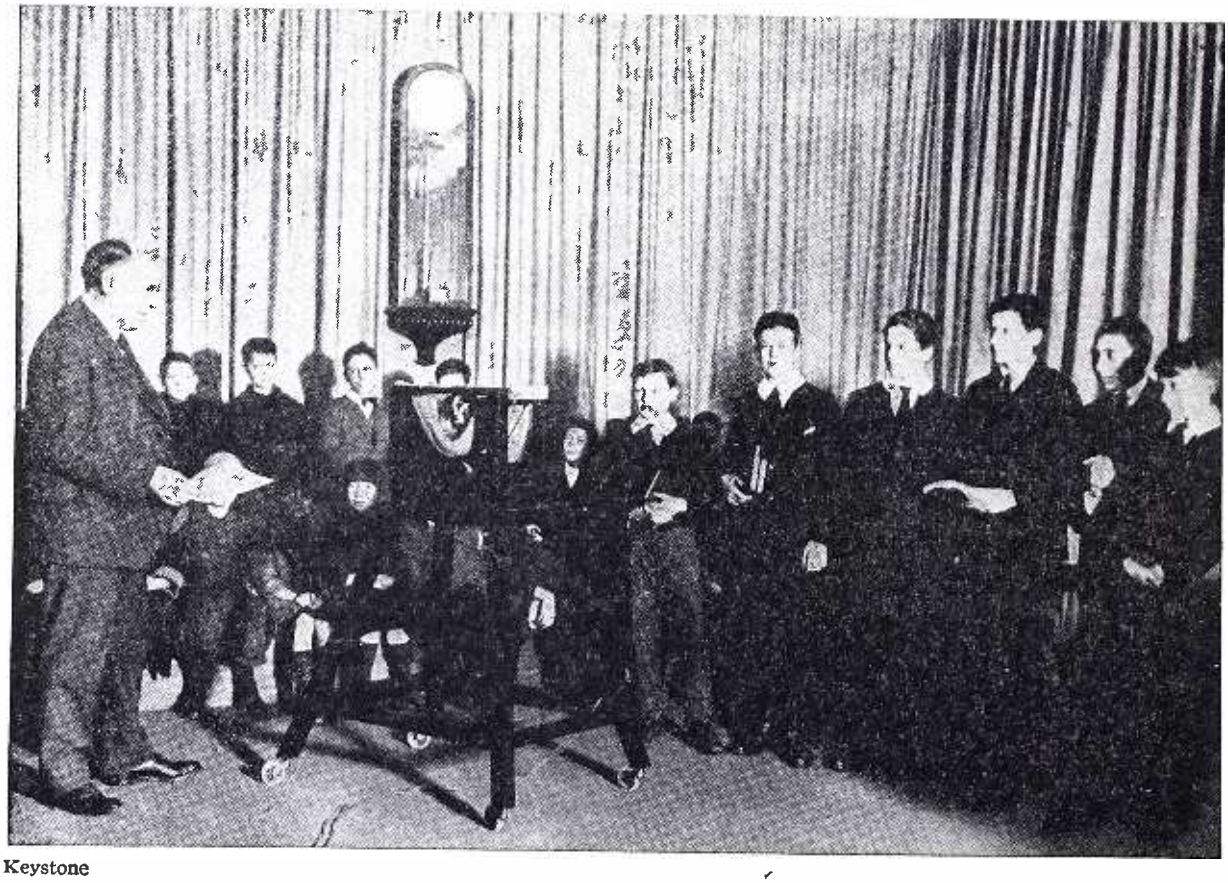
others to reproduce the color of the original object. Thus the filter corresponding to the red projection lantern above considered must transmit light from a photographed object to the amount which red light is going to be used in order to copy the color of the original. An orange, for instance, will be recorded partly through the taking filter for green; since red and green light are to be mixed to produce the orange color.

When the three record negatives are obtained they may be used to make a color picture in any one of several different ways. Transparency prints from the negatives may be placed in three projection lanterns and projected on a white screen in red, green and blue light; the three images being accurately superposed one on the other. Or three transparent films may be prepared which are to be laid one over the other. In this case the colors to be used are not red, green and blue but the complementaries, that is, the colors which mixed with these make white; they are blue-green, crimson and yellow. The object here is not to add lights to each other as was done with the lantern, but successively to absorb the primary colors from the white light. Accordingly the red record is printed in blue-green, so that where the red record is black, the transparency film will obstruct all the red light coming through; the green record is printed in crimson, the blue record in yellow.

It is now obvious that in order to send a three-color photograph over the wires, all that is necessary is to send three black and white record transparencies made from the original three-color negatives. One of the accompanying illustrations shows in black and white the three separate impressions of a single picture, which if they were printed in the proper colors and superimposed would give a colored reproduction. In making the positives for trans-

mission, each one was turned at a different angle in order that the structure of fine lines which is introduced in the process of transmitting over the telephone wires would appear in each received picture at such an angle as to prevent geometrical patterns when the three were superposed. Also the differences in the photographic density of the three records is clearly shown, corresponding to differences in color in the original object. The actual transmission time of the three positives together was about 20 minutes, which included the time for changing and making adjustments of the apparatus between each picture.

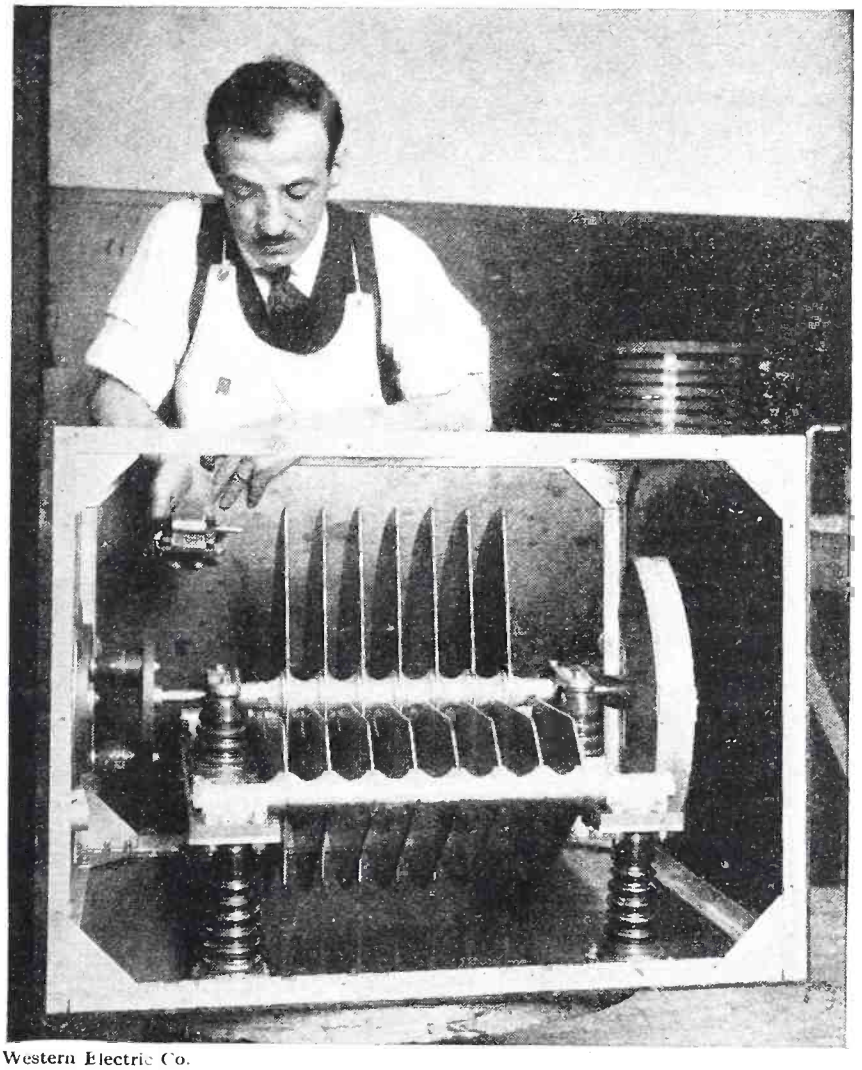
Regarding the applications of telephone transmission of colored pictures, there may be an important field in the production of three-color transparency lantern slides of news subjects. Lantern slides can be made from the transmitted photographs in a very few minutes and could be shown to large audiences so quickly as to offer promise of their utilization in photo-news service in such places as moving picture houses. Lantern slides in color would give additional interest to such a service. For this purpose it is of course necessary to have available color cameras capable of making the original three-color negatives with such short exposures under practical lighting conditions as to be able to cover all kinds of subjects. Recent developments in photographic speeds, lenses and apparatus offer promise of the early availability of such three color negatives.



Keystone

LONDON SCHOOL CHILDREN ENJOY "ASSEMBLIES" BY RADIO

Programs devised for the special benefit of school children are now being broadcast in London. Here you see Sir Walford Davies directing his choir that sings for their entertainment. Other features of this new educational program are orchestra recitals and talks by celebrated persons.



Western Electric Co.

TWO EXTREMES IN VARIABLE CONDENSERS

The gigantic condenser shown above is used with the LEVIATHAN'S *new high-power radiotelegraph. The air space between the plates is three-quarters of an inch, whereas the small receiving condenser in the man's hand has the usual one thirty-second of an inch air space.*

WHAT YOU OUGHT TO KNOW ABOUT

CONDENSERS

This article clears up some of the misconceptions about condensers—and tells what you can expect of condensers in your radio receiving circuits, and how to use variable condensers properly

By SYLVAN HARRIS

SEVERAL misconceptions are current about condensers for use in radio receiving sets. We have heard suggestions as to how to use condensers properly in tuning, as to what the proper capacity should be, and as to the smallness of the resistance allowable in the condenser.

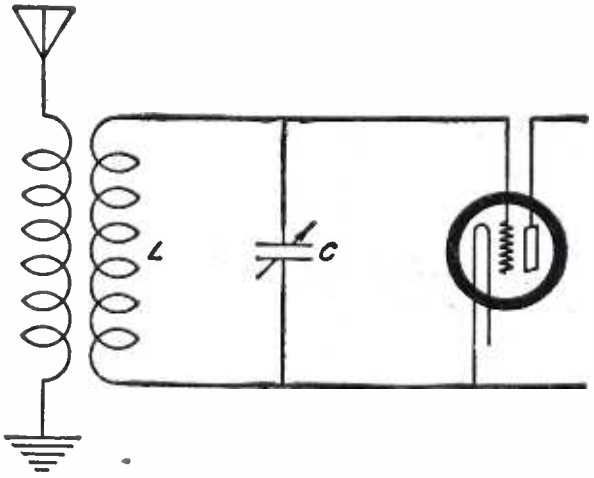


DIAGRAM OF AN ORDINARY TUNING CIRCUIT

FIGURE 1: *Shows the usual manner of representing a simple vacuum tube tuning circuit where the voltage arises in the windings of the inductor, L.*

"Low-loss" condensers have been placed on the market. Competition among the manufacturers of these low-loss condensers is very keen. As a consequence, many statements have been made concerning the resistances which are not based on absolute fact.

There are a few physical facts which we must understand to be able to comprehend the problem.

The three-electrode vacuum tube, for example, is used in connection with circuits that include an inductor and a condenser. The vacuum tube is essentially a voltage-operated device, so that the problem hinges around the voltages set up in the circuit.

Figure 1 represents a simple tuning circuit connected to a three-electrode vacuum tube in the usual manner. L is the inductor and C is the condenser. It can easily be shown that the tuning circuit can be represented in the form shown in Figure 2. The point is that the results are the same whether we consider the electromotive force as arising in the windings of the inductor, or as being applied in series with it. Actually it arises in the windings, but as the simple series circuit of Figure 2 is exactly equivalent, we will use this figure in these considerations.

Voltages, or differences of potential, are set up between two points in a circuit due to the *impedance* between these points. The impedance may be a pure resistance, a pure capacity, or a pure inductance, or a combination of these. Actually there are no such *pure* quantities, every electrical device containing all three of these quantities to some degree. For simplicity, however, we will consider the inductor as a pure inductance and the condenser as a pure capacity.

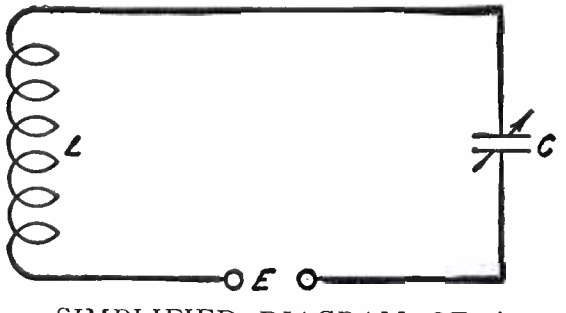
The part of the impedance which is due to either the capacity or the inductance, or both, is known as the *reactance*. The reactance due to the inductance alone is $X_L = 0.00628\,fL$ and that due to the capacity alone is

$$X_C = -\frac{159.3}{fC}$$

When a proper balance between the capacity and inductance in a circuit is obtained which results in resonance, these two reactances are equal and opposite in effect, and the total reactance of the circuit is zero.

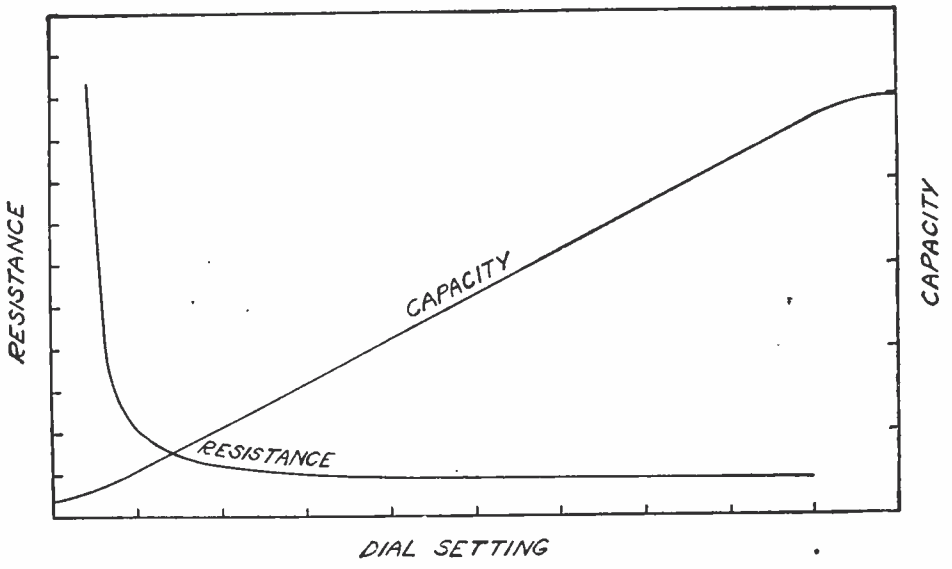
In these formulas X_C and X_L are the inductive and capacitive reactances respectively, in ohms, f is the frequency in kilocycles, C is the capacity in microfarads and L is the inductance in microhenries. These reactances exist in the circuit even when resonance is obtained, even though their net effect on the total circuit is zero.

The voltage drop between any two



SIMPLIFIED DIAGRAM OF A RECEIVING CIRCUIT

FIGURE 2: *This shows the equivalent tuning circuit of that in Figure 1. In this circuit the voltage is applied in series with the other elements.*



THE RESISTANCE CHANGES IN CONDENSERS AT DIFFERENT DIAL SETTINGS

FIGURE 4: *Notice that resistance rises sharply at the lower dial settings. These observations indicate that it is well to design your inductors so that you can tune with your condensers at higher dial settings (those above 30).*

points in such a circuit is the product of the current in the circuit and the resistance or reactance between the two points. Thus the voltage drop across a pure resistance is $V = RI$ and the drop across a pure inductance or capacity

$$V_C = X_C I = -\frac{159.3\ I}{f\ C},\quad V_L = X_L I = 0.00628\ fLI$$

To obtain a large voltage across the inductance or capacity in Figure 1, it is evident that the reactance for a given current and frequency must be high. In other words, a large inductance and small capacity should be used. This is the conclusion that has been arrived at by someone a long time ago, and everyone has been following it as sheep follow their leader. The author does not mean that this conclusion is incorrect; he means that it is not one half the story.

The story becomes somewhat different when we consider the resistances in the circuit. The presence of resistance represents a loss of power as given by the formula

$$P = RI^2$$

in which P is the power loss in watts, R the resistance in ohms, and I the current in amperes. It is to be noticed that the loss of power increases in proportion to the *square* of the current; that is, for a given resistance the power loss is quadrupled if the current is doubled. This loss of power results in broadness of tuning as well as inefficient operation of the receiving set and lowering of its receiving range. It is this loss that we are trying to overcome in our low-loss condensers and coils. We will now consider what effects are present in condensers and coils and other parts of the tuning circuits that give rise to these losses.

Until lately there have been no satisfactory methods known by which to measure the resistances of small air condensers. Various bridge methods of measurement have been used from time to time, but these are satisfactory only at lower frequencies than are used in radio reception; generally in the audible frequency range. When high frequencies are used there are losses of power in the bridge which vitiate the results of the measurement.

Substitution methods of measurement have been used, which require the assumption of zero resistance in a condenser specially constructed and used as a standard of comparison. Common

sense tells us that zero resistance in any piece of electrical apparatus is impossible, so that this method of measurement must be regarded as very inaccurate.

Experimenters have attempted to compute the resistance of condensers by making the measurements at 1,000 cycles on a bridge and then calculating the probable resistance at radio frequencies. The method used is outlined as follows, together with the objections to the method. Condenser resistances have been measured at low frequencies by the bridge methods and plotted as shown in Figure 3.

This is the curve for a glass condenser of capacity 0.002 microfarad. It will be noticed that this curve is straight throughout its whole length except for a very slight curvature at the lower end. Moreover, it will be noticed that it covers the range from 1,000 meters to 4,000 meters, or from 300 kilocycles to 75 kilocycles. These are frequencies which are not used in ordinary radio work (except in the case of long-wave transatlantic stations).

In this method of measurement, as the curve is practically a straight line, it was assumed to be straight all the way as the broken line shows. Experimenters therefore have assumed that the resistance of a condenser decreases in the same proportion as the wavelength is decreased. A bridge measurement which gives 125 ohms as the resistance of the condenser at 1,000 cycles (300,000 meters) would then have a resistance of 0.125 ohm at 1,000,000 cycles (300 meters), according to their method of reasoning. That is,

$$\frac{1{,}000}{1{,}000{,}000} \times 125 = 0.125 \text{ or } \frac{300}{300{,}000} \times 125 = 0.125$$

The calculation is given for both wave length and frequency.

That this method cannot be correct, or give even nearly correct values of the resistance is indicated by the slight curvature at the foot of the curve in Figure 3. A curvature so slight as amounting to only 0.01 ohm for a range of 1,000 cycles would not be noticeable on the curve, but its effect would be multiplied 1,000 times if the same curvature were maintained over a range of 1,000,000 cycles. The result would then be in error by 1 ohm and the actual resistance would be 11 times the computed value. This is an exaggerated example, used to illustrate the case, but it can be shown that even if the curvature is very much less than this the error in the result will be several hundred percent from the true value.

The trouble lies in the assumption that the curve is a straight line. This is equivalent to saying that the power-factor (known also as the phase-difference) of the condenser is constant. The power-factor is given in degrees by

$$\psi = 0.36\, f\, R\, C$$

in which f is in kilocycles, R in ohms, and C in microfarads. We can see from the formula that the power-factor cannot be constant. As f varies, the value of R also varies, due to skin effect, so that the power-factor must vary. If it did not vary the resistance would be inversely proportional to the frequency, and we would write

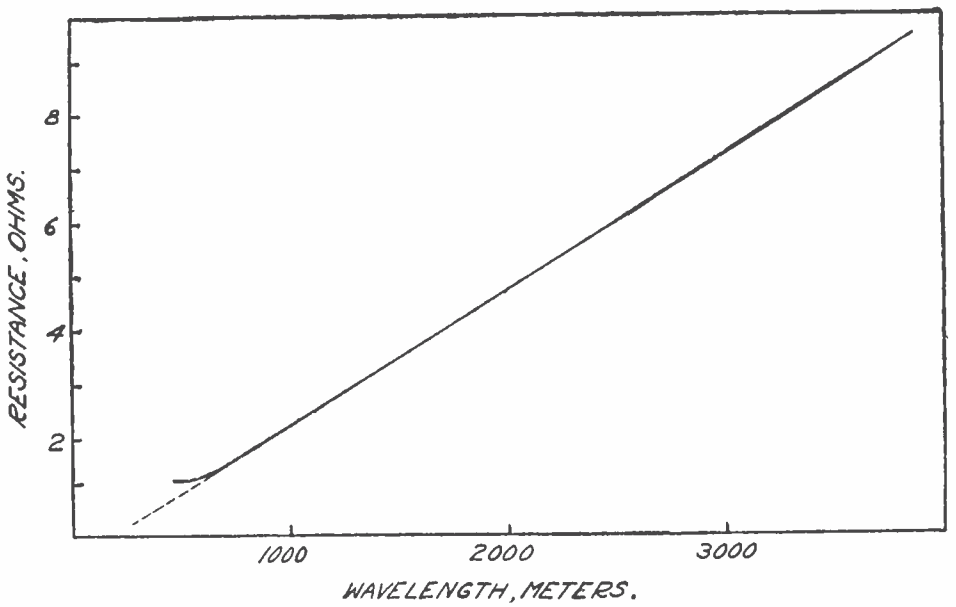
$$R \text{ proportional to } 1/f$$

But on account of the skin effect the correct relation is

$$R \text{ proportional to } 1/f^m$$

This is the effect that has been neglected in the method described above. As a result of all this a new method* has been devised which eliminates the inaccuracies of the above methods, and permits the measurements to be made under the same conditions which prevail in radio circuits. The measurements were on a great many condensers, including all types and all makes. The method was carefully checked by measurements made on known resistances. The resistances ranged from about 0.5 to 2.5 ohms, the low-loss types showing slightly lower

* The measurements were made by Mr. Charles N. Weyl and the author in the laboratories of the Moore School of Engineering, University of Pennsylvania.



RESISTANCE CURVE OF A CONDENSER OPERATING ON THE HIGHER WAVELENGTHS

FIGURE 3: *It has been assumed that resistance in condensers varies directly with the wavelength. Calculations of resistance made on this assumption are erroneous at low wavelengths where the resistance decreases at a slower rate as indicated by the slight curvature of the graph.*

resistances than the old types. We will not at the present writing go into the resistances of the particular makes. What the author wishes to do is to give his reader an unexaggerated idea of the importance of the condenser resistance.

Now, consider the subject of coils, for these are always used with condensers in tuning circuits.

It is well known that coil resistances run very high, especially at radio frequencies, which we are considering. One manufacturer of a concentrated inductance of 100 turns advertises the resistance of his coil to be 80 ohms at 500 meters. Another manufacturer advertises the resistance of his loop antenna to be about 30 ohms at 200 meters. In fact, as far as the writer knows, no inductances have as yet been designed having resistances which even approach the low values of condenser resistances.

Let us consider, for example, a condenser which has a resistance of 1 ohm used with the loop mentioned above which has a resistance of 30 ohms.

Suppose we replace this condenser with one which has a resistance of 0.5 ohm. The total resistance of the circuit will be reduced only 0.5 ohm out of 30.5 ohms, or less than 2 percent. The great worry about condenser resistance is therefore needless, and a great deal of undeserved pressure has been brought to bear upon the manufacturers of condensers by those who would better have devoted their time and energy to designing low-loss inductors.

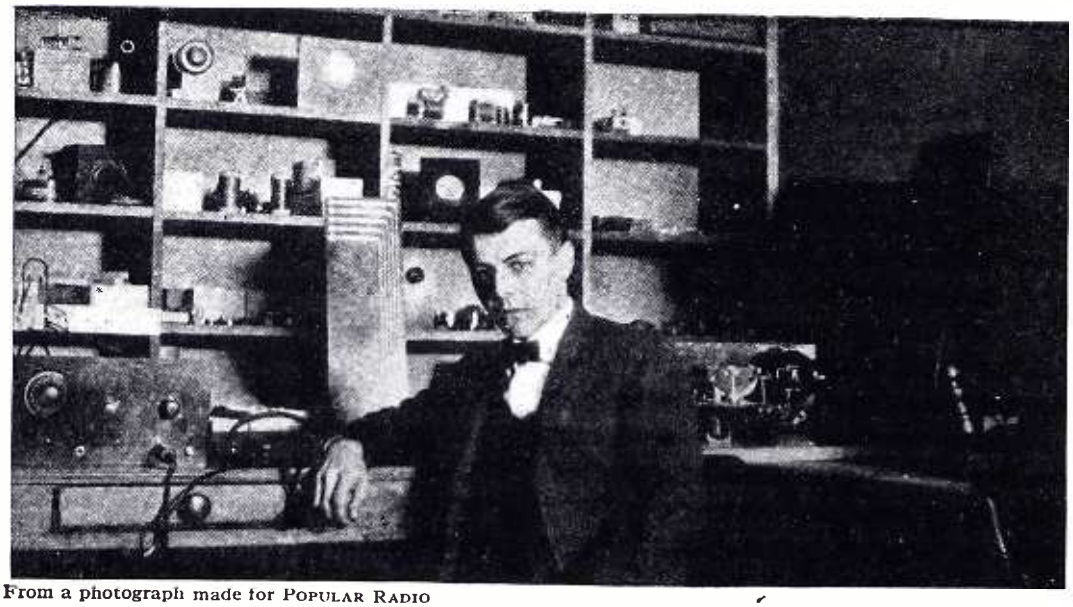
There is another very important point that should be brought out here. By the new method it was possible to plot the variation of resistance of a condenser with the dial setting. The general shape of this curve is shown in Figure 4. Its shape might be suspected from the inverse relationship between the resistance and cross-section of a conductor.

In Figure 4, the important point to consider is where the curve begins to bend. Experiments have proved that the resistance remains practically constant from 100 on the dial to about 30, at which point it turns up sharply. At 10 on the dial or less the resistance may go up as high as 15 or 18 ohms. This particular condenser had a capacity of .0005 mf.

Interpreting this in connection with receiving circuits, it is not well to use the condenser at the low dial settings. The inductance used with the condenser should be so designed that the wave range can be covered without having to go lower than about 30, or best 25 on the dial. This should relieve the situation somewhat with regard to the minimum capacities of condensers. If we should not use the lower end of the dial, who cares, then, what the minimum capacity is? The best practice, in consideration of these facts, is to select a condenser that has a large capacity ratio between 100 and 30 on the dial, and to design the inductance to give the wave range desired. This will mean using a larger condenser and small inductance which is often advantageous, since a small coil can be constructed to have lower resistance than a large one.

It is well to point out here, also, that the effect of soldered joints in various parts of the circuit, including those between the plates and elsewhere in condensers, is likewise negligible. More importance should be attached to the design of low-resistance coils. There are many forms on the market, but they are all more or less alike. There are some things in connection with coils that have not generaly been considered, and it is probable that a broader way of looking at the problem may result in considerable improvement in design. The writer has built an inductance coil of a special form which permitted reception on a loudspeaker at a distance of 15 miles from the local broadcasting station using a simple one-tube circuit and an old-style condenser.

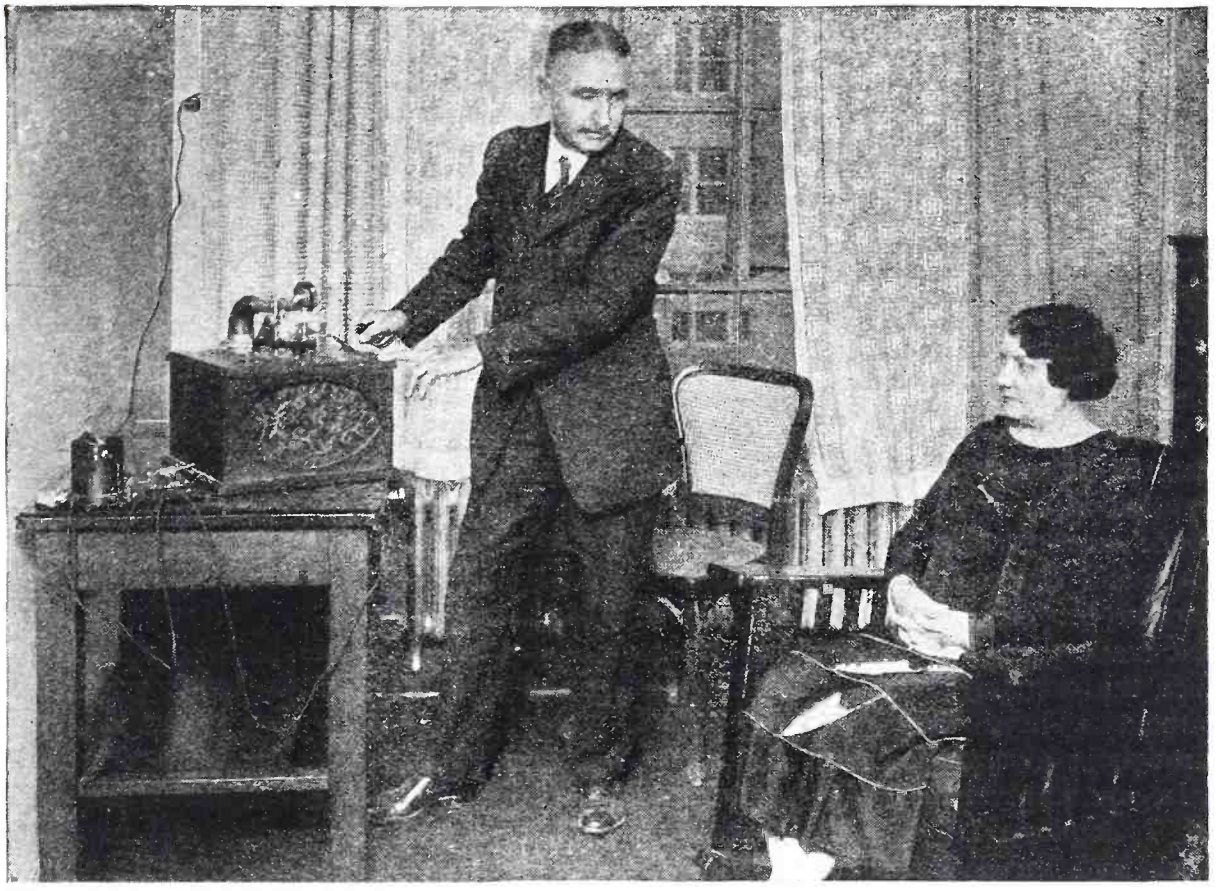
We are now ready to understand better what the relation of condenser to inductance in a tuning circuit should be. To obtain high grid voltages the capacity should be small and the inductance great. But large inductance goes with greater coil resistance. This means that our grid voltage will not be as high as we expected it to be. A compromise must be effected so that fairly high grid voltages can be obtained by having the reactances high, without sacrificing too much by the increased resistance. The usual 0.00025 or 0.0005 may be used satisfactorily for ordinary work, but in view of all the preceding arguments the author has lately been more inclined toward the 0.001 size, using a small 3 or 4-plate condenser shunted around it for accurate tuning.



From a photograph made for POPULAR RADIO

SYLVAN HARRIS IN HIS TESTING LABORATORY

Of such practical value to radio amateurs and novices does POPULAR RADIO *consider his experimental work that this magazine has arranged for a series of articles—of which this is the first—from him.*



From a photograph made for POPULAR RADIO

NO VACUUM TUBES ARE NEEDED FOR THIS LOUDSPEAKER

Mr. House, the author, is shown above adjusting his new reproducer, described in this article, to a crystal receiver. The moving element that he employs is attached to an ordinary phonograph.

A Loudspeaker for a Crystal Set

How a rotating electrode block is employed by the author to set an ordinary phonograph diaphragm into vibration to reproduce received signals

By WARREN D. HOUSE

EVERYONE who has not yet reached the tube-set stage and is still using a crystal radio set—(and expects to for some time to come)—looks enviously at those who have a loudspeaker. For a loudspeaker, of course, will not operate with anything but a tube set.

But the new invention described here makes it possible for the crystal-set owner to have a loud-speaking device that gives satisfactory results.

When radio broadcasting became popular I joined the army of radio enthusiasts and built a crystal set of the old two-slide type using the usual headphones with it. I was spurred to look for a loudspeaker for my set when my family objected to my monopoly of the headphones; in my ignorance of radio I had supposed that loudspeakers could be used with crystal as well as with tube sets.

I was not convinced, however, by radio-wise people about the impossibility of getting loud-speaking with a crystal set. So I proposed to make one.

As I had invented a loudspeaker for telephonic reproduction, I naturally thought that it might be used as a loudspeaker for radio reception; consequently I proceeded to construct an apparatus along the lines of my original telephone loudspeaker. For that device I made a block of conductive vibratory material upon which a metal electrode traveled in a circle. The received telephone currents that passed through the block and electrode caused variations in friction between the block and electrode that made them vibrate and thus reproduce the original sounds so loudly that without a horn they could be heard throughout a large room.

In my experiments with my crystal set I employed a similar reproducing block and metal electrode. With this apparatus connected to a telephone circuit, I obtained very loud reproduction, but in my first trials I could not get a sound with it when I connected it to my radio crystal set, although the headphones reproduced.

Finally I received very faint, but clear reproduction of locally broadcast programs on my crystal set. The reproduced sounds were not loud enough; they were barely audible in a quiet room. They needed to be amplified.

I obtained amplification with an old phonograph. It was the type that has a sound box carried by an outside metal horn, which was pivoted to a bracket fastened to the rear side of the phonograph box. It occurred to me that I could amplify the faint volume that I was getting by fastening the metal electrode of the loudspeaking device to the needle-holder of the sound box of the old phonograph. When I did this I materially increased the volume of the reproduced sounds. To further amplify the sounds, I made a metal horn and fitted to it the sound box. I could then hear the stations loudly and clearly throughout the room.

Having obtained satisfactory loud-speaking, I devised a means for obtaining a continuous rubbing movement between the metal electrode and the reproducing block. Formerly I had held the block stationary and moved the electrode, as I did with my old wire-telephone loudspeaker. It now occurred to me to use the phonograph motor to revolve the reproducing block after the manner of a phonograph record, and to have the electrode travel on it like a phonograph needle. The electrode was held stationary and attached as it was to the sound box.

The turntable spindle which supports the record table of the phonograph revolved too fast for my purpose. I removed the turntable and substituted a shaft in the phonograph motor for one of the slow speed shafts, and mounted the block on this shaft. I made a circular groove in the top of the block in which to guide the electrode needle. Then I pivoted the metal horn, which carried the sound box, to the bracket in the same manner as the original horn was mounted.

By connecting the reproducer block and electrode needle to the output of my crystal set, I could get satisfactory reproduction. There was no distortion, and the loudness was proportionate to the strength of reception by the crystal set. At that time I was using my electric light wiring for my antenna.

I have made several sets like the one just described, using an outside horn which carried the sound box. I made others along the lines of the modern phonograph, having the tone arm and enclosed horn. Each was arranged to play records or reproduce broadcast programs, and each contained a crystal set.

For those who already have phonographs and crystal sets I devised an attachment which can be used with most any of the standard makes of phonographs.

In carrying out this idea, I provided a small stand to set on top of the phonograph in place of the record turntable. On this stand I mounted the reproducer block, which is revolved slowly by a clutch which slips onto the upper end of the turntable spindle of the phonograph motor. I made a special needle to fit in the needle-holder in place of the usual phonograph needle. With this little attachment anyone who has a phonograph and a crystal set can have a loudspeaker without batteries or tubes —and without expensive upkeep and battery charging.

I have also obtained good results with my apparatus connected to a single-tube, dry-battery set as well as with a set of several tubes and a high "B" battery voltage, using a step-down transformer in the output circuit of the last tube. By properly tuning the set and connecting the transformer to the "B" battery, you obtain relatively low voltage for the reproducer block.

Many radio fans, like myself, are well satisfied with local broadcasting. By using a crystal set on local broadcasting in connection with this loudspeaker, the programs are faithfully reproduced without distortion or harsh sounds—and without the inconvenience and expense of batteries and tubes and costly equipment.

Kadel & Herbert

THE PROPER POSITION OF THE HANDS IN TUNING

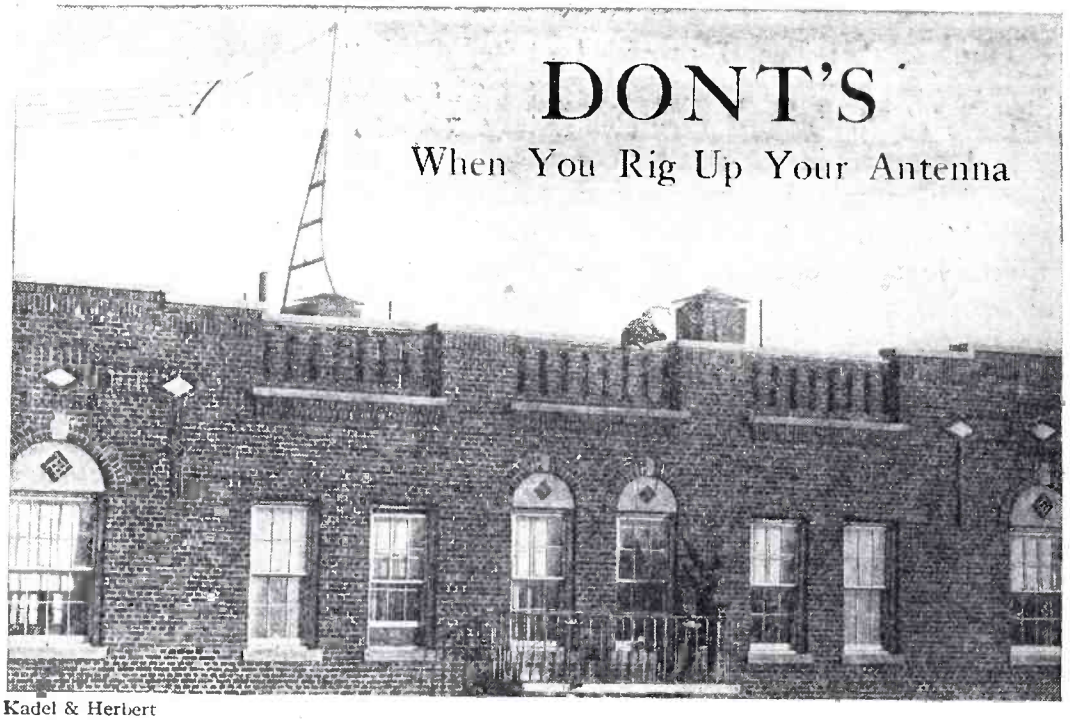
***Note** that the operator in the picture does not bear down upon his dials. His grasp is light which means delicate tuning.*

Tips on Tuning

1. Never allow your regenerative receiver to whistle while you are tuning. If you do you will interfere with your neighbor's reception.
2. Turn your tuning dials slowly when trying to pick up distant stations. If you rotate them too fast, you may pass directly over the signals without hearing them.
3. Don't grab the dials in a vise-like grip. Use your finger tips to manipulate the dials delicately.
4. Try to find out what the action is that takes place when you tune. Then, when you find out what each dial does, you will be able to tune more quickly and pick up signals more clearly and more loudly.
5. However, never tune in a signal with too great strength for the loudspeaker. Tune it in so that it sounds the best.
6. Make a log of the stations you hear and want to pick up again. Just jot down the settings of the dials for ready reference.

DONT'S

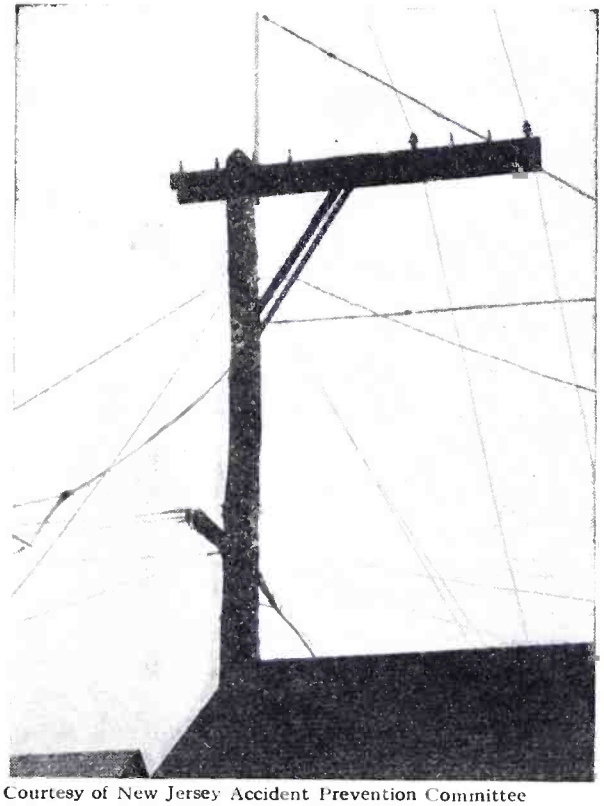
When You Rig Up Your Antenna



Kadel & Herbert

DON'T BUILD A WEAK-LEGGED ANTENNA

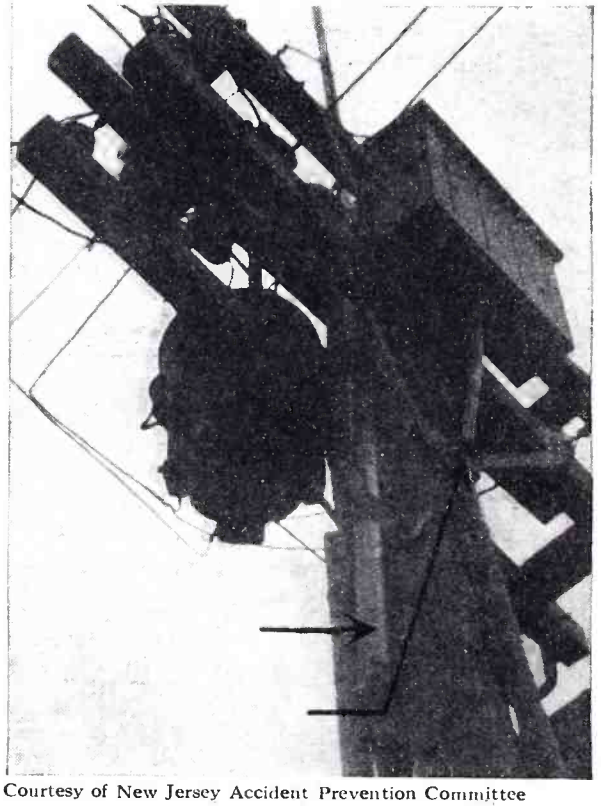
Although guyed in several directions this antenna might fall in a heavy storm. Note the bent condition of one of the supports. Not only may the owner of this rig be deprived of his program but his collapsing pole may destroy property.



Courtesy of New Jersey Accident Prevention Committee

DON'T STRING UP YOUR ANTENNA WHERE IT MAY TOUCH OTHER WIRES

You involve risk when you place an antenna in a maze of wires like the one shown above.



Courtesy of New Jersey Accident Prevention Committee

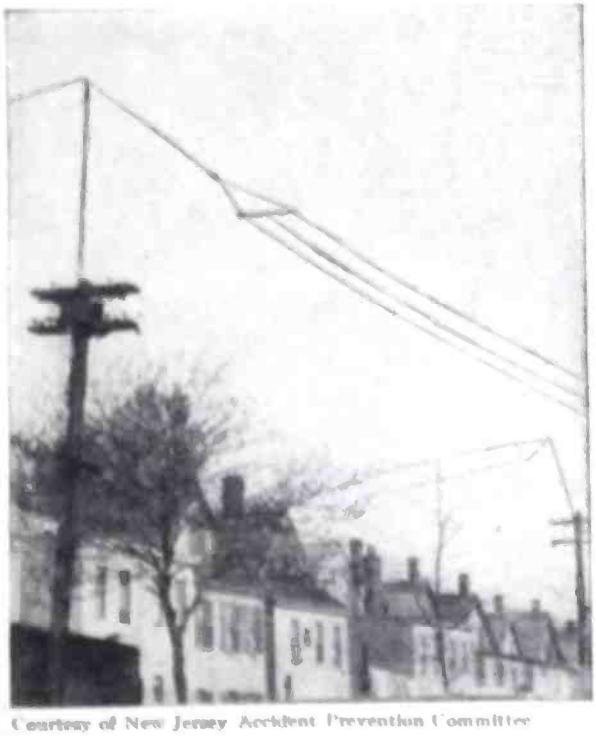
DON'T RIG ANTENNAS ON ELECTRIC LIGHT POLES

The short arrow points out an antenna supporting-pipe that passes close to power lines. The long arrow indicates an antenna pulley attached to a cable.

International

DON'T CROSS POWER LINES

The well-constructed antenna in this picture might cause injury if one of its wires fell on the high power lines on the roadside during a storm.



Courtesy of New Jersey Accident Prevention Committee

DON'T PLACE YOUR ANTENNA CLOSE TO HIGH-VOLTAGE FEEDERS

The antenna shown in this picture might fall on the high-tension lines.

DON'T PUT A GOOD ANTENNA IN A BAD ENVIRONMENT

A heavy storm might send the pole (shown in the illustration) crashing down through the glass skylight and endanger lives and property below. Besides, the guys attached to objects on the roof that, if loosened, might make the roof leak. Never place guys so that they might trip persons escaping to a roof in case of a fire. Be certain that your pole sets firmly so that it will not topple over should any of its guys break. An iron clamp bolted to a wall will make your pole safer.

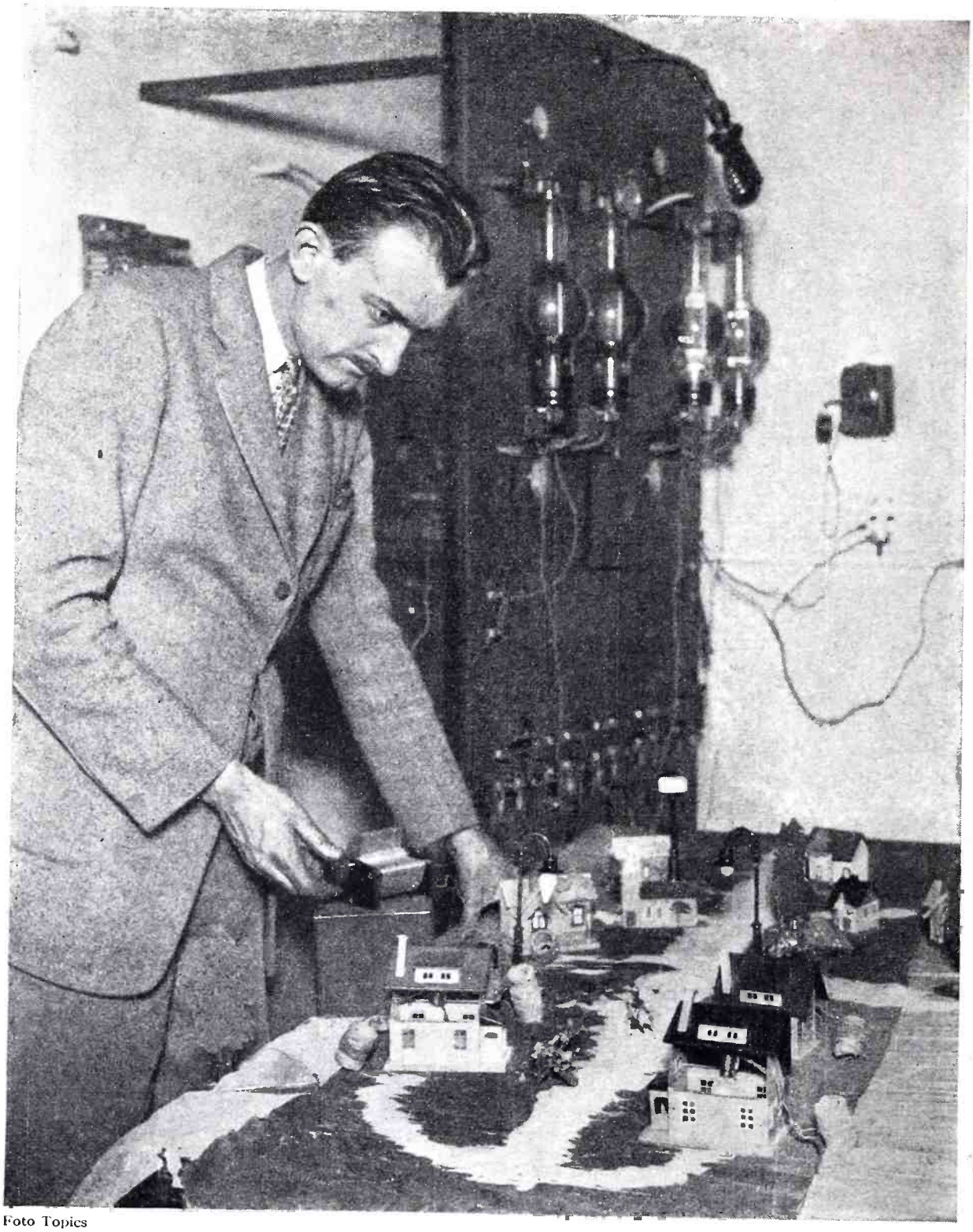


Foto Topics

Will Our Cities Be Lighted By Radio?

With radio-frequency currents generated in the tubes on the panel shown in this picture, Mr. John M. High, Jr., of Riverdale, N. Y., lights the electric bulbs of his miniature city without the use of wires. Near each house are small inductance coils of different wavelengths. By altering the frequencies of the radio waves with the variable condenser that Mr. High is operating, he is able to dim or put out lights connected with the coils. Some scientists believe that similar experiments foreshadow the day when cities will be lighted by radio from distant power plants.

Simple How-to-Build Articles for Beginners
No. 6

How to build a single-stage audio-frequency amplifier for use with dry batteries

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $11.00*

HERE ARE THE ITEMS YOU WILL NEED—

A—Amertran type AF6 audio-frequency amplifying transformer;
B—Fleron porcelain socket;
C—CRL filament rheostat, 30 ohms;
D—composition panel, 7 by 5 inches;
E—baseboard, 6¾ by 5 inches;
Seven binding posts.

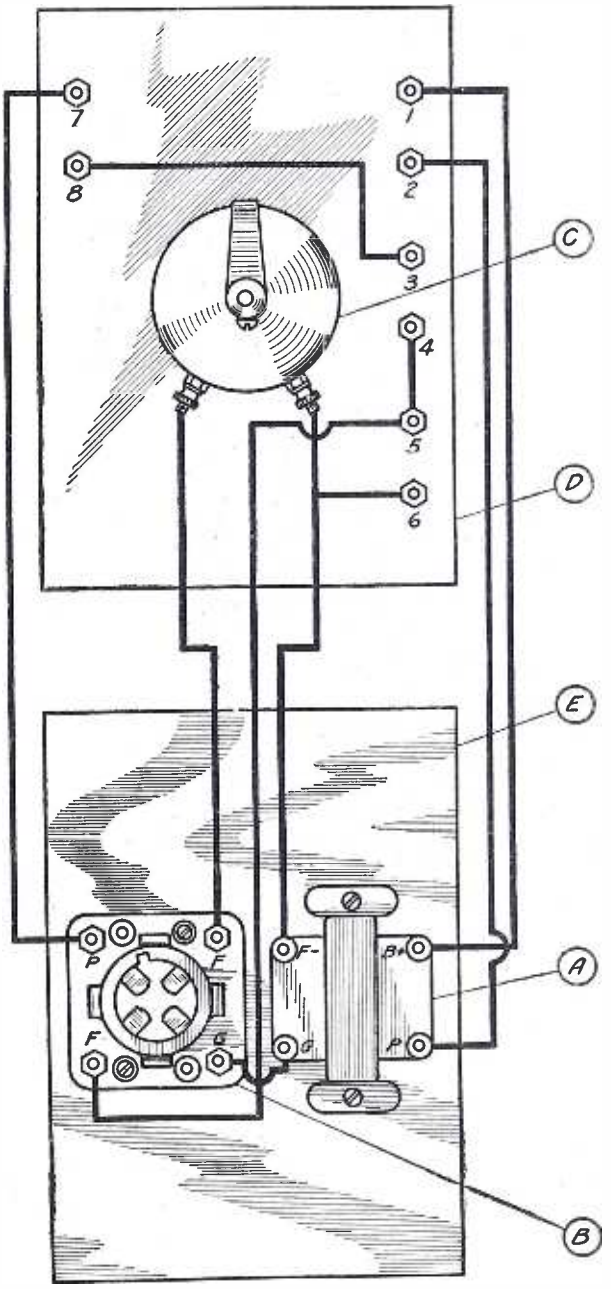
THE sixth piece of receiving apparatus to be described in this series is a simple audio-frequency amplifier that can be used with any single-tube receiver as a means of getting louder signals on the headphones whereby greater distances may be covered. This amplifier works on dry cells and uses either a C-299 tube or a UV-199 tube.

The amplifier, built and carefully tested out in POPULAR RADIO laboratory, gives satisfactory results. The construction of such an accessory is simple. There is only one control to operate—the rheostat.

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 according to the accompanying illustrations.

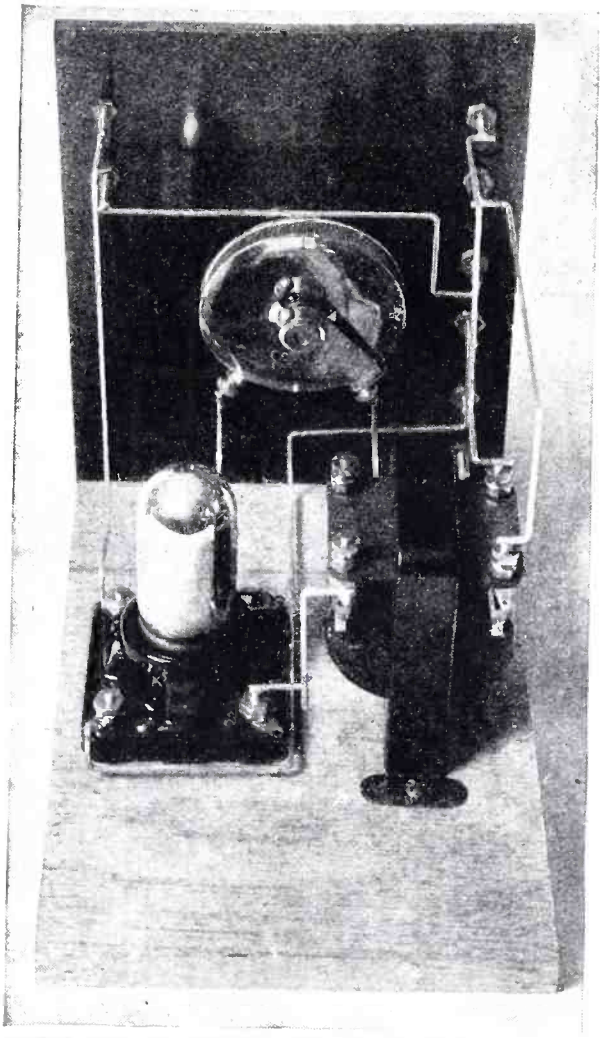
Next, wire up the instruments as indicated in the picture diagram. You can't make a mistake; all the connections are clearly indicated and the instruments are marked as they appear in the diagram and in the list of parts.

When you have finished wiring up, all you have to do is to connect the amplifier to the single-tube receiver or the



THE "PICTURE DIAGRAM" OF THE HOOK-UP

In this drawing the instruments are shown and the connecting wires are indicated IN THE EXACT MANNER THAT THEY SHOULD GO IN THE SET. *The upper rectangle represents the back of the panel and the lower rectangle is the baseboard.*



THE REAR VIEW OF THE AMPLIFIER

Study this view in connection with the picture diagram of the hook-up on page 141. The location and connecting points of each wire appear clearly and you can determine just how to bend the wires to get the shortest connection with the proper clearance.

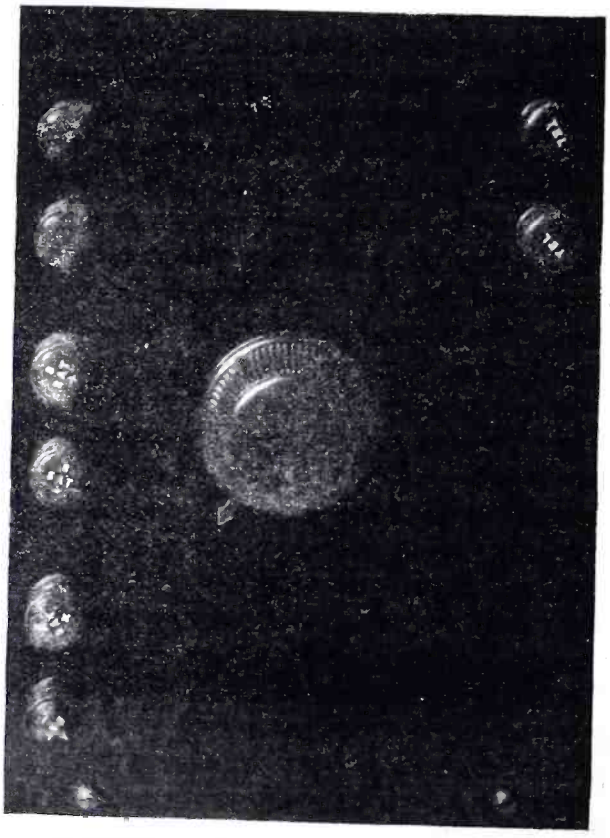
crystal set you are using now and your batteries; and you are ready to listen in to much stronger signals.

Set the amplifier on the right-hand side of your receiving set and connect the two posts on the amplifier, Nos. 1 and 2, in place of the telephones in the receiving set. Then connect the telephones to the amplifier to binding posts Nos. 7 and 8.

Next connect the batteries. Connect the "A" battery, which is composed of three ordinary dry batteries connected in series, across the two posts Nos. 5 and 6 with the positive terminal connected to post No. 5. The "B" battery of either 45 or 90 volts should be connected across the posts Nos. 3 and 4 with the positive terminal connected to post No. 3. All you have to do after that is to insert the tube and turn up the rheostat C and tune in on the tuner.

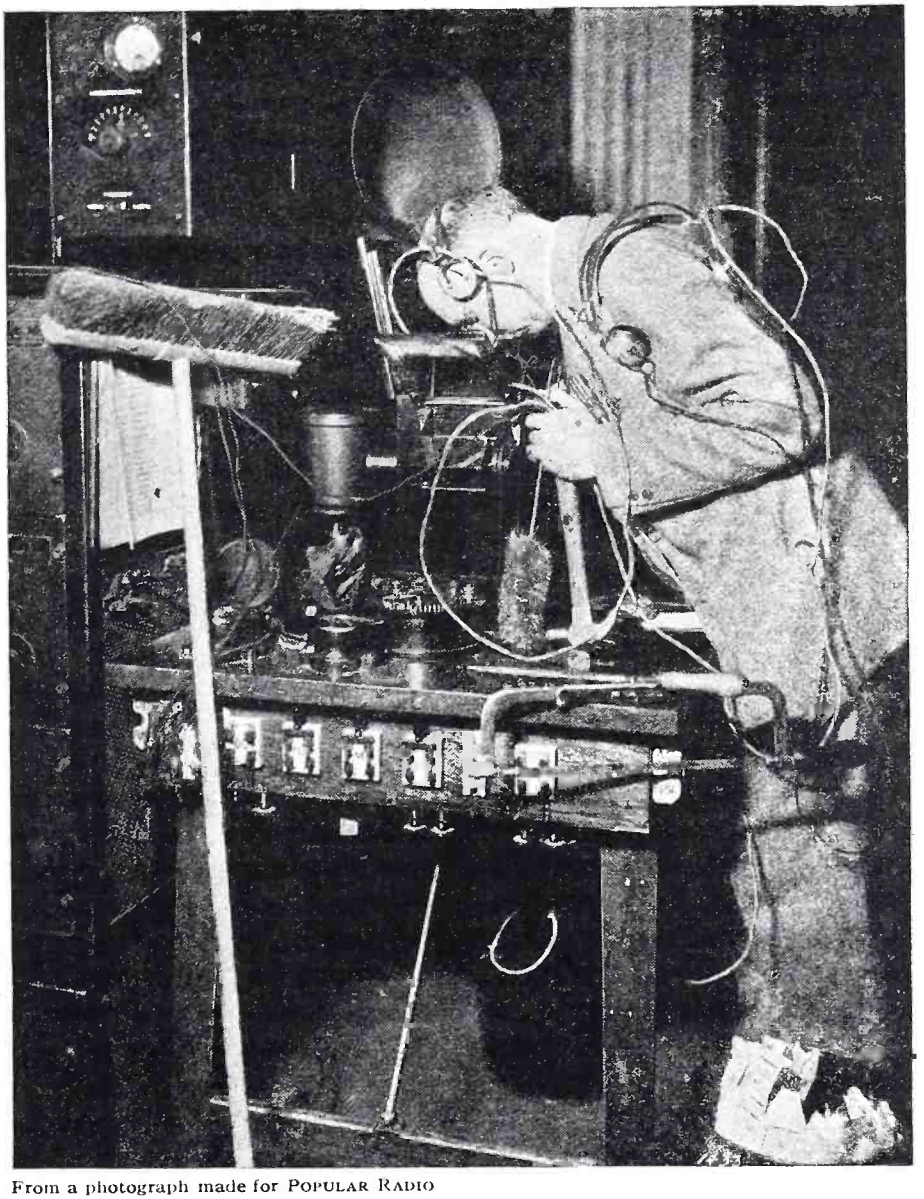
If another stage is desired for loud-speaker reproduction it can be built as described and set alongside the first one and connected up in the same manner.

The use of the smaller tubes makes the amplifier applicable to a set located in a place where storage batteries cannot be used, such as on a farm or wherever there are no charging facilities. All that is necessary is to have a set of extra "A" battery dry-cells on hand, in case the batteries in use should die down unexpectedly. (Caution: never use this amplifier, with the tubes specified, on a six-volt storage "A" battery! The tubes will be damaged if you do.)



PANEL ARRANGEMENT OF THE AMPLIFIER

The headphone binding posts are on the right. The "A" and "B" battery connections are shown at the left, marked plainly with positive and negative signs. The two upper binding posts at the left are used to hook the amplifier to your receiving set.



From a photograph made for POPULAR RADIO

"Almost ready to rend the oscillograph piece from piece"

Broadcasting Made Plain

"There is a great deal more to radio broadcasting than merely carrying a sound up to the top of a tall building and pushing it off," explains Don Herold. *"This is what really happens—"*

UNTIL you have actually taken a couple of the world's largest broadcasting stations apart and put them back together again, as I have, you too are apt to have the impression that there is something mysterious and difficult about the process of radio transmission on a large scale.

Broadcasting used to baffle me, so I decided to go to the bottom of it.

I bought myself a large screwdriver.

I told the clerk at the hardware store that I would like a screwdriver suitable for dismantling and reassembling a broadcasting station from stem to stern, and he said: "I might give you more

exactly what you want if you would tell me exactly which broadcasting station you are going to tear up. We have a great many kinds of screwdrivers."

"Well, I haven't decided on the station. What kind of screwdrivers have you?"

"Why not analyze two of them while you are at it?" he suggested. "You know that WJY and WJZ are both operated in the same building and both run by the Radio Corporation of America. Perhaps you might get a better idea of broadcasting if you would just tear down and put together two stations at once. You would get every impression twice instead of once, and you might find you needed some of them twice." Just what hidden significance this remark had, I did not bother to learn.

"A good idea!" I exclaimed. "Have you some of that kind of screwdrivers?"

If you heard some scratching on WJY and WJZ the other afternoon and evening, that was I—taking those two stations apart, screw by screw, and laying bare for my own satisfaction every possible secret of broadcasting. I even took down the antenna that you may have seen on top of Aeolian Hall.

I took microphones apart and put them back together again after I had analyzed them. I took the amplifier panels in the control room apart and put them back together again. I unwound a couple of motors and memorized them. I dropped a $400 transmitting tube on the cement floor and put it more or less together again in the wastebasket without being discovered.

As I went about my work I got the idea of writing this article so that broadcasting would become as simple for thousands of radio fans as it was fast becoming for me.

Let me now go back to the beginning.

I thought I would go up to the broadcasting station and begin the evening in the guise of an ordinary citizen. I gave the name of Mr. Renfrew. The colored attendant in a white coat said: "Are you broadcasting this evening?"

"Well—" I started, thinking how *much more* than mere broadcasting I was going to do. *I* was going to *interpret* broadcasting.

The attendant looked at a typewritten schedule, and said: "Oh, yes, I see. Just have a chair." He had found me or somebody like me on the evening's program.

While I was waiting to get at my real work, I made a number of observations and asked a great many questions. I thought a little information in this article might help it.

It was exactly like waiting to have a tooth pulled. There were several patients around the room, and once in awhile one of them went into the operating room to have himself broadcast. To most of them this was as much an adventure with the unknown as breathing dentists' gas, and they all had something of the manner of a man who is about to face his Maker. Going into an almost empty parlor to sing or talk to nearly a million people is a little bit uncanny and gaseous.

I slipped into the studio with a male quartette from a business college.

The broadcasters see none of the works and paraphernalia of broadcasting as I afterwards did. I imagined that the performers would have to be strapped into electric chairs in a room full of wires and switches and dynamos and guys in overalls. But broadcasting is altogether parlor. There is only one instrument in the "studio," and that is the microphone, and it is just a round mahogany affair with scroll work and silk in the front of it, much like that of the front of a phonograph. A double wire runs from this out to—the world. And, oh, yes, the announcer has a couple of kitchen colanders which are his private microphones. And there is a red light to warn the broadcaster that he has only two minutes more.

From a photograph made for POPULAR RADIO

"Getting at the gist of the microphone"

This red light means what it says, too, I learned. Some of the highbrow broadcasters resent it, but most of them realize that a schedule is a schedule. The operators told me of one obstinate lecturer who would not stop after they had flashed him, and even given him a few minutes overtime. They then pulled the plug on him and let him broadcast into the wastebasket in the control room. They opened the control room door to show him he was not getting into the air, but he continued his speech for fifteen minutes, just out of obstinacy.

Anyway, they take their own medicine at a broadcasting station. I imagined that it was one place in the world where it would be possible to get away from radio, but there are receiving sets all over the place. There is one in each of the reception rooms, and there is one for each group of control instruments in the control room. (WJY and WJZ have separate studios and separate plants, side by side, throughout. In fact, these two stations are really four stations, because each has a "spare" set of instruments all the way through. They even carry a few spare broadcasters for use in case some of the "artists" do not show up on time.) And there are receiving sets in the manager's office—in fact, re-

ceiving sets wherever you turn. I believe these people are really interested in radio.

At any rate, they take great pains to get the ultimate consumer's point of view on their product. They broadcast and receive right in the same building. (I will clear up all mechanical details a little later and explain fully why they do not broadcast on their receiving sets and receive on their broadcasting sets. I discovered the card index file with which they keep their broadcasting and receiving all straight. I took this card index file all apart with my screwdriver, so I understand it fully.)

Radio, I found, has produced a new kind of nut—the person with the broadcasting instinct. Just as nine persons out of ten think they can act, ten persons out of ten now think they can radio broadcast, and much of the work of the staff of a big station is in sorting out the real program material from the chaff. One of the announcers told me that more than half the people who want to broadcast are turned away from WJY and Z. A long period is given every afternoon to "auditions" to ambitious talent. Music students back from Europe, mothers with children, people with pet canaries, whistling bullfinches and dance orchestras by the dozen, as well as propagandists of every ilk and creed, come up and want to tell the world.

Some very excellent singers have voices that will not broadcast well. If the audition manager has his doubts, he will try various tests. He may even go so far as to "broadcast" the voice back to the audition room only—which is like trying out a show in Atlantic City.

A bass drum can not yet be broadcast. In some ways, radio is, you see, still in its infancy.

Low voices as a rule go out better than big ones. I was surprised at the calm of the announcers. They simply talk casually into their microphones in an easy tone of voice.

As I listened to them talk softly into their kitchen colanders, and thought of hundreds of thousands of people listening to them, I made an epigram: "There is nothing like being prepared for what you are going to do." I was glad that I had brought my screwdriver.

A negro quartette came in and sang half a song before they discovered they were not plugged in. Then they commenced again . . . "I'm going to put on my shoes and roam all over God's heaven."

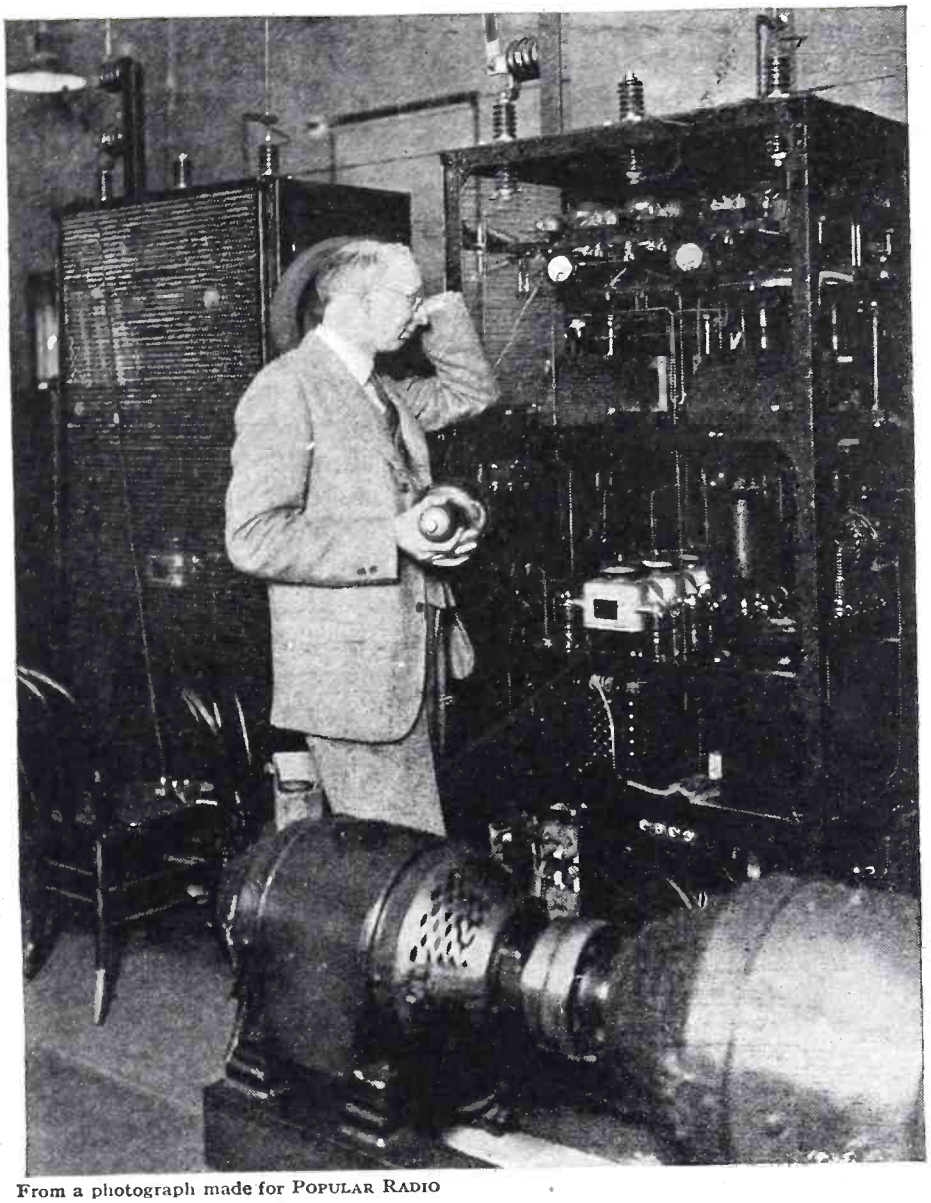
Studios have to have walls deadened with asbestos padding, felt, air spaces and drapery, to prevent reverberation. Noises must not hit the microphone twice. The difference between oil paint and porous, water-color paint on the walls may mar or make a good broadcasting room. Marble halls do not make good broadcasting studios. When a brass band broadcasts at the studio, the microphone is put in the other room and a towel is thrown over its face.

Before you broadcast, be sure that your personal record is clear. A man was once arrested at WJZ for wife desertion—while telling a bedtime story. The wife and a policeman came up while he was still on the air. Be careful who you are before you broadcast.

The more people who are listening to a broadcasting program, the shorter the distance traveled by the waves. If lots of receiving antennas are tuned in, they suck up the program before it travels its normal distance. (I simply *drank up* facts like this.) The normal audience of WJY and Z is somewhere around a million, but when there is a big prize fight or when the President speaks or when there is some other event of national cultural significance, the audience becomes three or four million. The range of the stations is thus sucked down considerably. Forty-second Street is the best place to live!

But I know you want to know just how broadcasting is accomplished. Now we come to the mechanical explanation.

There is a great deal more to radio



From a photograph made for POPULAR RADIO

"Just before I started to take the transmitting apparatus apart"

broadcasting than merely carrying sound up to the top of a tall building and pushing it off. If only this were done, the route of the sounds so pushed would be largely vertical (since sound is eventually heavier than the air and, like apples, subject to the laws of gravity) and the broadcasting area would therefore be pitifully limited. People would have to live practically in the same block to tune in effectively.

The chief difficulty in broadcasting, then, is to get the sounds to travel in a more or less horizontal direction for a great distance. Experts say that radio travels in all directions, but I have my own theory of this. My theory is that it travels horizontally and evaporates upwards to a certain extent as it travels, and is subject to the laws of gravity (downwards) as it travels, and therefore gives the impression of going in all directions.

In the absence of wires, something must be supplied for these sounds to travel upon. (Wires are impractical because of their expense, and because of the possibility of their getting crossed or

blown down, and because small boys shoot the glass insulators off the poles. Wires are all right for telephones, but not for radio.)

It is simple enough to understand the invention or discovery of radio. The pioneers realized that they had nothing but air through which to transmit sounds and they reasoned simply that they would have to do something to the air to get it to carry the sounds. Well, about the only thing that you can do to air (or ether) is to shake it vigorously, or splash it so that waves emanate. Thus the idea of the radio wave was arrived at in less than five minutes. There was and is no other way to get radio.

Broadcasting then is largely a process of splashing or waving air and of putting sounds on the waves. One of the difficulties of broadcasting is that ordinary sounds have to have special treatment before they will stick on the waves splashed out from the broadcasting building.

You see most of us are troubled with audio frequency. This applies also to musical instruments.

Audio frequency is something under, well, say, just guessing it off, 10,000 vibrations a second. Your voice may vibrate that fast and your ear, being normal, may hear that fast. United States Senators may vibrate down as low as five times a month.

If, on the other hand, you have ever watched the antenna on your radio receiving set you will have noticed that it is vibrating (when WJY is coming in) about 660,000 times a second.

How is it possible to get ordinary audio-frequency sounds to shimmy fast enough to keep up with radio frequency?

When I have explained that you will have the secret of broadcasting.

There are three departments of a broadcasting station: 1, the studio containing the entertainer and the microphone; 2, the control room; 3, the transmitting room with antenna attached.

Starting in the studio with my screwdriver I took a microphone apart and discovered there was nothing to it.

It is nothing more or less than a sort of telephone which gets the thing started. I took it all apart but found nothing in it with which I was not perfectly familiar. There were a few slices of Buick magneto, some miscellaneous screws and widgets, and a lot of springs, some dirt, and one thing and another of no consequence.

Having fathomed the microphone, I went into the control room. The boys told me they had never seen the place so upset. I opened up all the switches and started the electric fan and took the lids off of everything in sight and emptied the wastebasket. I unbuttoned most of the secrets of the control room in less than fifteen minutes. I found there is not much to it, aside from control.

If a tenor sings too loud, the control operators note it immediately on the oscillograph and they hear it even more immediately on one of the receiving sets in the room, and they squeeze the control a fraction of an inch, and can thus do wonders with a tenor who is only so so. If he is weak, they give the apparatus a little more gas, and raise his voice to normal. Incidentally, I took the oscillographs (one for each station) apart but they were not very interesting, so I believe I put them back together again.

Thus far we have been dealing with audio frequency, as you have perhaps sensed.

On the roof everything changes.

The operators up there talk in radio frequency, and it took me perhaps five minutes to adjust my ears to their strange lingo. The tempo up there was much faster in every way. I found myself using my screwdriver in radio frequency, as I took all of the transmitting apparatus apart and spread it out on the roof. It was a clear, starlight night.

What struck me as I delved into the transmitting apparatus was its utter sim-

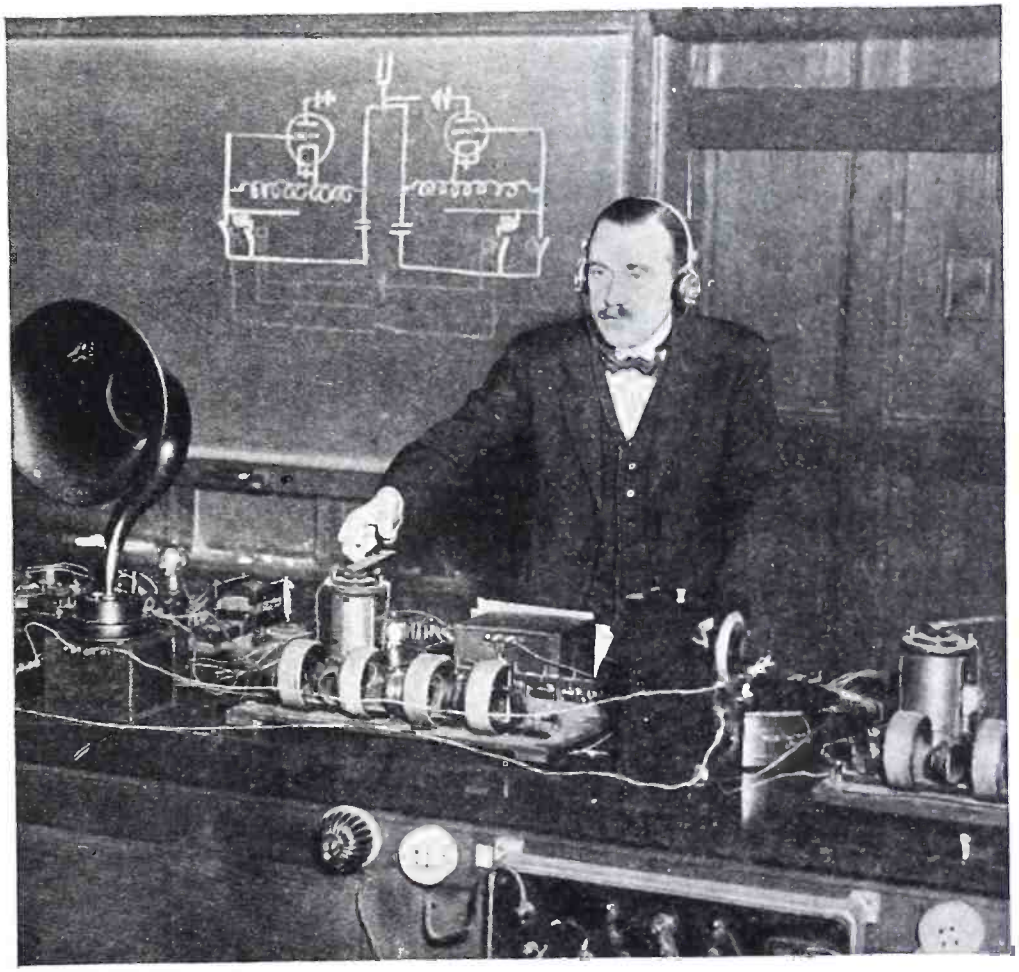
plicity, and the necessity for saying almost nothing about it other than it was a transmitting apparatus such as one finds in a broadcasting station. There were the dynamos for waving the air, and there were big $400 tubes for changing sounds from audio frequency to radio frequency. These were about the size of ice cream freezers, and, oddly, their action is quite analogous to that of ice cream freezers. It is a perfect picture of the tubes themselves and a perfect explanation of how they do their work.

In short, the broadcasting station does exactly what your receiving set does, except that it does it backwards. I imagine that the first broadcasting station was patterned closely on a receiving set.

The only thing I have neglected to mention is the water cooler in the front hall. I did not take this apart, nor did I take apart the telephone switchboard, as I thought I might only complicate, for others as well as myself, a matter which is otherwise simple.

During the course of a year, WJY and Z receive and take care of more than 10,000 temperamental broadcasting artists.

This explains static.



Pacific & Atlantic

A NEW RADIO TRANSMITTING DEVICE THAT MAKES VOWEL SOUNDS

Instead of using the Continental code for the transmission of intelligence, Prof. William Eccles of London (shown above operating his new apparatus) proposes to transmit vowel sounds that can be heard in the usual manner in headphones at the receiving end. As vowel sounds are easily recognized by the ear, Prof. Eccles believes great speed can be attained in sending messages. The feasibility of the idea is attested to by the Hawaiian language in which vowel sounds predominate.

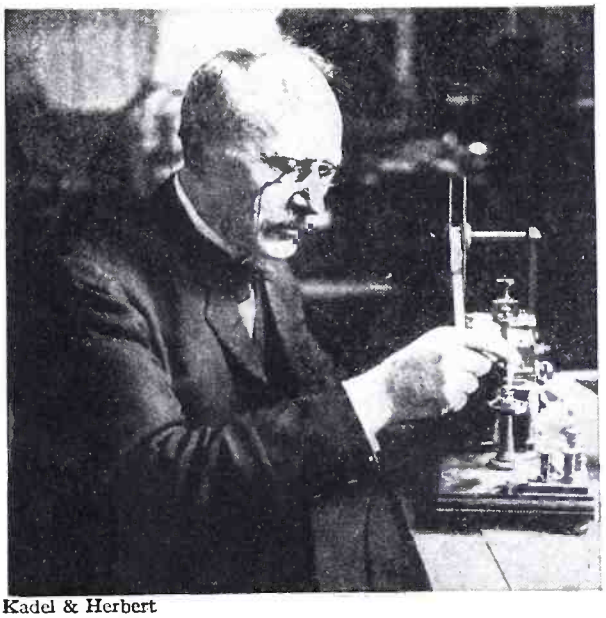
From a photograph made for POPULAR RADIO

The MEN WHO

3rd Installment

THE FIRST TO PROPOSE ELECTRIC POWER TRANSMISSION BY WIRELESS

WHILE *most popularly known for his alternating current motor and high-frequency oscillator,* NIKOLA TESLA *is more directly associated with the work preceding radio experiments on account of his wireless power transmission schemes. Realizing that it requires tremendous pressure to force an electric wave through the atmosphere at sea level and considerably less in the rarified air above the earth, Tesla in 1892 proposed to erect towers on mountain tops between which electric energy might be transmitted through the air.*



Kadel & Herbert

THE INVENTOR OF THE SENSITIVE COHERER

BY *employing some of the same principles employed by David Hughes, a Frenchman,* EDOUARD BRANLY, *in 1890 devised a sensitive detector of radio waves. This instrument was called a "coherer" because the metallic particles used in it cohered or clung together under the influence of electromagnetic oscillations. This contact of the fine specks of metal allowed the passage of an electric current through them, whereby a signal could be recorded. Branly's device provided one of the first highly sensitive instruments for detecting electromagnetic waves and was somewhat like the device later employed by Marconi in his first radiotelegraph reception tests*

Pacific & Atlantic

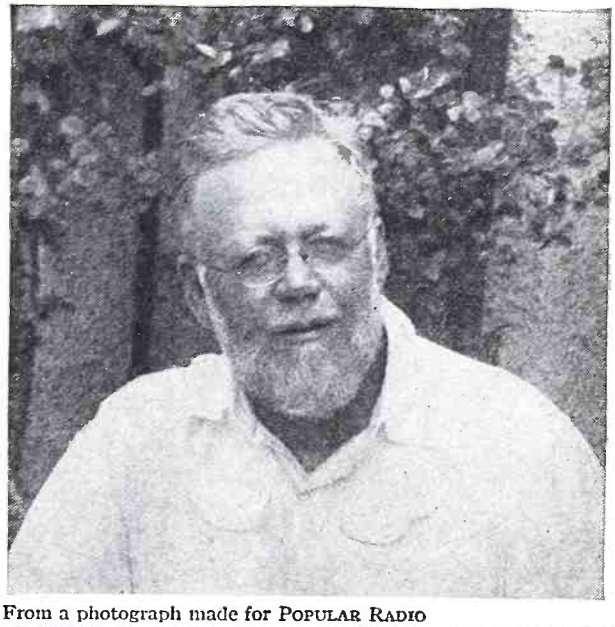
THE FIRST MAN TO SPAN THE ATLANTIC BY RADIO

WITH *the heritage of numerous investigators and his own ingenuity and persistence,* GUGLIELMO MARCONI, *in 1901 succeeded in transmitting the letter "S" in Morse code by radio from Poldhu, England, to St. John's, Newfoundland. He used an elevated wire for an antenna, a ground connection and a large induction coil to produce electric oscillations that were detected with a coherer. Previous to this Marconi had transmitted over a distance of 34 miles at sea. As a pupil of Professor Augusto Righi at Bologna, Italy, Marconi became interested in the experiments of Hertz, the first man to create and detect electric waves.*

MADE RADIO

THE INVENTOR OF THE FIRST SENSITIVE DETECTOR

BEFORE *1903 the antiquated coherer was the most sensitive radio wave detector. Professor* REGINALD A. FESSENDEN, *an American, patented at that date a liquid detector. A silver-plated platinum wire, just barely touching a weak solution of nitric acid, formed Fessenden's electrolytic detector. Chemical action between the metal and acid was believed to build up an insulating film of gas around the wire. The detector behaves like a rectifier, possibly because radio waves in only one direction can break down the obstructing film.*



From a photograph made for POPULAR RADIO

THE PARENT OF THE TWO-ELEMENT VACUUM TUBE

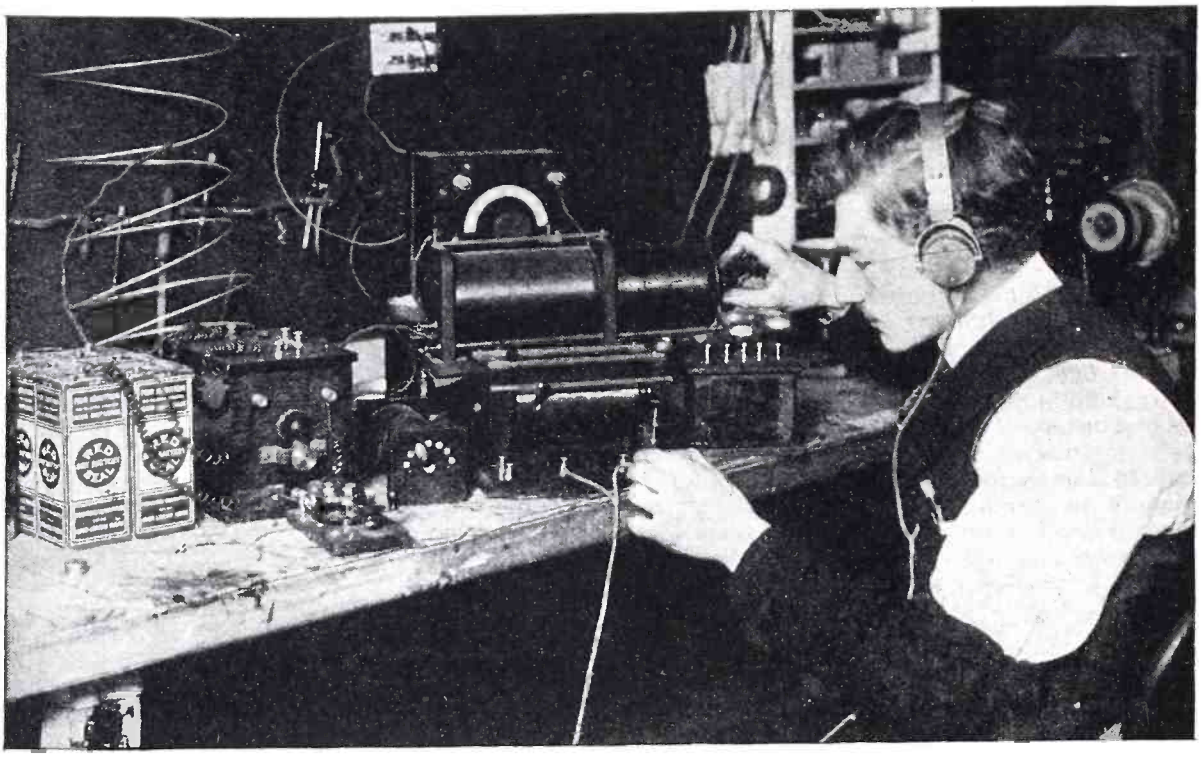
PROFESSOR J. A. FLEMING *of London was familiar with Edison's experiments with discharges of particles from a filament in an incandescent lamp, called "the Edison effect." In 1902 he employed a modification of one of Edison's lamps to detect electromagnetic waves and called it the thermionic valve. He succeeded in using it as a rectifier in a radio receiving circuit, and it was proved later in the laboratory that his valve could oscillate. His detector had only two elements whereas those used today have three.*

Special Press

ONE OF THE FIRST OF THE RADIO SIGNALERS

SIR OLIVER LODGE *is one of the very earliest of the radio investigators. His frequent lectures in which he expounded the results of his experiments were sometimes a direct stimulus to other inventors. In 1894 he sent signals by the discharge of a Leyden jar and devised numerous receiving devices, among which were several types of coherers. Sir Oliver was one of the first to devise methods of tuning.*

International



OLD TYPES OF TUNERS MAY COME INTO THEIR OWN AGAIN

Broadcast listeners with crystal sets will receive programs without interference almost as well as those with highly selective tube sets, if super-power broadcasting becomes a reality. Radio will then reach thousands who might otherwise never arrive at the tube-set stage.

HOW TO IMPROVE

Broadcast Reception

V: Cutting Down Spark Interference

Despite the new grouping of wave frequencies recommended by the recent Radio Conference, spark transmitters that cover a broad waveband will continue to be nuisances. Super-power broadcasting is an immediate solution for the damped wave problem.

By JOHN V. L. HOGAN

SINCE the fourth article of this series was prepared the Third National Radio Conference has been held, under Secretary Hoover's direction, at Washington.

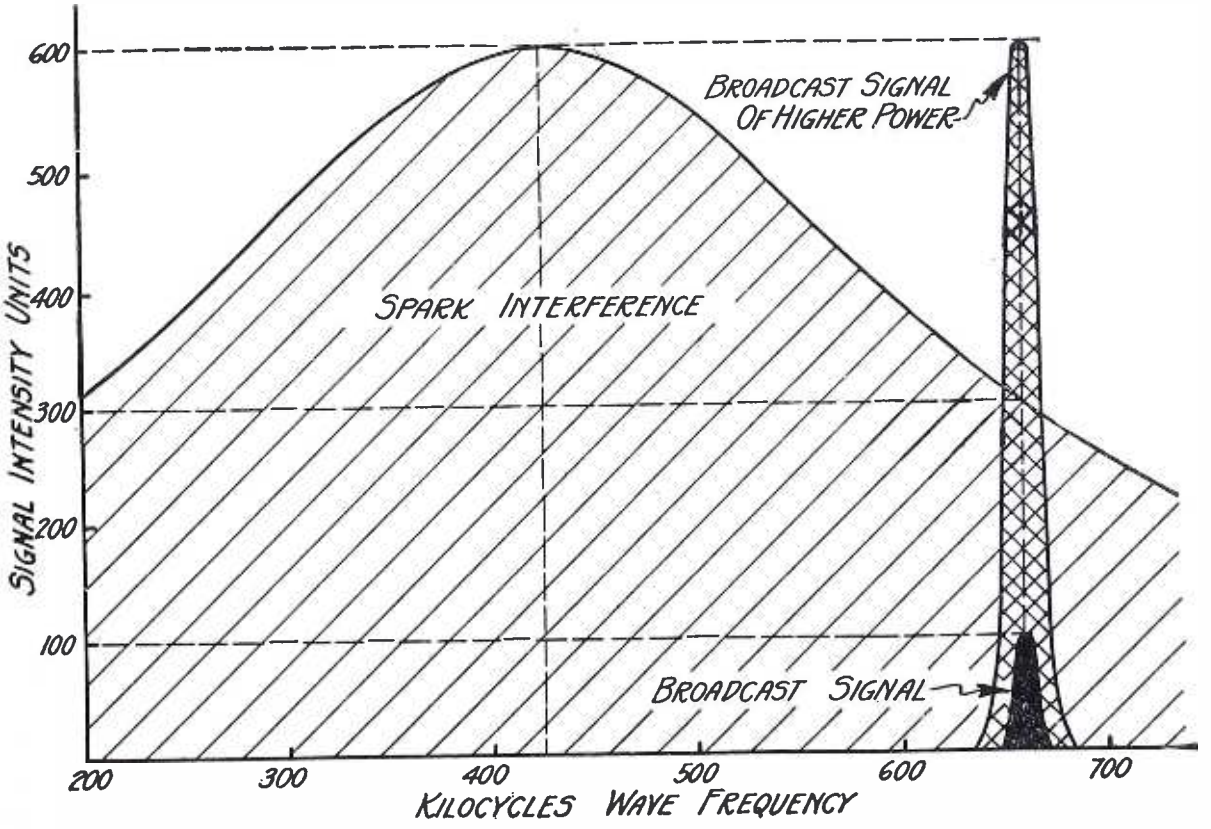
Interference with broadcast reception caused by spark transmitters was one of the topics that the Conference studied with a good deal of care, and a number of recommendations were made that should be directly helpful in improving the situation.

In increasing the number of wavebands or channels to be used for broadcasting, so as to allow the broadcast stations to operate with less mutual interference, the Conference suggested a new grouping of wave frequencies and a new classification of broadcasters, as shown in the table on the next page.

Frequency	*Wavelength*	*Service*
2,000,000 cycles	150 meters	Amateur CW and ICW Radio Telegraph
to	to	
1,764,000	170	
1,764,000	170	Amateur Radio Telegraph
to	to	
1,666,000	180	
1,666,000	180	Amateur CW and ICW Radio Telegraph
to	to	
1,500,000	200	
1,460,000	205	Class 3 Broadcasters
to	to	(less than 100 watts power)
1,420,000	211	
1,400,000	214	Class 2 Broadcasters
to	to	(corresponding to old Class A)
1,090,000	275	
1,070,000	280	Class 1 Broadcasters
to	to	(corresponding to old Class B)
550,000	545	
500.000	600	Marine calling and distress signals

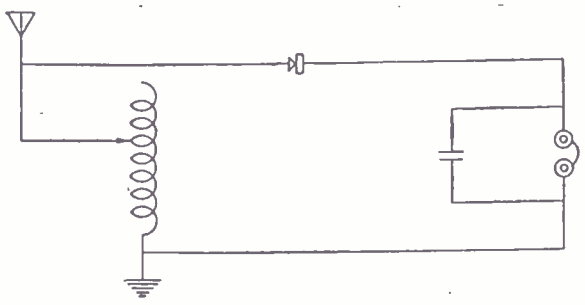
Outstanding features shown by this tabulation, and features that are bound to help out our recent troubles from spark and other wave-interference, are the following:

1. The amateurs have agreed to eliminate spark transmission, thus freeing the high-frequency end of the broadcasting range of waves from this interruption.
2. The amateurs have agreed to restrict their radiotelephone experiments to the band between 1,666 and 1,764 kilocycles



HOW HIGH POWER STATIONS CAN AVOID SPARK TRANSMITTERS

As long as the signal intensity of the broadcasting station is less than that of the spark set, interference will exist as shown graphically in the diagram. However, by increasing the intensity of transmitted signals as indicated above the broadcaster will break through spark "jamming."



THE OLD-STYLE SINGLE-SLIDE TUNER HOOK-UP

Crystal sets wired in the manner shown in this diagram tune too broadly for satisfactory radio-telephone reception.

(170 to 180 meters) to aid in removing this sort of interference from the broadcast range.

3. The marine interests have agreed to stop the use of the old 1,000 kc (300 meter) and 666 kc (450 meter) waves, which caused so much trouble in broadcast reception.
4. The marine interests have agreed to use the 500 kc (600 meter) wave, adjacent the broadcast band, for calling and distress purposes only. Ship-and-shore message traffic will thus be handled upon the new lower-frequency channels more remote from the broadcasting waves.

It is only natural for all of us to hope that these various recommendations and agreements of the Conference can be put into practical operation at the earliest possible date. They are likely to produce an immediate improvement in broadcast reception, though of course no one expects any or all of them to prove itself a perfect panacea that can overcome all difficulties. It still remains for us to do everything we can to improve the selection or discrimination power of our radio receivers, for unless we do our utmost in that direction we may expect to suffer interference from spark transmitters even under the new wave assignments.

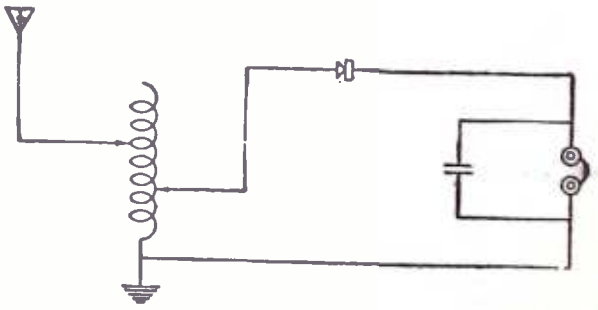
Why Interference Will Continue to Exist

You may wonder why the changes in working wave frequencies will not be sufficient to prevent the occurrence of such interference. It seems entirely unreasonable to many people that they should be disturbed, in receiving broadcast speech or music, by dots and dashes sent out at what appear to be widely different wave frequencies. For instance, even a reasonably selective receiver can take programs from WJZ (New York) on the 660 kilocycle wave without interference from WEAF at 610 kc or WNYC at 570 kc. The frequency-differences are 50 and 110 kc respectively. Yet this same receiving set, while tuned to WJZ, may be badly interfered with by a ship at sea operating at the nominal wave of 425 kc (706 meters), differing from WJZ's wave by 215 kilocycles!

The main reason that such interference can occur lies in the second factor of the problem, as listed in the January article. This factor is the width of wave-frequency band occupied by the interfering wave. Spark transmitters, such as are commonly used in the ship and shore service, are notoriously bad actors in this particular.

The Difference Between the CW and the Spark Wave

Whereas a modern continuous-wave (CW) or interrupted-continuous-wave (ICW) radio-telegraph transmitter will work within a waveband less than one or two kilocycles wide, and produce little or no interference in receivers sharply tuned outside of that band, the old spark transmitter may spread out its signal



THE DOUBLE-SLIDE TUNER

The re-arrangement indicated in this diagram of a single-circuit tuner shows how selectivity may be improved whereby closer tuning for broadcasting can be accomplished.

Radio Corp. of America

THE GIANT RADIO PLANT THAT TALKS ABOVE THE SPARK

This picture of the Rocky Point station, the radio central near New York City, shows a typical high-powered plant. Large broadcasting stations are the first steps toward solving spark interference. No damped wave transmitter will be able to "bust" the super-power station of the future.

splashes over all wave frequencies within a few hundred kilocycles!

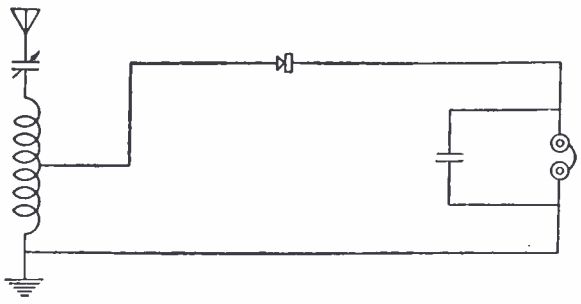
Thus, a CW transmitter working at 405 kc can hardly be heard, if at all, in a good receiver tuned below 404 kc or above 406 kc, even though the receiving point is located relatively near to the sending station. On the other hand, a spark station having high damping might be heard, in the same receiver, on all settings from 200 to 700 kilocycles.

Some of you are perhaps now wondering why the radio art tolerates such inefficient use of the "ether" as is necessary when spark transmitters are permitted to operated. The answer is that the spark installations were in existence and were doing fairly satisfactory work long before the demand for more and more radio channels became as acute as it is today. All of these old sets on shipboard represent a substantial investment, and the amount of money involved in replacing or converting them is no small sum. They are gradually being changed-over or scrapped, however, and some day we may expect to see them only in museums.

Spark Transmitters Are the Radio Road-Hogs

But in the meantime, as has aptly been pointed out, traffic in the radio channels can be no more effectively regulated or utilized than could traffic on a boulevard where huge juggernauts fifty or a hundred feet in width were allowed to plunge along at will. We shall have spark transmitters with us for years, however, unless somebody loses patience with their propensity to tear through the radio channels, and, over the protests of their owners, legislates them out of existence.

What can we do in these spark-ridden years, then, to make the interference as



A VARIABLE CONDENSER USED WITH THE ELEMENTARY SET WILL HELP FIGHT THE SPARK

Introducing capacity in the antenna circuit as shown above will enable you to improve tuning with a single-circuit crystal set.

little as possible? Is there anything that will help us to receive broadcast programs free from dot-and-dash interruptions?

Fortunately there is. We may take advantage of the third and fourth factors of the problem (as outlined in the fourth article of this series). We may improve the excluding-power (or sharpness of tuning) of our receivers; and we may improve the intensity of the broadcast signal we desire to receive, as compared to the intensity of the interference.

Why We Have Trouble in Tuning Out the Sparks

The first of these items—the improvement of receiver selectivity—cannot cure the spark evil.

That is true because the spark station distributes its power all over a vast number of wave-frequencies, and, if you are at all near to the spark transmitter you will be likely to pick up some interference on any broadcasting wave no matter how sharply you tune to it. Nevertheless, there are some features of this interference problem that appear to have been overlooked in many quarters and yet which offer some hope to us.

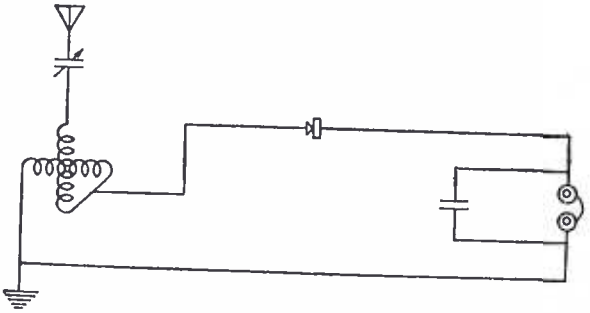
Most broadcast receivers do not exclude interference from powerful, nearby stations even though they are capable of discriminating sharply between waves from distant stations. There is vast room for a general improvement along these lines, and it is this type of improvement that will be helpful in cutting out spark interference. Incidentally, gains in this direction will also be valuable in reducing interference from "static" or strays, and from nearby radio telephone stations.

How Broadcast Stations Can Help to Increase Broadcast Signal Strength

The second point of attack on the spark interference problem is one which the listeners can help only indirectly. It consists simply of increasing the power of broadcasting stations.

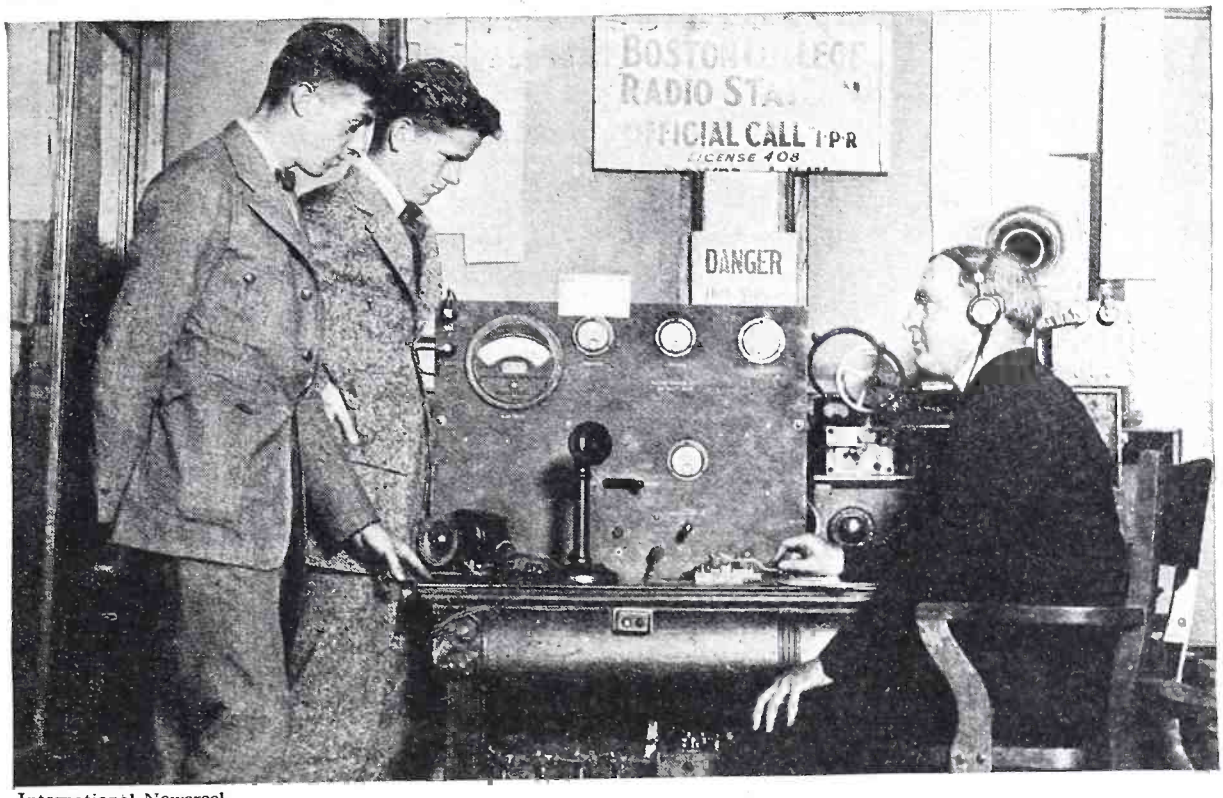
This is by far the most certain way to overcome all kinds of interference, as has been demonstrated again and again in all branches of the radio field. Years ago transatlantic radio telegraphy was attempted with transmitter powers as small as five kilowatts. Even with such small power signals were received at great distances, but only under the quietest and most favorable conditions. By increasing the power of the transmitters to as much as two hundred kilowatts the received signal was made six or seven times as loud, so that it could be distinguished through whatever part of the interfering noises could not be filtered out in the receiving apparatus.

The best broadcasting stations are using, on the average, something over one-half kilowatt of power. At distances of even fifty or one hundred miles the sig-



THE ADDITION OF A VARIOMETER WILL GIVE GREATER REFINEMENT FOR TUNING

The crystal set that is used with a variable condenser and variometer wired as in this diagram will meet ordinary needs for reception from super-power stations.



International Newsreel

THIS TYPE OF SMALL TRANSMITTER IS AT THE MERCY OF THE SPARK

This 50-watt set is operated at Boston College. Such low-powered sets as these are likely to have their programs spoiled by high-powered spark transmitters in their vicinities.

nals from such stations are often too faint to be heard clearly through interfering noises. To be sure, conditions are sometimes so good that the stations are heard over thousands of miles, but we must all admit that such long distances represent exceptional and not average day-and-night, summer-and-winter, performance.

Let us suppose that some particular evening you are receiving from a moderately distant half-kilowatt broadcaster whose signal may be said to have a strength of 100 units in your receiver. Now imagine that an interfering spark "breaks through" with a received intensity of 300 units. Of course your reception will be spoiled. If, now, the broadcast station could quadruple its power, making it two kilowatts, the signal would be doubled to 200 units. This would still be too weak to be heard above the interference of even a few local spark transmitters.

Why We Need Higher Powered Transmitters

But if the broadcast plant could be increased to twenty kilowatts, the received signal would rise to over 600 units in strength and would dominate the interference.

This is such a simple and positive way of overcoming many interference troubles that one wonders that it has not been more generally applied. The reason is probably that twenty kilowatt radio-telephone stations cost more than half-kilowatt plants, just as the big electric stoves used in some hotels cost more than household electric toasters. The hotel stove may use twenty kilowatts of power; the toaster uses about half a kilowatt. It is certainly high time that radio broadcast stations got out of the toaster class, so that their signals might override much of our present-day interference. It is profoundly to be hoped that more powerful broadcast stations will soon come into operation, and you can do

a part toward advancing the art by encouraging such larger plants.

Having reviewed the possibilities in this direction, let us return to the matter of receiver selectivity and see what can be done to gain some freedom from interference by that means.

Of course there are all kinds of radio receivers in use for listening to broadcasting, and the various kinds have varying degrees of selectivity. Lowest on the list is probably the single-tuned-circuit crystal set, and since this is doubtless the least selective outfit in common use, let us first find out what can be done to improve it.

How We Can Improve the Receiver

If the receiver consists simply of a coil of wire connected in variable amounts (by a multiple-point switch or a sliding contact) between antenna and ground, and having the crystal, telephones and accumulating condenser shunted across the entire portion of the coil that is in circuit, we can do a good deal to improve matters. Probably the most effective step would be to connect the side-circuit containing the crystal and condenser across only *half* or even less of the active part of the coil.

Further improvement would be had, though probably less in amount, by cutting out the switch or sliding contact and putting a variable condenser in series between the entire coil and the antenna. This variable condenser would then be used for tuning. A still better arrangement would be a condenser and a variometer in series between antenna and ground, with the crystal side-circuit tapped across only half of the variometer.

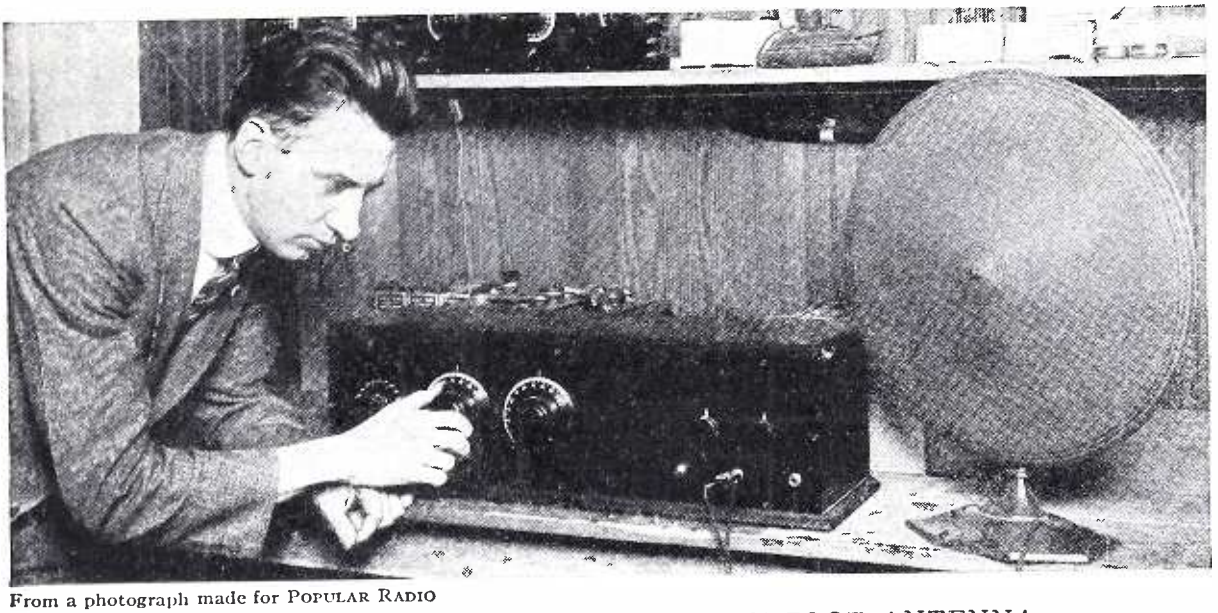
This marks about the limit of what can be done with a single-tuned-circuit and crystal detector, though in any event it is a good plan to be sure that there are no insulation leaks or high-resistance joints in the antenna-to-ground circuit. Signal strengths in a receiver have often been doubled or trebled by the simple plan of scraping bright and re-splicing every connection in the circuit.

A considerably greater degree of freedom from spark interference can be had by converting the single-tuned receiver into one using two tuned circuits. This will be discussed in the next article of the series.

Pacific & Atlantic

THE FIRST TRANSATLANTIC CHESS MATCH BY RADIO

A new milestone in the history of radio was established on December 8, 1924, when the students of Haverford College in Pennsylvania began a series of games with the students of Oxford in England.



From a photograph made for POPULAR RADIO

THE NEW REFLEX WORKING ON A 30-FOOT ANTENNA

Two stages of resistance-coupled amplification are used in the set shown above after one reflexed stage of transformer-coupled amplification. This hook-up results in much improved quality of reproduction.

HOW TO BUILD A REFLEX RECEIVER

—*With the New Sodion Detector*

The set here described is particularly recommended because *it will not radiate.* It is further notable for its distortionless operation. It tunes simply and will work well on a short antenna

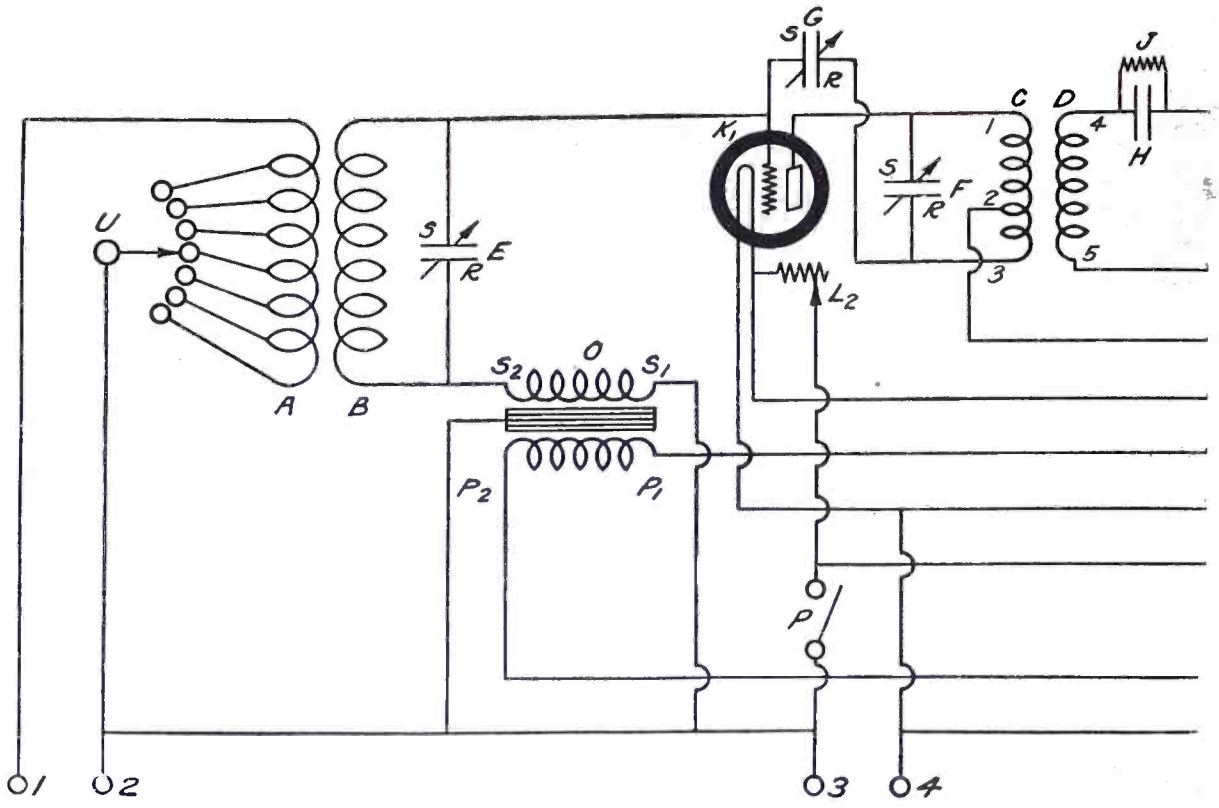
By ALBERT G. CRAIG

COST OF PARTS: *About $65.00*

RECEIVING RANGE: *Up to 3,000 miles*

HERE ARE THE ITEMS YOU WILL NEED—

A, B, C, D—Sickles Coil-set No. 20 (A and B—primary and secondary coils of coupler; C and D—primary and secondary windings of radio-frequency transformer);
E—Duplex Engine Governor, series FR, 21-plate variable condenser (with Na-ald 4 inch dial);
F—Duplex Engine Governor, series FR, 21-plate variable condenser (with Na-ald 4 inch dial);
G—Cardwell 7 plate variable condenser, (.0001 mfd.);
H—Dubilier mica fixed condenser, .00025 mfd. (with grid-leak clips);
I—Dubilier mica fixed condenser, .0005 mfd.;
J—Daven grid-leak, 5 megohms;
K1, K2, K3 and K4—Na-ald standard sockets, type 400;
L1—Cutler-Hammer rheostat, 30 ohms;
L2—Cutler-Hammer rheostat, 4 ohms;
M—Carter closed-circuit jack, type 102A;
N—Carter filament-control jack, type 103;
O—Federal No. 65 audio-frequency transformer;
P—Bradley switch;



THE COMPLETE CIRCUIT DIAGRAM

FIGURE 1: *This is the hook-up for the new reflex. Notice that all the symbols for the instruments bear designating letters which reappear in the list of parts given on pages 159 and 160, as well as throughout the text and the following illustrations.*

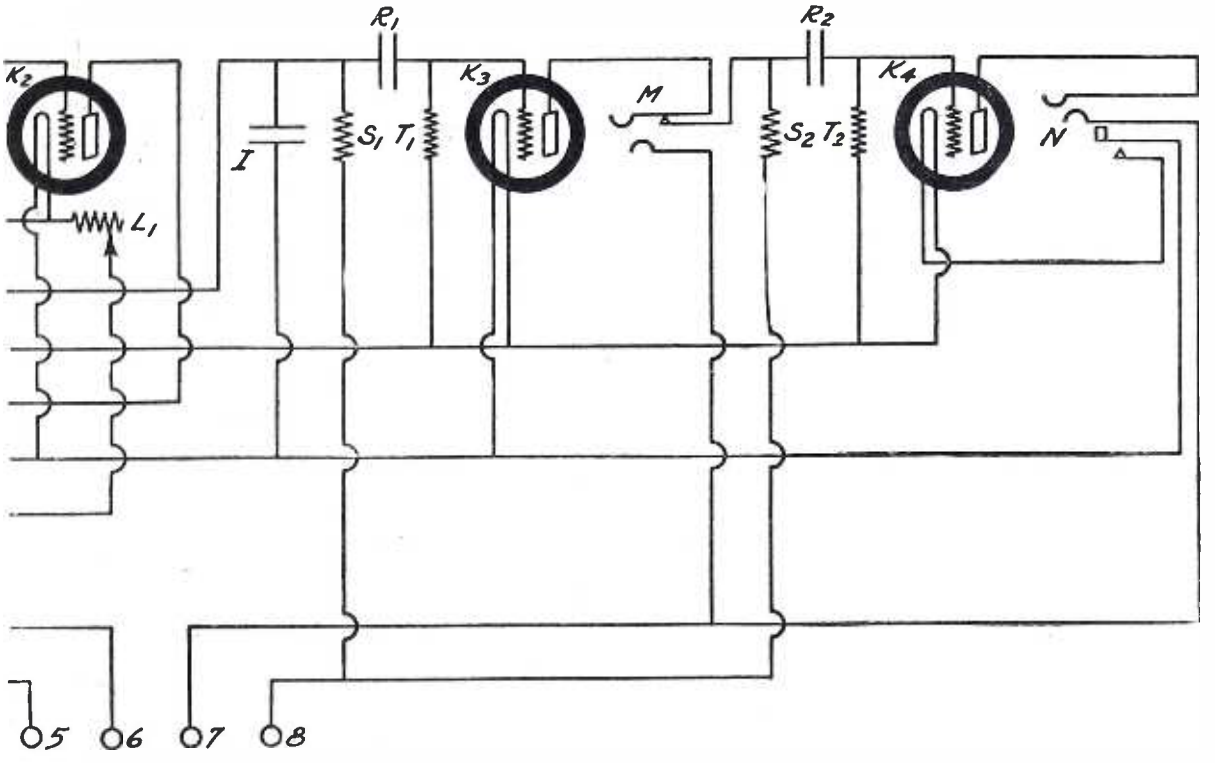
Q1 and Q2—Daven resisto-couplers;
R1 and R2—Dubilier mica fixed condensers, .006 mfd.;
S1 and S2—Daven resistors, .1 meghom;
T1 and T2—Daven resistors, .25 megohm;
U—Amsco switch lever, with points and stops;
V—composition panel, 7 by 26 inches;
W—hardwood sub-base, 6⅞ by 24¾ inches;
X1, X2 and X3—binding post, coupler, and radio-frequency transformer panels;
Y1, Y2 and Y3—binding post, coupler, and condenser mounting brackets;
Z—cabinet, 7 by 26 inches (7 inches deep);
8 Eby binding posts;
machine screws; wood screws; bus wire;
1 D-21 sodion detector tube and 3 UV-201-a or C-301-a vacuum tubes;
"A" battery (6-volt storage);
"B" battery (total 135 volts).

HERE is a circuit which will not radiate! That alone should be almost enough to interest those who listened in on the recent transatlantic tests or who have had some important part of a program blotted out by their neighbors. Sooner or later the radiating receiver must be banned, as even a competent operator can hardly expect to make a set behave at all times.

However, this latest tuned radio-frequency receiver has other points to recommend it and several improvements over the two circuits of the same type that have been previously described in POPULAR RADIO.

The set operates on a short antenna of 50 to 75 feet, which span can be found in practically any location. In the laboratory it was also tested on an indoor antenna 30 feet long, on which good loud-speaker reception of local stations was obtained.

As the radio-frequency tube has been reflexed to give a stage of audio-frequency, the resultant amplification is at least equal to that of the customary five-tube set.



After the reflexed stage of amplification, two stages of resistance-coupled amplification have been employed to improve the quality of reproduction of speech and music.

The new sodion detector tube has been utilized because of its excellent sensitivity and low current consumption. The set with four tubes burning takes the same amount of current as one of the standard detector tubes.

Construction of this set has been simplified by designating coils that are obtainable ready-built.

The theoretical wiring diagram of Figure 1 will give a good conception of the circuit that is employed. The picture diagram of Figure 2 will furnish specific directions for connecting up the instruments which are mounted in their proper places.

The Parts Used in Building the Set

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

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

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

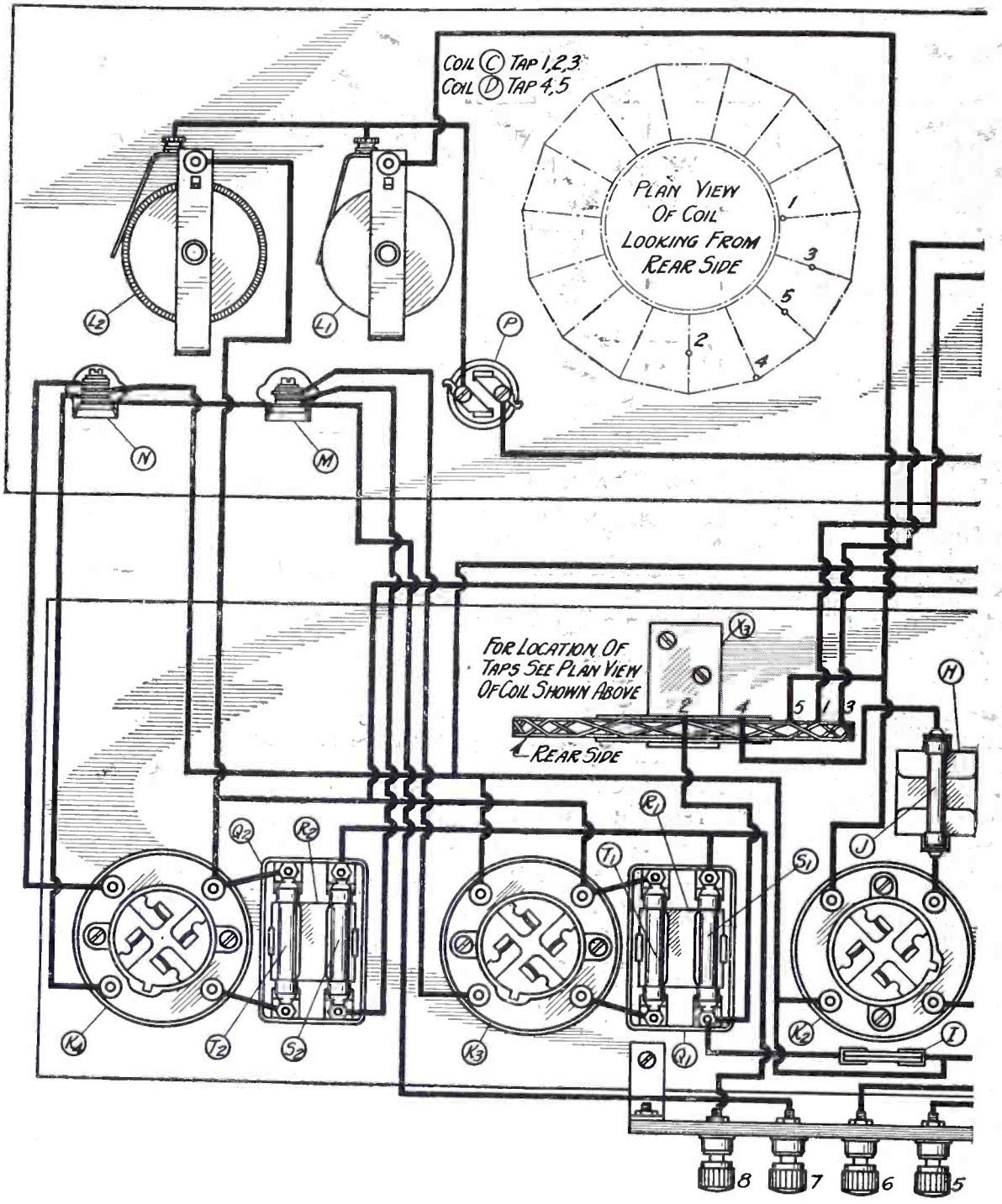
How to Construct the Set

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

First, cut the panel to the correct size, 7 by 26 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.

The holes outlined with a double circle

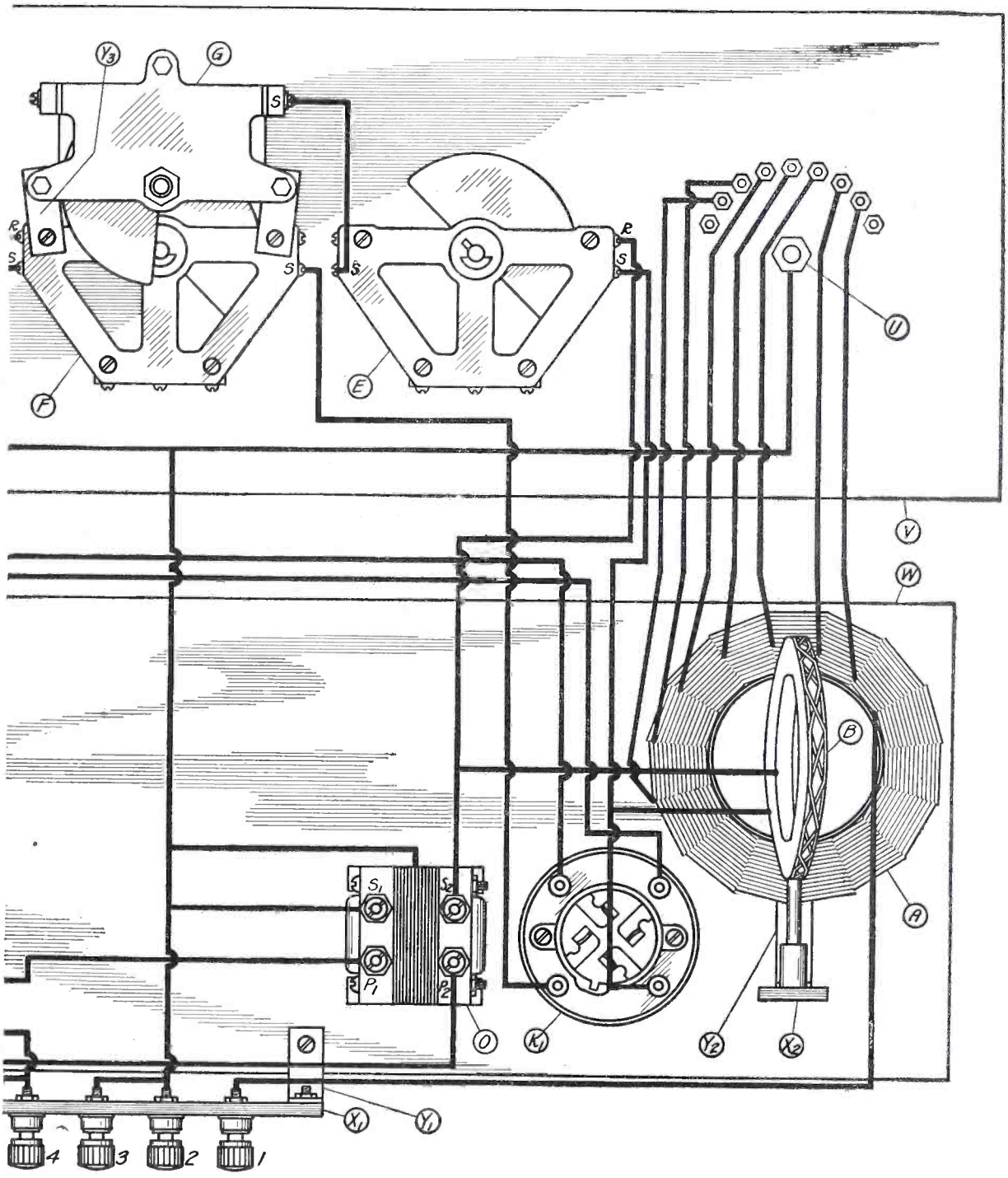


THE WORKING PLAN FOR CONNECTING UP THE VARIOUS

FIGURE 2: *The upper rectangle represents the panel and on it the instruments are drawn just as they appear. The lower rectangle represents the baseboard and the instruments are drawn in about their relative positions.*

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

When the panel is drilled, it may be given a dull finish by rubbing lengthwise with fine sandpaper until the surface is smooth; then the same process should be repeated, except that light machine oil should be applied dur-



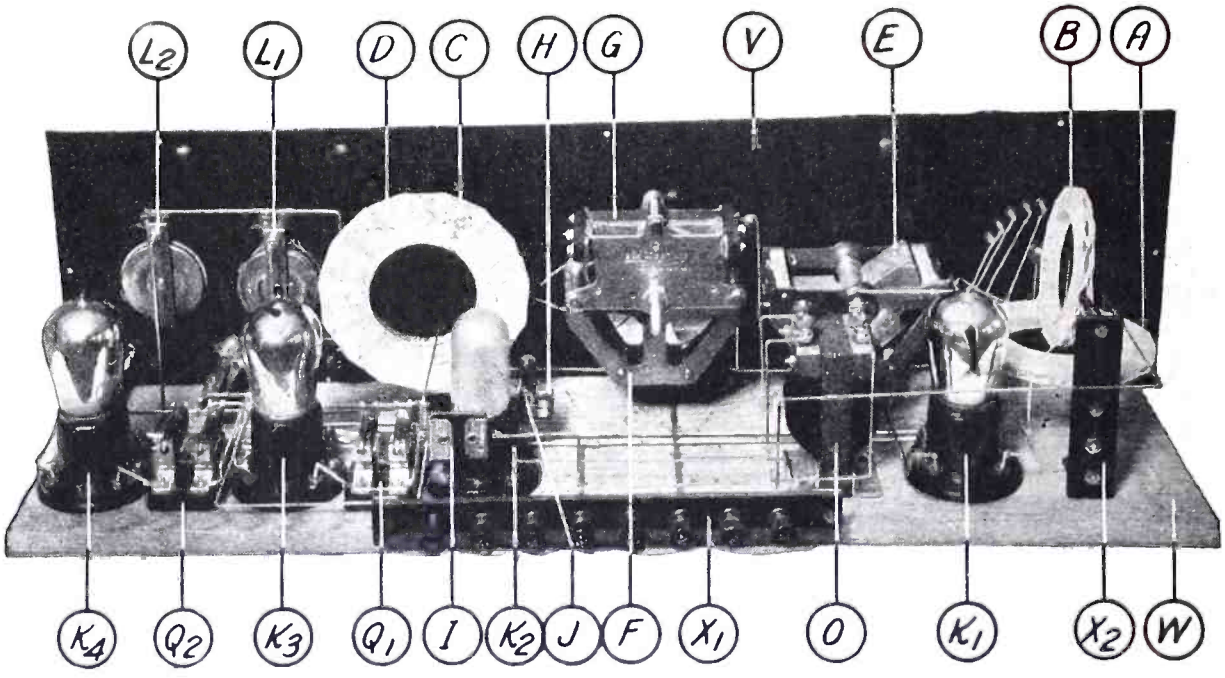
INSTRUMENTS TO MAKE UP THE COMPLETE CIRCUIT

The wires drawn in in heavy black lines show the exact way to run the wires *to connect the instruments and parts after you have mounted them according to the instructions given.*

ing the rubbing. The panel should then be rubbed dry with a piece of cheesecloth; a dull permanent finish will be the result; or, left shiny if care is exercised, so that it is not scratched during the drilling.

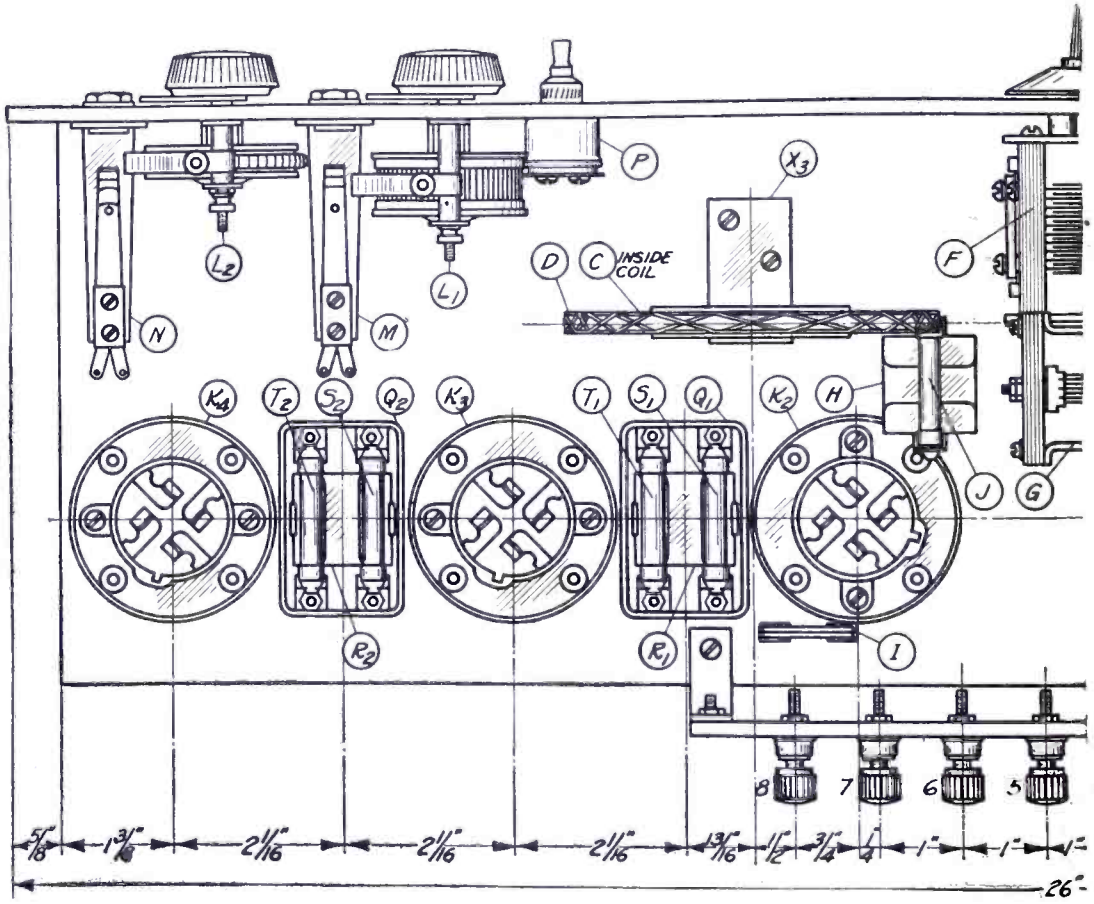
The sub-base W (see Figures 4, 5, 6 and 7), should be cut to size 6⅞ by 24¾ inches. If a piece of ½-inch hardwood, surfaced on both sides, can be obtained the work of squaring up and finishing the edges will be a minimum.

Make up the composition binding post panel X1, the coupler panel X2 and the radio-frequency transformer panel X3 according to the dimensions given in Figure 10.



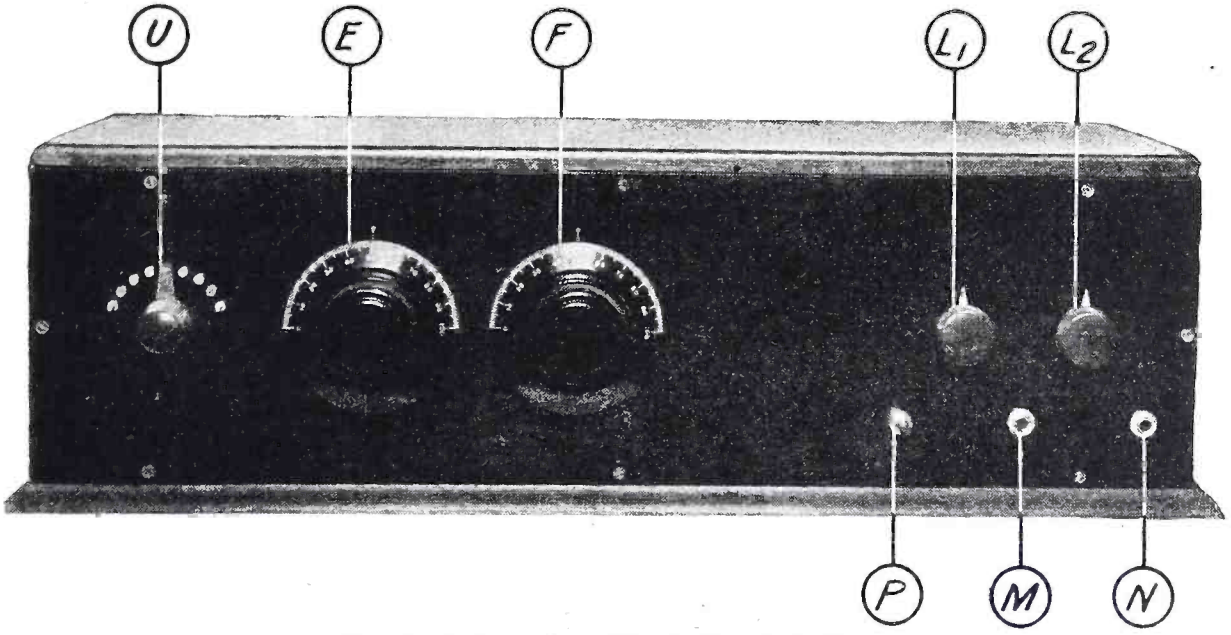
VIEW OF THE SET FROM THE REAR

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



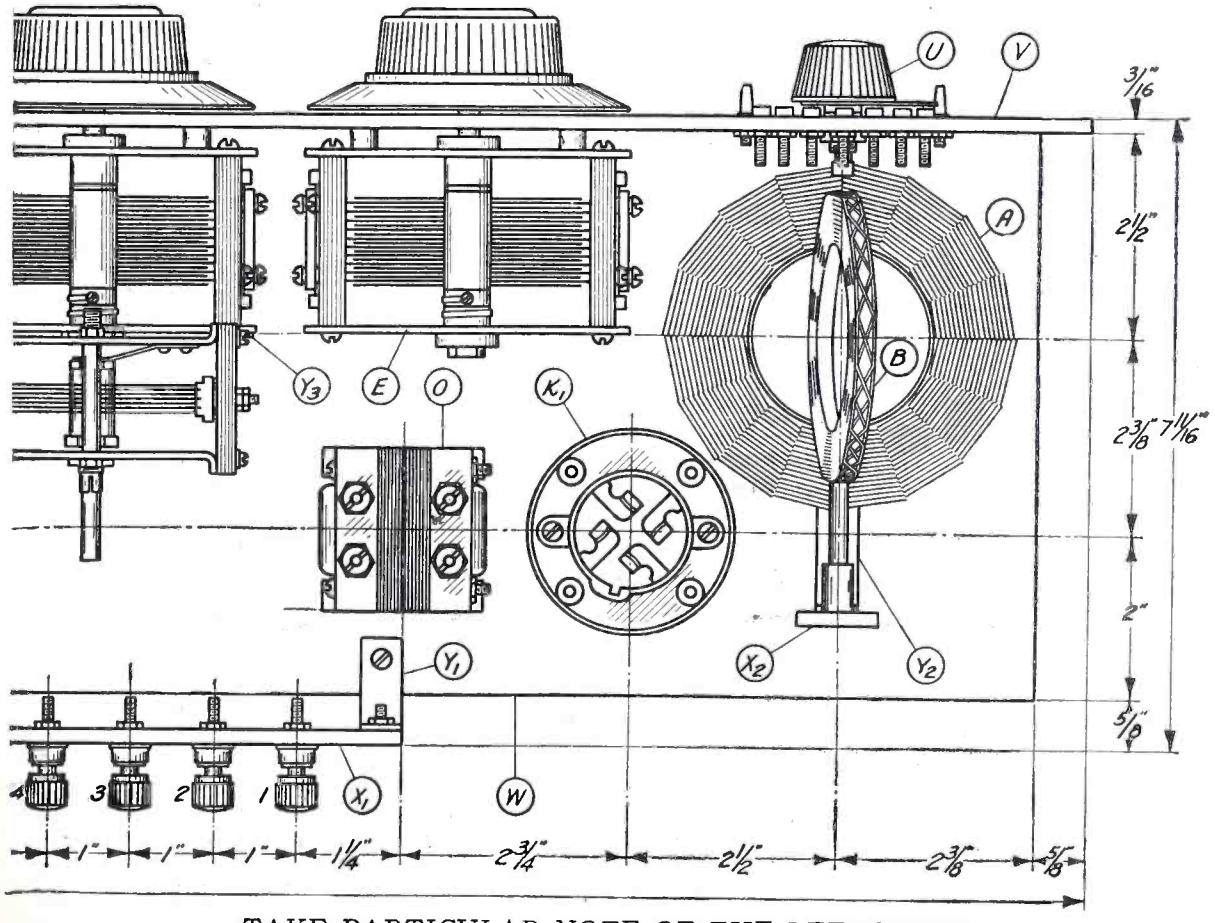
THE WORKING DRAWING FOR CONSTRUCTION

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



THE PANEL VIEW OF THE RECEIVER

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



TAKE PARTICULAR NOTE OF THE LETTERING

All of the designations in numbers and letters agree with those used throughout the drawings, text and list of parts. By following these carefully you should make no errors in wiring or placing your parts.

Next, cut the two binding post panel brackets Y1, the coupler mounting bracket Y2 and the two condenser mounting brackets Y3 out of ½-inch by ⅛-inch strip brass as shown in Figure 10. All the brackets used in this set were made by cutting up the small standard brass angles which can be obtained in hardware stores; this method will save some work.

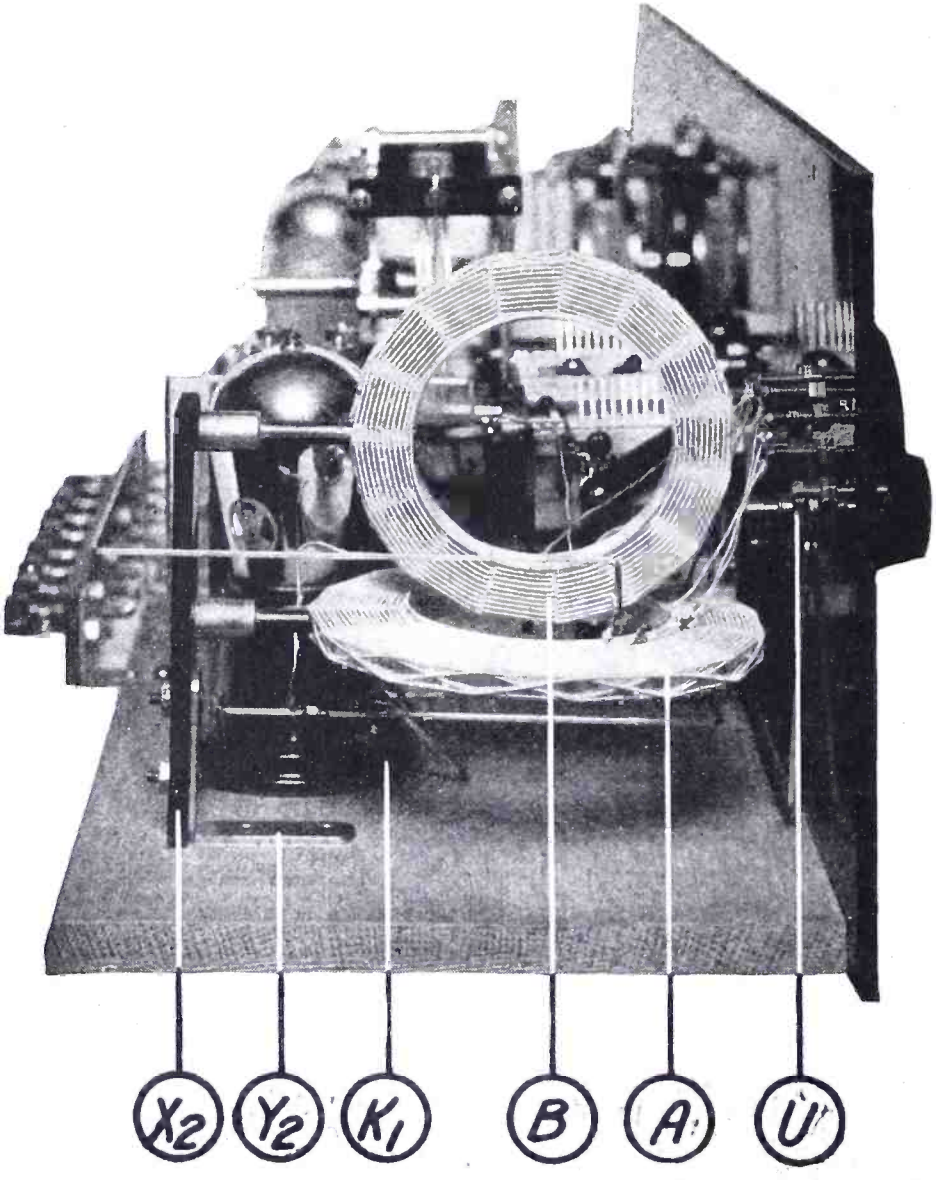
Complete specifications for constructing the cabinet Z, are shown in Figure 9. It may be made out of ½-inch hardwood such as mahogany, walnut or oak, and finished to suit the taste of the builder. Or the cabinet may be purchased from your radio dealer as it is a standard size. In the latter case it will be necessary only to cut the slot in the back of the cabinet for the binding post panel.

Preliminary to mounting the parts of the set fasten the panel V at right angles to the sub-base W. (See Figures 4, 5, 6 and 7.)

Now, mount the two variable condensers E and F on the panel. The correct positions are shown in Figures 4 and 5. Attach one of the Na-ald dials to the shaft of each condenser.

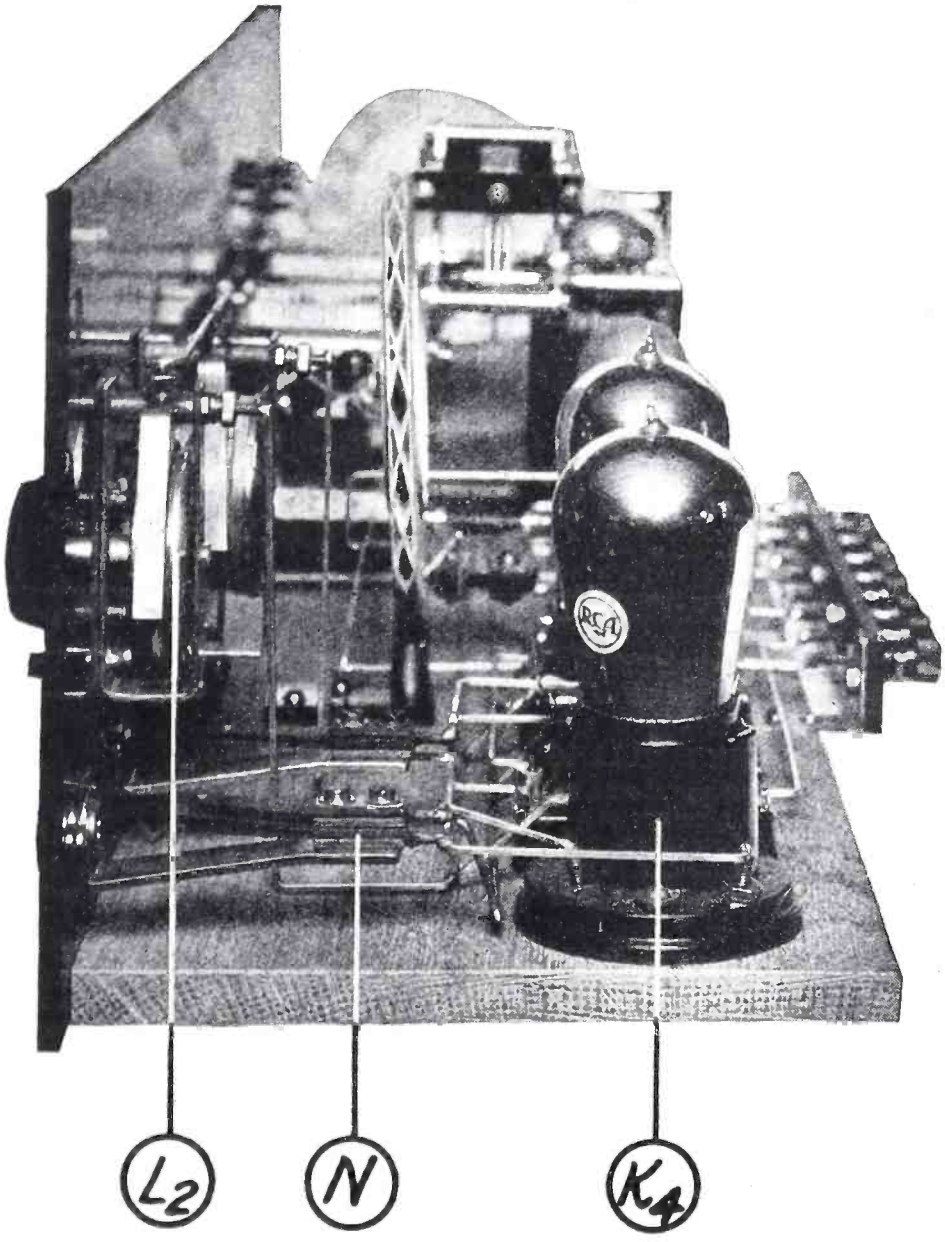
By means of the two condenser mounting brackets Y3, secure the neutralizing condenser G on the back of condenser F as indicated in Figures 4 and 5. In each case the brackets are fastened under the machine screws which hold the metal end plates on the condenser. First remove the proper screws from condenser G and replace them with the brackets under them, at the same time lining up the remaining bracket holes with proper screws of condenser F. In the same manner fasten the brackets to condenser F, thus securing condenser G in position.

Next, fix the switch lever U and its seven



VIEW OF THE SET AS SEEN FROM THE LEFT

FIGURE 6: *This illustration shows the general manner of mounting the sockets, the inductance units and the primary switch.*



VIEW OF THE SET AS SEEN FROM THE RIGHT

FIGURE 7: *This end view gives the manner in which the rheostats, sockets, the jacks and binding posts are mounted.*

switch points and two stops on the panel. See Figures 3, 4, 5 and 6.

Mount the jacks M and N on the panel as shown in Figures 3, 4, 5 and 7. The frames of the jacks are to be turned down.

In the same horizontal line with the jacks, secure the filament switch P on the panel. See Figures 3 and 5.

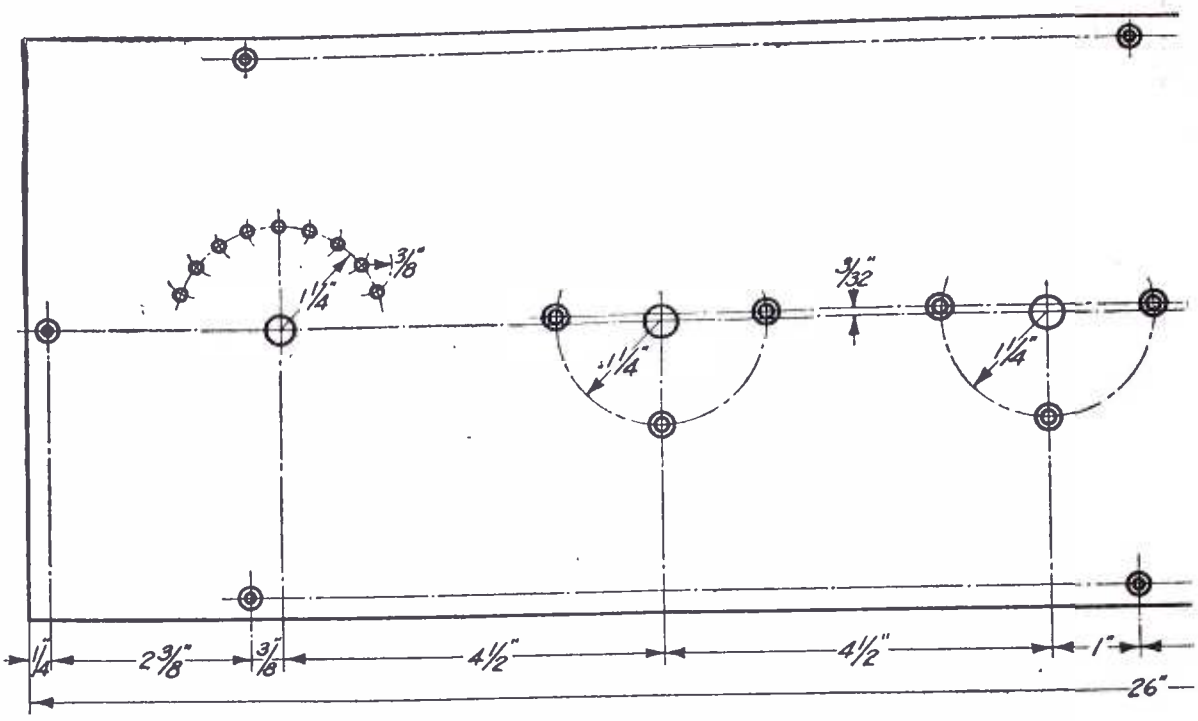
To complete the panel, mount the two rheostats L1 and L2 on the panel in the positions indicated in Figures 3, 4 and 5. The terminals are towards the top.

Beginning with the base-mounted instruments, fasten the sockets K1, K2, K3 and K4 to the sub-base with wood screws in the positions shown in Figures 4 and 5. Note the positions of the socket slots from Figure 5.

Now, mount the two resisto-couplers Q1 and Q2 with the P and G terminals towards the rear of the set. See Figures 4 and 5 for the exact positions.

Fasten the audio-frequency transformer O to the sub-base with the P1 and P2 terminals towards the rear of the set. The position is shown in Figures 4 and 5.

Secure the radio-frequency transformer, consisting of coils C and D wound one over the other, to the small panel X3 with a flat-head machine screw, turning the terminals of the transformer towards the longer portion of the panel X3. The radio-frequency transformer is now fastened to the sub-base as indicated in Figures 4 and 5. The terminals should now be on the side near the main panel V.



THE DRILLING PLAN FOR THE PANEL

FIGURE 8: *This drawing shows where to drill the holes for mounting the instruments. The correct spacings are given for the holes. The holes outlined with a double circle should be countersunk. Always start drilling holes in the panel with a small drill—one-sixteenth is a desirable size. Never attempt the drilling without using a sheet of paper with the holes properly marked on it and then pasted on the panel.*

Starting on the fixed-coupler, fasten the brass bracket Y2 to the panel X2 with the countersunk side of the upper holes on the opposite side of the panel. Now screw the bracket Y2 down on the sub-base, thus securing panel X2 in a vertical position. By a machine screw through the lower remaining hole in panel X2, fasten primary coil A in a horizontal position. In the upper hole in panel X2, fasten secondary coil B at approximately the angle shown in Figures 2 and 4. Figures 4, 5 and 6 also show clearly the assembly and position of the fixed-coupler.

To complete the construction work fix the eight binding posts on the panel X1, and then fasten the binding post panel to the sub-base by means of the two brackets Y1. (See Figures 4 and 5.)

How to Wire the Set

When wiring, it should be remembered that all connections from the high-voltage side of the transformers or coil (that is to say the side next to the vacuum tubes) should be kept about ½ inch away from other wiring and should not run parallel to it for any considerable distance. This also includes the wiring from the radio-frequency transformer to the condenser G.

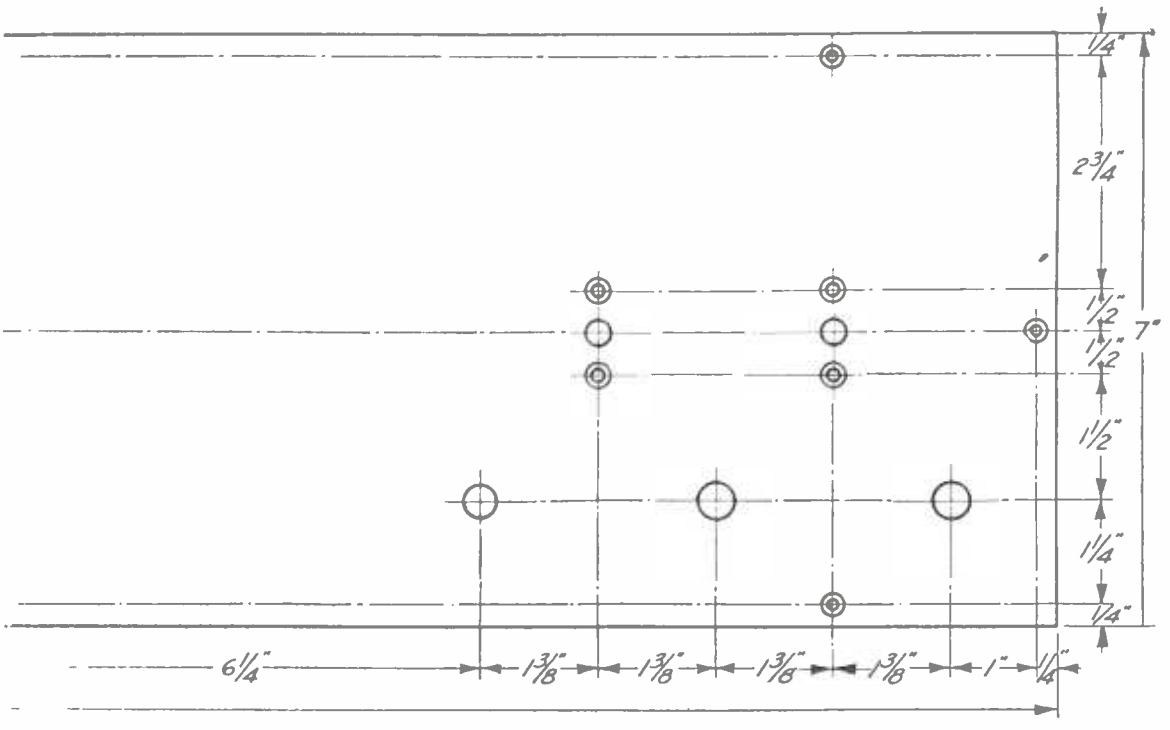
Use tinned-copper bus wire throughout. All connections should be bent into the proper shape and then soldered in place.

Start wiring the filament-lighting circuit according to Figures 1 and 2. The main positive and negative filament bus wires run along on the side of the sockets towards the panel and close to the sub-base. Connect the positive terminals of sockets K1, K2 and K3 and continue the wire to the second terminal of jack N, counting from the top. Now connect this main positive filament bus to the positive "A" battery binding post (No. 4) and the negative "B" battery binding post (No. 5). Connect the top terminal of jack N to the positive terminal of socket K4.

Next, connect the negative terminals of sockets K1, K3 and K4; then continue this wire to the horizontal binding post of rheostat L2. Also connect the negative terminal of socket K2 to the horizontal binding post of rheostat L1. Connect the vertical binding posts of rheostats L1 and L2 to the filament lighting switch P. From the other terminal of switch P run a wire to the wavelength switch U. Take a connection off this wire to negative "A" battery binding post (No. 3) and the ground binding post (No. 2). This completes the filament wiring.

Now, connect the inside terminal of primary coil A to the antenna binding post (No. 1). Join the remaining seven taps of coil A to the switch points.

Join the grid terminal of socket K1, the stationary plates of condenser E and the outside terminal of secondary coil B. Connect the rotary plates of condenser E, the S2 terminal of audio-frequency transformer O and the in-



side terminal of secondary coil B. Attach the S1 terminal of transformer O to the negative "A" battery lead before it reaches the rheostats.

Starting on the plate circuit of the first tube, connect the plate terminal of socket K1 to the stationary plates of condenser F and these plates, in turn, to terminal No. 1 of the primary coil C of the radio-frequency transformer. Join terminal No. 3 of the same coil C to the rotary plates of condenser F. The rotary plates of condenser F are already connected to the rotary plates of condenser G through the supporting brackets Y3. Connect the stationary plates of condenser G to the stationary plates of condenser E. Connect terminal No. 2 of coil C to terminal P of the first resisto-coupler Q1. Then, connect the B+ terminals of resisto-couplers Q1 and Q2 to the positive "B" battery binding post (No. 8).

Insert the 5 megohm grid-leak J in the clips of the .00025 mfd. grid condenser H and, with a short piece of bus wire, connect one side of the condenser to the grid terminal of socket K2. Run terminal No. 4 of the secondary coil D of the radio-frequency transformer to the other side of the grid condenser. Attach terminal No. 5 of the coil D to the wire running from the negative binding post of socket K2 to rheostat L1.

Run a wire from the plate binding post of socket K2 to the P1 terminal of transformer O. Connect the P2 terminal of transformer O to the positive "B" battery binding post No. 6.

Connect the G terminal of resisto-coupler Q1 to the grid binding post of socket K3. Connect the F terminal of resisto-coupler Q1 to the negative binding post of socket K3.

Connect the plate binding post of socket K3 and the top terminal of jack M. Run a wire from the P terminal of resisto-coupler Q2 to the middle terminal of jack M. Connect the bottom or frame terminals of jacks M and N to the positive "B" battery binding post (No. 7).

Connect the G terminal of resisto-coupler Q2 to the grid binding post of socket K4. Connect the F terminal of resisto-coupler Q2 to the negative binding post of socket K4.

Run a wire from the plate binding post of socket K4 to the third terminal (counting from the top) of jack N.

Condenser I is supported on the wiring directly back of socket K2. Connect one side of this condenser to the wire running to the P terminal of resisto-coupler Q1. Connect the other side to the wire running to the positive "A" battery binding post (No. 4).

Finally, ground the core of transformer O by attaching a wire under one of the screws which hold the transformer down.

Insert the .006 mfd. fixed condensers R1 and R2 in the clips provided on resisto-couplers Q1 and Q2. Insert the .1 megohm plate resistors S1 and S2 between the P and B+ terminals of resisto-couplers Q1 and Q2. Insert the .25 megohm grid-leaks T1 and T2 between the G and F terminals of resisto-couplers Q1 and Q2 respectively.

How to Install the Set

After the set has been completely wired, place it in the cabinet and fasten with wood screws through the holes provided in the panel.

The binding post panel will now fit into the slot in the back of the cabinet and will come approximately flush with the back of the cabinet.

Attach the antenna lead-in wire to binding post No. 1 (the first one on the right, look-

ing at the rear of the set). Connect the ground wire to binding post No. 2. Attach the "A" battery and "B" batteries according to the diagram of connections given in Figure 11.

See that the rheostats L1 and L2 are in the "off" position (the counter-clockwise stop position) and that the battery switch P is in the "off" position (pushed in).

Insert one Sodion D-21 vacuum tube in the detector socket K2, and insert one UV-201-a or C-301-a vacuum tube in each of the remaining stockets K1, K3 and K4. Insert the loudspeaker plug in jack M.

Set the neutralizing condenser G with approximately half of the rotor plates meshing between the stator plates. See the picture diagram Figure 2 for the correct position. The set is now ready for use.

Operating Data

The tuning chart of Figure 12 was made up from the stations received with the laboratory set and, if the same apparatus has been used, should be approximately correct in all cases. The method of using the chart is as follows. Pick out the station which you wish to receive and find its wavelength from the local newspaper. On the bottom scale of the tuning chart find this wavelength and run a line up vertically until it strikes the curve for condenser E; at this point run a horizontal line over to the left of the chart and read the correct dial setting. Repeat this process, using the other curve, to find the correct dial setting for condenser F.

Now, pull out the black plug of switch P. Turn rheostat L1 in the clockwise direction until the detector tube burns with somewhat less brilliancy than the ordinary frosted electric light bulb. This should be about one-half to three-quarters of the full-on position. Turn rheostat L2 clockwise until the vacuum tubes in sockets K1 and K3 just light. The tube in socket K4 will not light unless the loudspeaker is plugged in jack N.

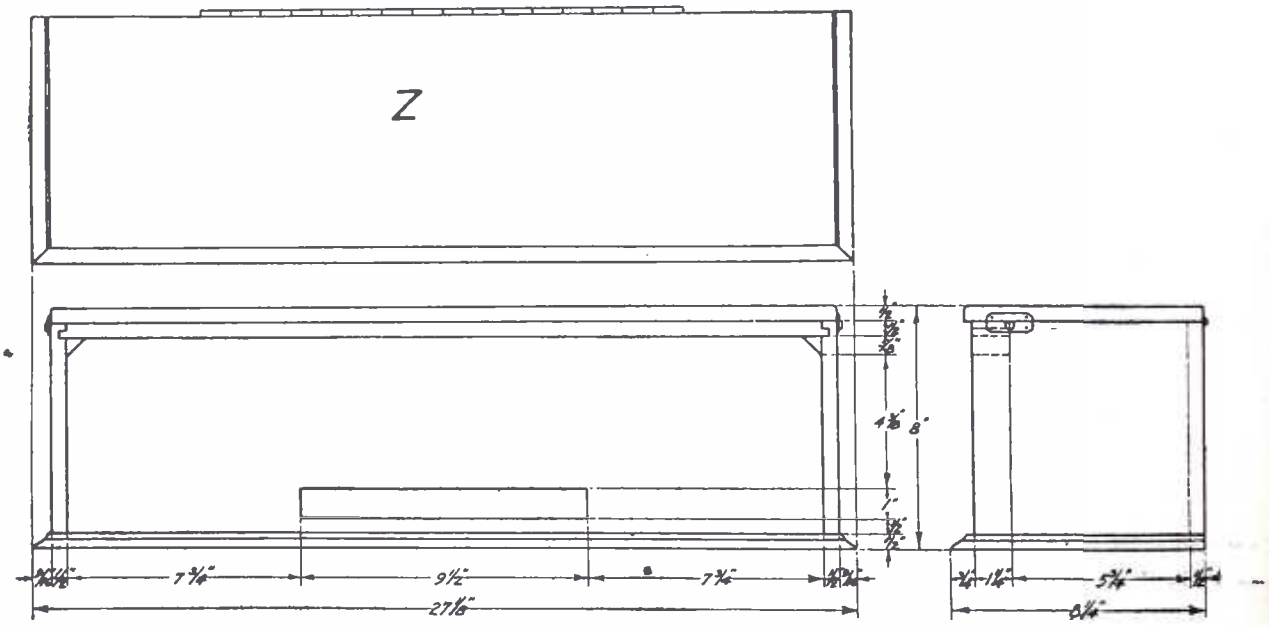
Set the wavelength switch U on the center switch point for a trial. The setting of this switch will vary with the antenna used.

Now, gradually rotate condensers E and F about the settings picked out from the tuning chart until the station is tuned in. After tuning in the station to best advantage with condensers E and F, adjust the wavelength switch U to the best point. This is the point with the smallest number of turns in the antenna circuit, consistent with loud reception. If too many turns are used in the antenna circuit the tuning will be broad. It will usually be found that, for any given antenna, there will be about three switch points at which the tuning for high, medium and low wavelengths can be done.

The rheostats L1 and L2 should now be readjusted so that all the tubes burn at the lowest point, consistent with satisfactory reception.

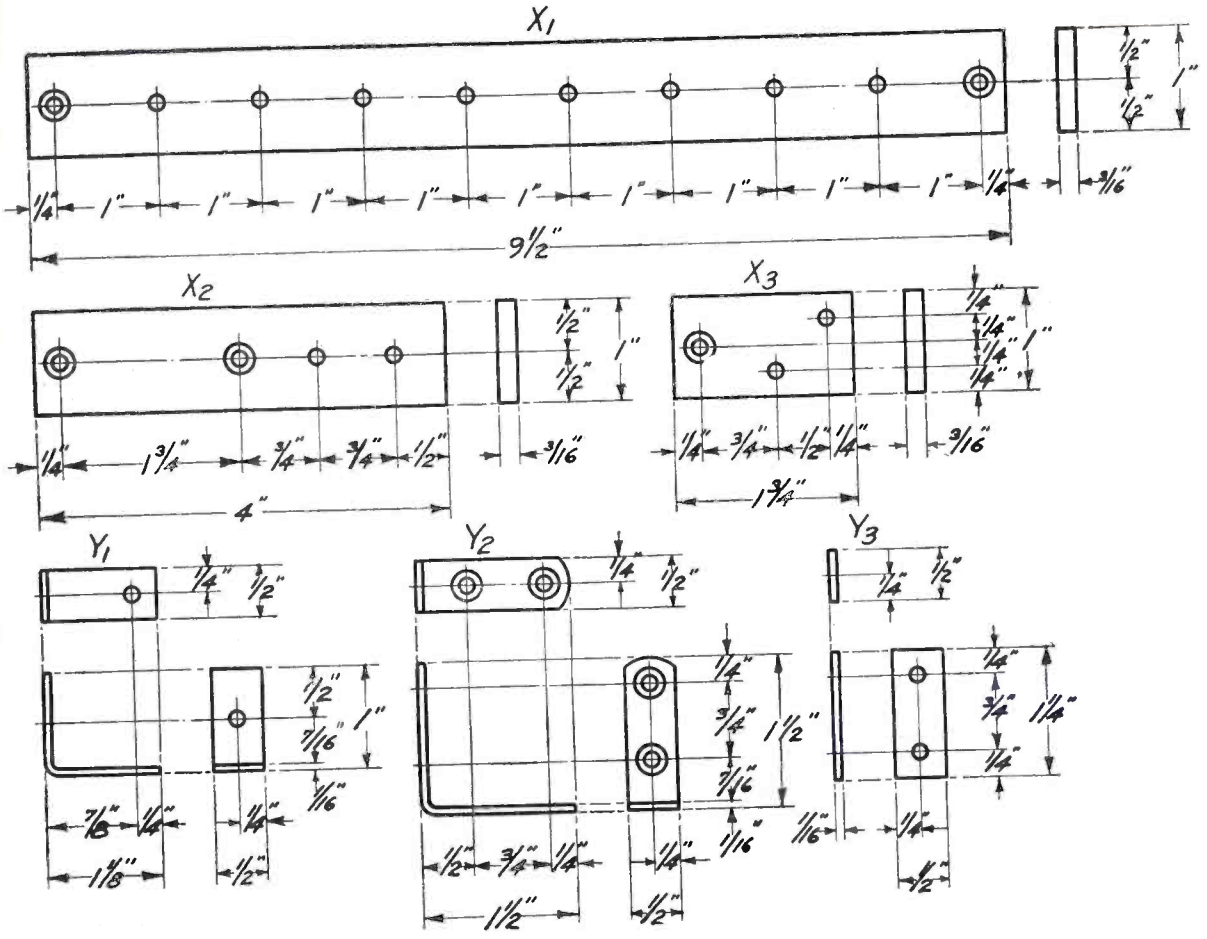
If more volume is desired the loudspeaker can be plugged in jack N. This will light the tube in the last socket and it may be necessary to advance rheostat L2 a trifle.

No dial has been provided for the neutralizing condenser G as the setting is permanent for any particular tube. The setting given is approximately correct for the tubes specified and was measured before the set was reflexed. However, it will be found that there is some latitude in this respect and that condenser G



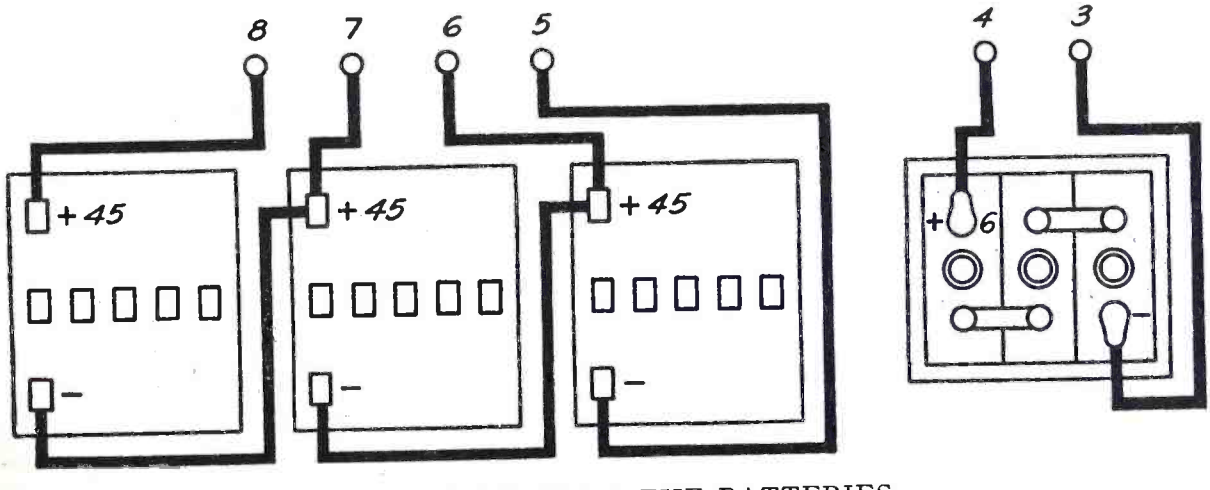
THE DIMENSIONS FOR THE CABINET

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 who can build from these directions exactly the right sized cabinet for the panel.*



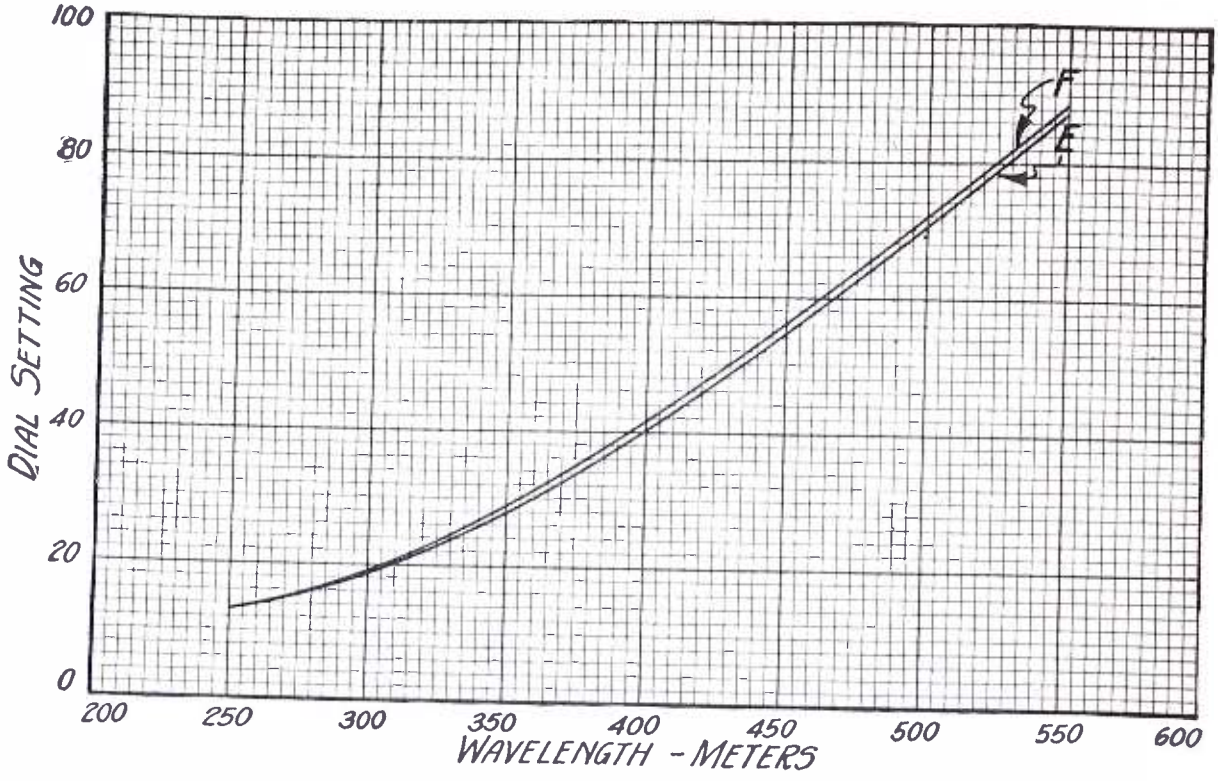
DETAILS OF THE CONNECTION BLOCK AND THE SMALL BRASS BRACKETS

FIGURE 10: *This drawing gives the necessary data for making the insulated block or strips on which the binding posts are to be mounted. It also gives the dimensions for the small brass brackets that are used to fasten the instruments to the baseboard.*



HOW TO HOOK UP THE BATTERIES

FIGURE 11: *This drawing prevents you from making mistakes in connecting the batteries to the set. If you follow these instructions, the set will be hooked up correctly because the terminals shown in the wiring diagrams are marked with designations that correspond with the numbers given here.*



THIS TUNING CHART TELLS YOU HOW TO SET THE DIALS

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

can be varied on each side of the correct setting before the set will oscillate.

The battery switch P offers a convenient means of turning the set off and on without disturbing any of the adjustments. With the aid of the tuning chart all controls may be set for any particular station with the switch P in the "off" position. Anyone can now receive that station by simply turning on the set, even if they are not familiar with its operation.

Working Blueprints of This Receiver

IN order to accommodate readers who may desire actual-size diagrams of this four-tube Reflex Receiver with a Sodion detector, a set of three blueprints has been prepared, consisting of—

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

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

Remarkable Remarks About Radio

The Effect of Radio on Newspapers

"THE newspapers and press associations of the United States are already the fastest news collectors in the world. But that speed will have to be increased to compete with radio. Inch by inch radio is edging into the business of news distribution."

—KARL A. BICKEL
President, United Press Associations

Speech in Flashes of Light

"IF our eyes were sensitive to the ultra-red electric waves which are used in radio telephony you would see my voice transformed into so many flashes of more or less vivid light."

—GUGLIELMO MARCONI

Radio; the World's Peace-maker

"OF all the complicated mysteries on this earth conceived by the brain of man the radio is the most marvelous. We can most aptly term this amazing instrument the soul of the world. It reflects the thought of the world more clearly and more definitely than any other existing force. Along with it you have the warmth and feeling of the human voice. It throbs with life.

"Can we imagine its stupendous power in binding the nation together—in making us one great big family, arousing interest in those things that broaden our mental vision and give us a clearer understanding of human affairs? It will help us to come into more direct contact with our brother man. We will know him better. He will know us better."

—BERNARR MACFADDEN

Radio Censorship

"IT is absurd to talk of setting up a radio censorship because of the employment of a broadcasting station to advertise for chorus girls. . . . If this country regrets the direct contacts between the home and the dance-hall and the theater which have been established by wireless, it should have thought of that before it adopted the radio. Since it is too late to scrap the invention, any citizen who objects to the radio programs of a broadcasting station is at liberty to tune in to some other or to shut off the instrument altogether."

—THE WORLD *(New York)*

Radio and Church Attendance

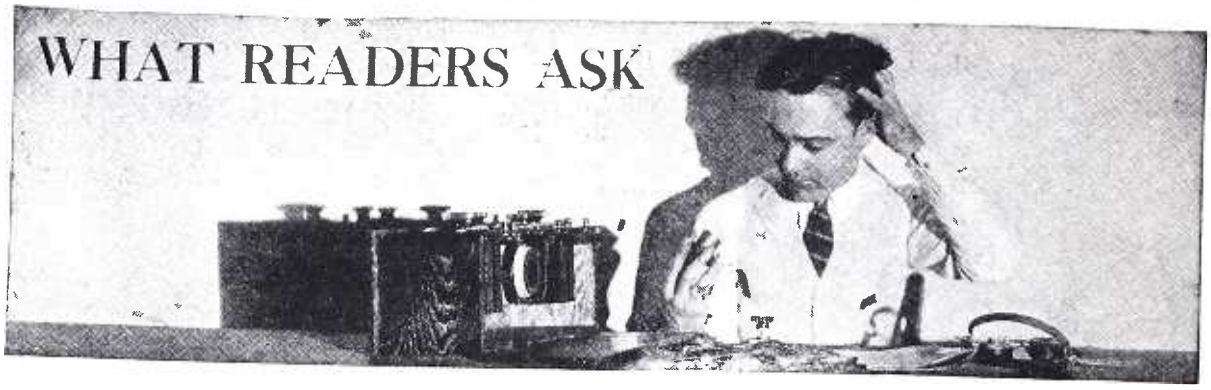
"THE effect of radio on religion is both good and bad. I believe it discourages people from going to church, especially in the rural communities where the sermon is often a humdrum affair. It is much more pleasant to listen to the preaching of some well-known orator. And it is slowly causing people to lose the art of worship, and to give up the corporate form of expression, which seems to me essential to a community."

—REV. IRVINE GODDARD
Emmanuel Episcopal Church, La Grange, Ill.

Radio Communication with Mars

"BELIEVERS in the theory that Mars supports life of an intelligent nature, which, of course, has far outstripped our own in process of evolution, are inclined to think the Martians will make elaborate efforts to study us. As the earth is considerably larger than Mars, and granting the Martians possession of instruments compared with which the radio is as primitive as a stone hatchet, they may have better luck. Under such circumstances, however, it is probable that we should be interesting only to Martian antiquarians."

—THE WORLD *(New York)*



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 Five-tube Radio-frequency Receiver

QUESTION: I have three of the Schoonhoven radio-frequency transformer coils, type "D," and would like to know if you have had any experience with them so that you could send me the hook-up of the best circuit to use them with.

DON N. TRUEDALE

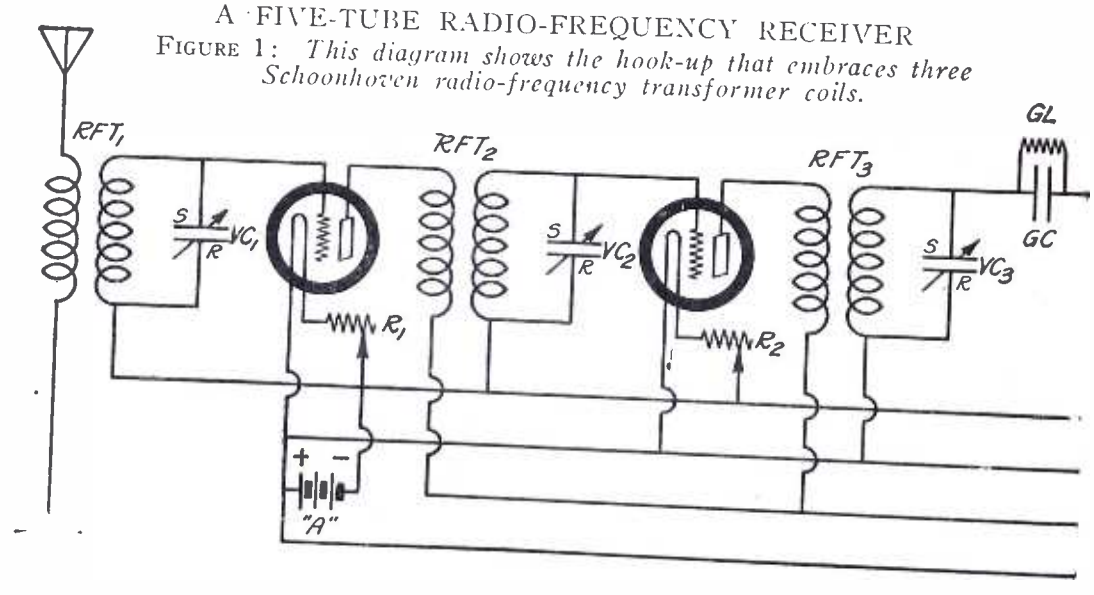
ANSWER: In Figure 1 you will find the circuit diagram that you request. The list of parts that you will need for this set exclusive of the three coils marked RFT1, RFT2 and RFT3 is given below.

VC1, VC2 and VC3—variable condensers, .00025 mfd.;
C—mica fixed condenser, .0005 mfd.;
GC—mica fixed condenser, .00025 mfd.;
GL—grid-leak, variable;
J1 and J2—double circuit jacks;
J3—single circuit jack;
AFT1 and AFT2—audio-frequency amplifying transformer;
R1, R2, R4 and R5—filament rheostats, 20 ohms;
R3—filament rheostat, 6 ohms.

The tubes recommended for the first, second, fourth and fifth sockets are either UV-201-a tubes or C-301-a tubes. These tubes function as the radio-frequency and audio-frequency amplifiers. The tube recommended for the third socket should be either a UV-200 or a C-300 tube. The three sets of coils RFT1, RFT2 and RFT3 should be mounted in back of the condensers at an angle approximately 60 degrees from the vertical. This angle, however, should be varied until oscillation is reduced. Note that the tube audio-frequency amplifiers have a "C" battery of 4½ volts included in their grid circuits.

A FIVE-TUBE RADIO-FREQUENCY RECEIVER

FIGURE 1: *This diagram shows the hook-up that embraces three Schoonhoven radio-frequency transformer coils.*



Transatlantic Tests

QUESTION: I tried, during the recent transatlantic tests, to pick up the British stations that were transmitting. I used your calibrated superheterodyne-reflex. I had the exact settings of eight of these stations predetermined by means of a borrowed wavemeter but the most I got during the test was a terrible rushing sound and millions of whistles. I did hear what I believe was a woman's singing. Most of the whistles and other noises were bunched around the settings on which the signals should have come in. Another thing I noticed was that the whistles were loudest when I turned the loop east and west, which makes me believe that I was actually picking up the broadcast carrier, but along with it the radiation of thousands of listening receivers. I can get the west coast stations right here on Long Island and therefore am pretty sure that I could receive the British stations if there were no radiating receivers listening in at the same time. Can't something be done to reduce this interference? I cannot believe that *all* of this trouble is due to regenerative receivers alone because there are not enough of them. Do any other types of receivers radiate?

FRANK BRADLEY

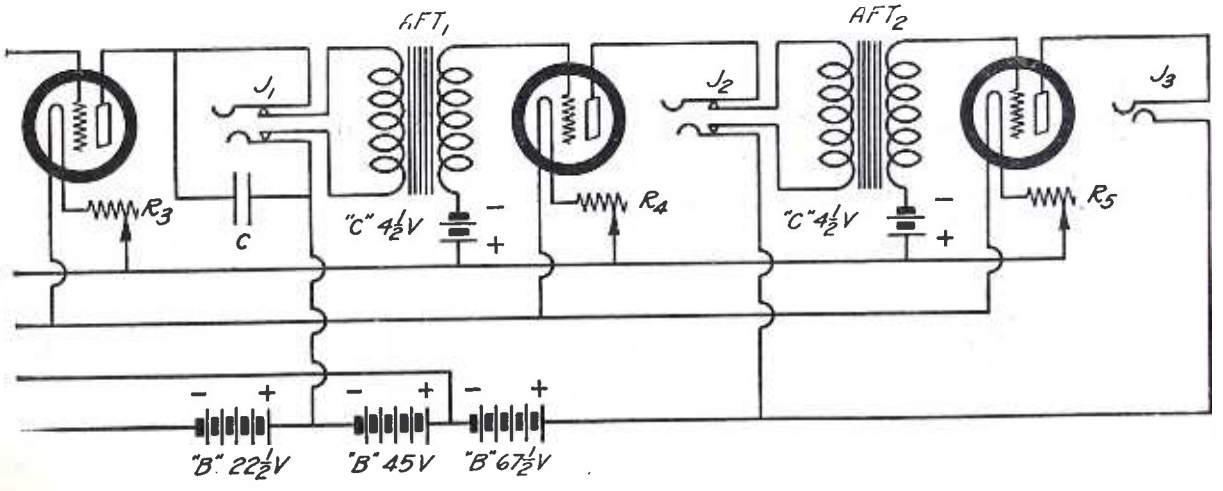
ANSWER: You have had the same experience at your set during the tests, that we experienced in the POPULAR RADIO LABORATORY. The interference from radiating receiving sets almost completely blotted out reception. At least, it rendered the modulation of the transmitting stations totally useless. Other types of sets than regenerative receivers *do* radiate. Tuned-radio-frequency receivers which employ a potentiometer for stabilizing can radiate just as badly as the regenerative type, and home-built neutrodynes improperly neutralized can cause just as much trouble. Superheterodynes with grid modulation of the first tube, also can radiate. This receiver, unless specially designed, can cause trouble for other listeners, without the owner being aware of it. This is because no whistle is heard by the operator himself. However, someone listening in in the neighborhood on a different wavelength will find that he will hear a loud whistle. It is quite evident then, that the way to fight the nuisance of radiation is to educate and teach the public how to operate their sets so that they will never allow them to oscillate or closely approach oscillation.

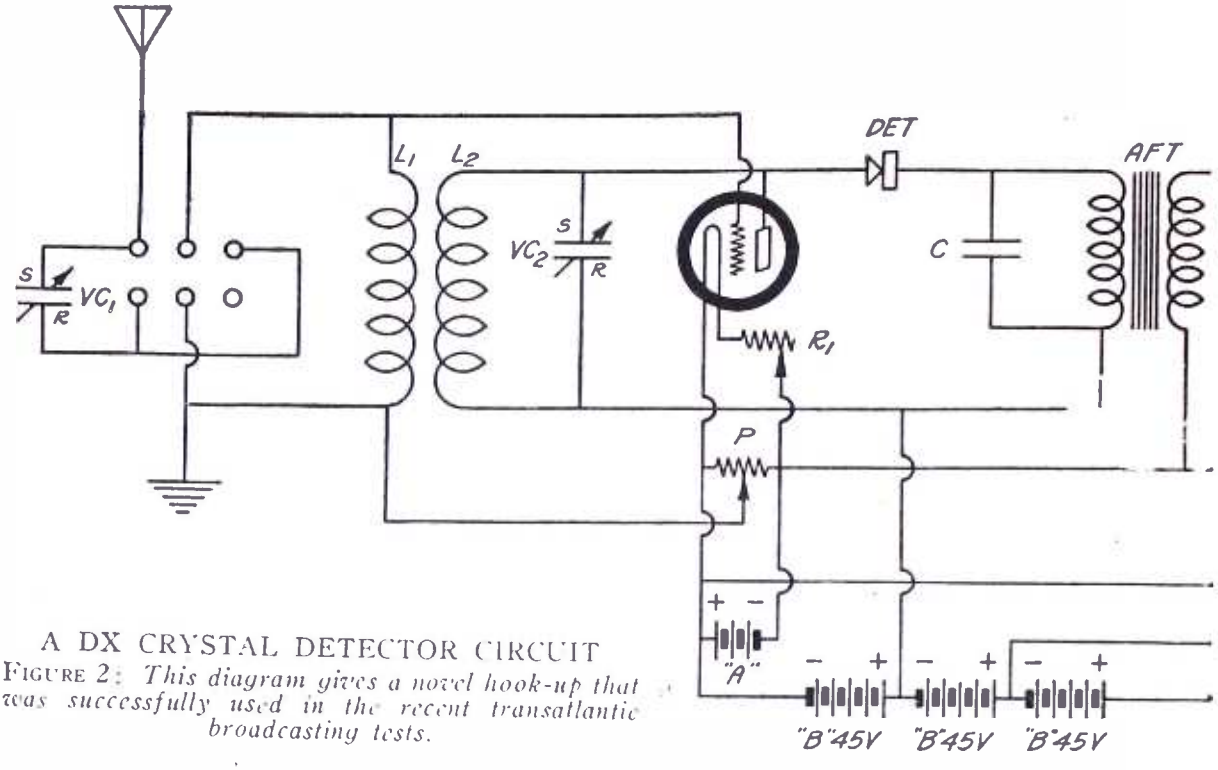
An Outdoor Loop Antenna

QUESTION: Can a loop antenna be used on the roof? Would it be any more efficient if so used rather than in the room where the set is located? How far could the loop be removed from the receiving set, if at all?

ALLEN H. BERESFORD

ANSWER: Yes; a loop antenna will sometimes give much better results if it is placed on the roof than when it is in the room with the receiver. This is only true where the room containing the receiver is shielded. Some buildings are constructed of steel or have walls built up with metal lathe for holding the plaster. In these cases the loop works better when placed above such a screen. However, the leads should be kept as short as possible; not more than 20 to 25 feet long.





A DX CRYSTAL DETECTOR CIRCUIT

FIGURE 2: *This diagram gives a novel hook-up that was successfully used in the recent transatlantic broadcasting tests.*

A Novel Circuit

QUESTION: Please give me the wiring diagram for the four-tube and crystal detector receiver—the set used by Mr. T. N. Thornton in picking up the British Broadcasting Company's station in Birmingham, England.

ALBERT JOICE

ANSWER: The circuit diagram is shown in Figure 2. The instruments and parts you will need for building this set are the following:

L1—honeycomb coil, size L-50;
L2—honeycomb coil, size L-35;
VC1 and VC2—variable condensers, .0005 mfd.;
C—mica fixed condenser, .0005 mfd.;
GC1 and GC2—mica fixed condenser, .02 mfd.;
R1, R2, R3 and R4—filament rheostats, 20 ohms;
R5 and R6—plate resistances, 250,000 ohms;
GL1 and GL2—grid resistances, ½ meg.;
P—potentiometer, 400 ohms;
AFT—audio-frequency amplifying transformer;
DET—crystal detector;
J—single-circuit jack.

The tubes recommended for use with this receiver are either DeForest DV-3 tubes, UV-201-a tubes, or C-301-a tubes. The coils, L1 and L2 should be mounted in a double-coil mounting with one coil variable so that the coupling between the two coils can be shifted.

Low Wave Antenna for Amateurs

QUESTION: What length of antenna would you advise for use with a low-wave receiver for reaching low-wave stations from 80 to 200 meters? I want to use a single-wire antenna.

H. K.

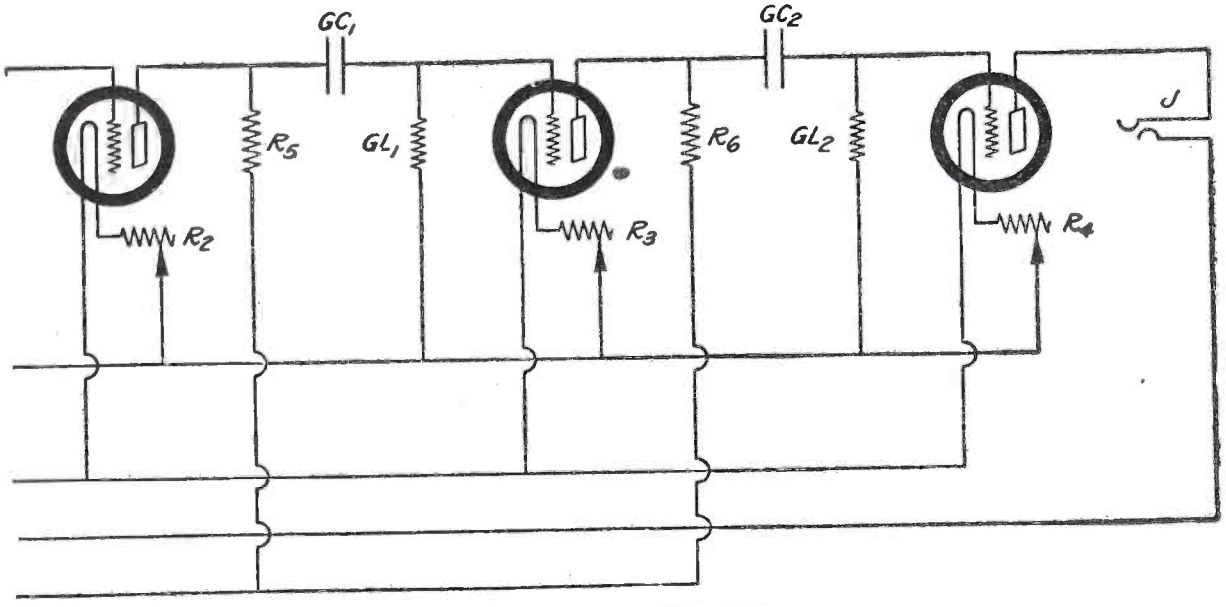
ANSWER: Use a single wire not more than 50 to 60 feet long and not less than 40 feet long. Keep the lead-in as direct and short as possible. Make the whole construction of the antenna as rigid as possible, so that it cannot swing to any extent.

What the Autodyne Is

QUESTION: Please tell me what an autodyne oscillator is; and what the function of an autodyne coupler is.

FRED NELSON

ANSWER: The autodyne oscillator as used in a superheterodyne receiver consists of a tube circuit which acts as a detector and as an oscillator at the same time. The autodyne coupler usually consists of two coils, one of which is connected in series with the grid circuit of a vacuum tube and the other in series with the plate circuit of the same vacuum tube. The second coil is placed in inductive relation to the first. By tuning the grid coil with a variable condenser a radio-frequency current of variable frequency can be generated and a beat produced between this frequency and the frequency of signals.



Spiderweb Secondary for a Variocoupler

QUESTION: Would a spiderweb winding used for the rotor of a variocoupler decrease the coupling capacity between the primary and secondary windings? If so, I would like to try it because I am located in the midst of a number of powerful local broadcasting stations and need greater selectivity than my ordinary variocoupler gives. How many turns would I need, starting with a one-inch core for the spiderweb coil, to cover the broadcast range with a variable condenser of .0005 mfd. capacity?

JACK H. BENSON

ANSWER: Such a coil would help you because it would allow for much looser coupling. You should have approximately 65 turns of No. 22 DSC copper wire.

A By-pass Condenser for the Lane Circuit

QUESTION: I have a little trouble with the control of regeneration with the Lane low-wave set. The control is a bit "sticky"; that is, the set bursts into oscillation when the regeneration is advanced to a critical position.

WAYNE HAMILTON

ANSWER: This condition can be corrected by shunting a small fixed condenser across the primary of the amplifying transformer. This capacity acts as a by-pass for the radio-frequency currents that flow in the plate circuit of the detector tube. Try small condensers that vary from .0005 to .001 mfd. until you get the one that gives the best results.

Soldering Lugs Are Preferable

QUESTION: Which do you recommend, soldering right on to the screws or soldering lugs on radio instruments, or, using the binding posts?

GEORGE V. DAHL

ANSWER: Use soldering lugs. If the instruments you have are not equipped with them, take off the screw nut and solder right on to the screw itself. The more modern and better apparatus *is* equipped with soldering lugs and we believe these should always be used whether the binding posts are part of the instruments or not.

The Second-harmonic Oscillator

QUESTION: Is it possible to use the second-harmonic principle with a home-built superheterodyne? Can you give me some data on the coils for such use?

HAROLD VAOTTI

ANSWER: It is possible. In the January, 1925, issue of POPULAR RADIO you will find an article that describes a superheterodyne reflex that utilizes this principle; you will also find there the circuit diagram for the oscillator.

A Recent Modification of the Four-circuit Tuner

QUESTION: I have read in two newspapers, one in Chicago and one in New York City, of a new circuit that goes by the name of the Filter Tuner. I am a four-circuit fan who built one of the first four-circuit receivers when it was first explained in your magazine. This prompts me to write you asking if there is not a great similarity between the filter tuner and the Four-circuit Tuner? In my mind they are one and the same thing except that the circuit has been switched around a bit and the absorption increased by adding more resistance in the absorption circuit. Will you kindly advise me and also give me the correct diagram of the filter tuner, as the two diagrams I have do not agree.

GEORGE CROSS

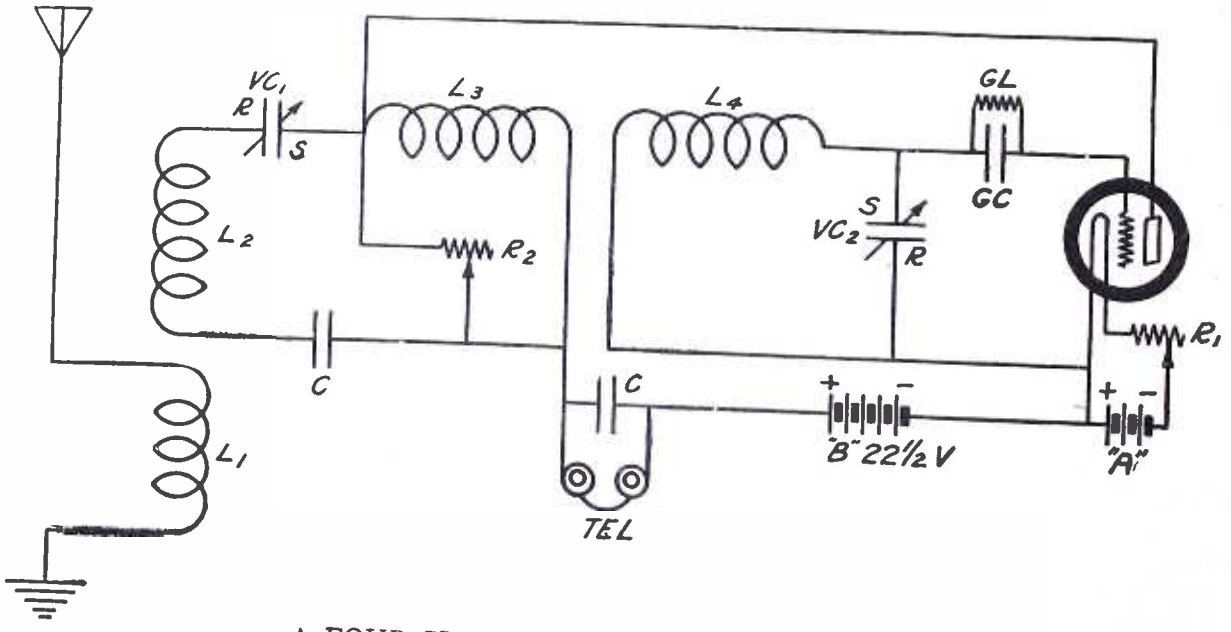
ANSWER: The circuit you want is given in Figure 3. The principle of both circuits is the same and the circuit arrangement materially the same except that in the filter tuner the coupling from the detector circuit (that produces feedback) is directly coupled to the absorption circuit instead of inductively coupled as in the case of the four-circuit tuner. As the feedback is therefore materially increased, there must be more absorption produced in the absorption circuit for proper control, and for this reason part of the absorption circuit inductance is shorted with a resistance. One difference between the two modifications is that the coupling between the antenna and the absorption circuit is much greater in the filter than in the true four-circuit tuner. For this reason the filter tuner radiates when the resistance R2 is not set exactly right.

Howls from an Audio-frequency Amplifier

QUESTION: I have a regenerative receiver and a two-stage audio-frequency amplifier. This set worked perfectly satisfactorily for the past ten months, but lately it has developed an annoying howl. This howl continues even when the detector tube is extracted from the socket; in fact it gets worse when this is done. Does not this prove that the trouble is in the amplifier itself? My "A" batteries are fully charged and I have had the "B" batteries for only nine months, so that the trouble should not rise from these. Could it be that one of the transformers has burned out?

H. K. T.

ANSWER: Your trouble is undoubtedly due to run-down "B" batteries, as the symptoms you have outlined most clearly indicate.

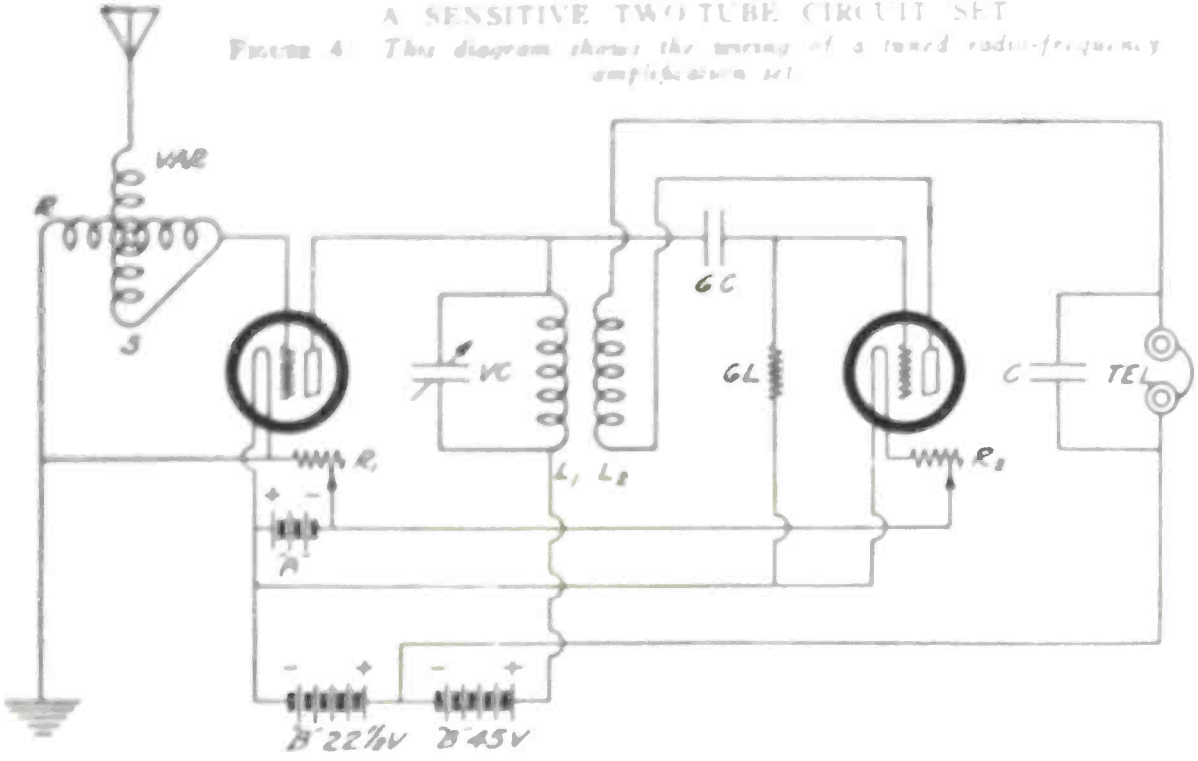


A FOUR-CIRCUIT TUNER MODIFICATION

FIGURE 3: *The correct wiring of the Filter Tuner is shown in this hook-up diagram.*

A SENSITIVE TWO-TUBE CIRCUIT SET

FIGURE 4. *This diagram shows the wiring of a tuned radio-frequency amplification set.*



A Novel Form of Tuned Radio-frequency Amplification

QUESTION: I am an experimenter and follow all your circuits that you publish in POPULAR RADIO. Will you please let me have a circuit that employs tuned radio-frequency amplification, with honeycomb coils for the radio-frequency coupler? I do not want to use any audio-frequency amplification as all I am interested in is to learn the principles of radio amplification. Let me have something a bit out of the ordinary if you can.

HOWARD HOLMES

ANSWER: In Figure 4 you will find an interesting circuit that should give you a lot of pleasure in mastering. The parts you will need and their proper constants are given in the following lists:

VAR—variometer;
L1 and L2—honeycomb coils, sizes L-30 and L-35 respectively;
VC—variable condenser, .0005 mfd.;
C—mica fixed condenser, .0006 mfd.;
GC—mica fixed condenser, .00025 mfd.;
GL—grid-leak, variable;
R1—filament rheostat, 20 ohms;
R2—filament rheostat, 6 ohms;
TEL—telephones.

The two coils L1 and L2 should be mounted in a double-coil mounting so that the coupling between L1 and L2 may be varied until the best setting has been ascertained. Use either a C-300 or a UV-200 tube for the second tube (detector), and any hard tube for the first tube (radio-frequency amplifier).

Coupling Resistance for a Resistance-coupled Audio-frequency Amplifier

QUESTION: What do you consider to be the most effective value of resistance to use for the coupling resistance in the plate circuit of a resistance-coupled amplifier for audio amplification?

G. S. STUART

ANSWER: The value we recommend is a resistance of 250,000 ohms (¼ megohm).

Stranded Wire for Antennas

QUESTION: Is stranded wire all right for use as antenna wire or should I get ordinary solid wire?

H. M. PIERCE

ANSWER: The stranded wire will be entirely satisfactory. It is this type of wire that is used almost always for radio antennas. The usual size is No. 14 seven-stranded wire. Either copper or phosphor-bronze wire may be used.

CONDUCTED BY DR. E. E. FREE

The Surface of Mars Is Not Too Cold for Life

ALTHOUGH the attempts to listen this summer to supposed radio messages from the equally suppositious Martians have come, as was expected, to nothing, the astronomers are still actively at work collecting such data about our sister planet as they can obtain by the telescope, the spectroscope and similar less sensational but more efficient instruments.

At least one important result has already been announced, the measurement of the surface temperature of the planet made by Dr. W. W. Coblentz of the United States Bureau of Standards and Dr. C. O. Lampland, working at the famous Lowell Observatory at Flagstaff, Ariz. These measurements are based on the examination of the heat rays that reach the earth from the planet.

These heat rays are almost inconceivably feeble. They come merely from the heating of the Martian soil by the rays of the sun, for the planet possesses, we are quite sure, an insufficient internal heat to keep the surface warm from inside. When one remembers that these heat rays have to traverse the thirty odd millions of miles that separate us from Mars the wonder is that we can detect them at all, let alone be able to measure them with any accuracy.

Nevertheless the sensitive apparatus set up by Dr. Coblentz and Dr. Lampland in the clear air of Arizona and with the aid of the great telescope of the Lowell Observatory did succeed not only in measuring the total intensity of the heat rays and infra-red rays received from the Martian soil but also in determining the proportion of the total energy of this radiation contained in different parts of its wavelength range.

This last piece of information permits the calculation, from physical theory, of the temperature of the Martian surface. As a result of their work Dr. Coblentz and Dr. Lampland report,* "the equatorial zones are much warmer than the polar regions which emit practically no planetary radiation; the morning side of the planet is at a lower temperature than the afternoon side which has been exposed to the sun's rays for a longer time; the dark regions are at a higher temperature than the light ones, and a gradual rise in temperature of the surface of the southern hemisphere, where summer is now advancing, was recorded."

This is a picture not unlike that which would be exhibited by the surface of our own earth and this similarity goes farther. Calculations of the actual surface temperature of Mars indicate, it is reported, that the reading "under a noonday sun is up to 20 degrees Centigrade or even higher." Twenty degrees Centigrade corresponds to 68 degrees Fahrenheit which is quite a comfortable temperature, even for terrestrial creatures. It must be remembered, of course, that this is a noonday temperature. The atmosphere of Mars is known to be thin, as is the air of the tops of high mountains on earth. It is probable that during the Martian night the temperature falls well below what we call zero. Nevertheless, the new data indicates that Mars is not so bad a place to live, so far, at least, as temperature is concerned.

The other one of our planets that has been suspected by some scientists of being possibly the abode of life is Venus. The temperature of this planet was measured, also, by Dr. Coblentz and Dr. Lampland. The results obtained are mysterious in that they indicate the planet to be actually emitting very long-wavelength infra-red rays of its own. This might be explained if the surface of the planet were still hot from internal fires, but this is improbable.

The most reasonable interpretation is one suggested by Dr. Coblentz and Dr. Lampland themselves in a subsequent communication.† It is that the planet rotates rapidly and that some of the heat received from the sun is carried around to the dark side of the planet, whence it reaches us as radiated infra-red

* "New Measurements of Planetary Radiation," by W. W. Coblentz and C. O. Lampland. *Science* (Lancaster, Pa.), vol. 60, page 295 (September 26, 1924).

† "A Tentative Interpretation of the Radiometric Data on Venus," by W. W. Coblentz and C. O. Lampland. *Science* (Lancaster, Pa.), vol. 60, page 318 (October 3, 1924).

rays. The surface of Venus that we see is white, glistening and featureless. Most astronomers imagine that it is not really the solid surface of the planet at all but is a permanent layer of cloud or dust occupying the upper layers of the planet's atmosphere.

How to Make a Selenium Cell

SELENIUM cells are already familiar to readers of POPULAR RADIO as the devices which are able to convert light variations into electric variations. They were used, for example, in the famous "electric dog" of Mr. John Hays Hammond, Jr., the little battery-driven car that followed a light in any direction. They were used, also, by Mr. H. Grindell-Matthews of "diabolic ray" fame, in his apparatus for the control of boats by light signals.

Selenium is a chemical element. In some ways it resembles metals; in other ways it seems to be non-metallic. Chemically it belongs in the group including tellurium and sulphur. Its most remarkable property, and the one that makes it suitable for use in these various light-detecting devices, is the property of altering its electric resistance when light falls on it.

This property is not disclosed very well by a thick plate of selenium. Furthermore, the selenium occurs in a number of different physical forms, ranging from a black, glassy variety to a gray, metallic-looking powder. To get satisfactory results from this element in the electric detection of light one must have the selenium in the form of a thin film between conducting terminals of some kind and one must be sure that the selenium of this film is in exactly the correct physical condition.

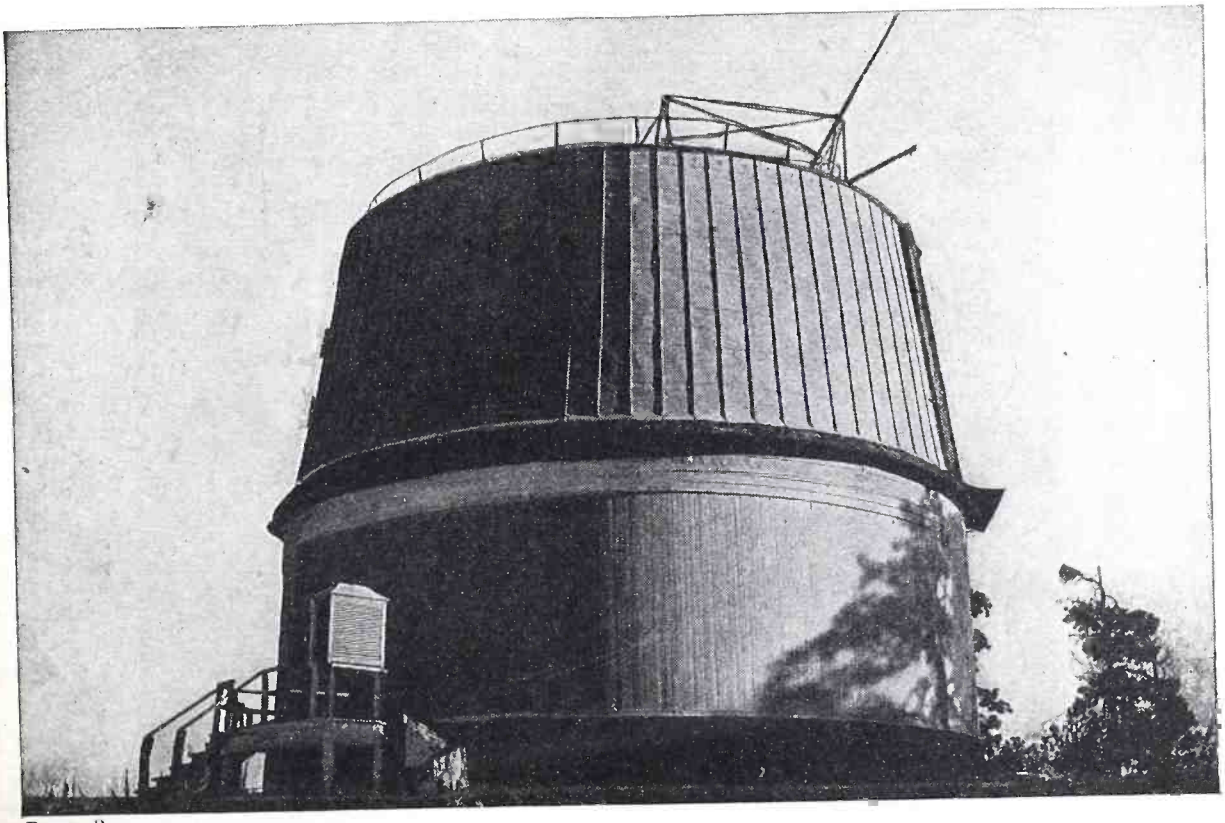
Dr. E. E. Fournier d'Albe, an English scientist who has been for years the chief expert on the use of selenium in light detection, has just published a book on the properties, handling and uses of this element,* from which we quote the following description of how a sensitive and dependable selenium cell may be made:

"Cut with a hack-saw a piece of ordinary writing slate of the size required—say two inches square. One surface should be smoothed by means of sandpaper. (If two pieces of slate are prepared, the two surfaces should adhere for a short time if pressed together.)

"Now cover the smooth surface with graphite by rubbing it over with a soft pencil. After a good covering is attained, rub in the graphite with a piece of leather and produce a good black polish.

"Next, inscribe a to-and-fro line in the graphited surface with a sharp steel point, cutting just sufficiently deep to penetrate the graphite surface. The cut (see the figure)

* "The Moon Element, an Introduction to the Wonders of Selenium," by E. E. Fournier d'Albe. D. Appleton and Co., New York, 1924, 166 pages, illustrated. The quotations are from pages 42-45.



Brown Bros.

WHERE THE TEMPERATURE OF MARS WAS MEASURED

The Lowell Observatory at Flagstaff, Ariz. (shown above), is where Dr. Coblentz and Dr. Lampland succeeded in measuring the heat of feeble rays from Mars. From these measurements they deduced the temperature on that planet.

should not be more than half a millimeter wide (about one-fiftieth of an inch).

"Now comes the more difficult operation—that of coating the surface with selenium.

"As the fumes of selenium are unpleasant, the coating should be done in the open air or in a well-ventilated place.

"Have ready two pairs of pliers, a Bunsen burner, a slab and a narrow strip of glass.

"Light the burner and grip one corner of the slate in a pair of pliers. Grip a piece of selenium about the size of a hazel nut in the other pliers. Plunge the slate into the flame, moving it to-and-fro so as to get an even heat. After half a minute or so the slate will crackle, without actually breaking. Whip it out of the flame and apply the selenium as if you wanted to paint it on. It will probably collect into drops. Apply a little more heat and you will find a temperature at which it spreads like butter, though it will then be too thick. Put down the selenium bit and take up the strip of glass. With this glass, spread the selenium evenly with the exception of the ungrooved portions at each side. The surplus selenium will adhere to the glass.

"The above operation is difficult, but with some practice a smooth, even glossy black covering of selenuim can be obtained. Do not keep smoothing after the selenium has begun to congeal, or you will get a purple crystalline variety which is quite insensitive.

"After coating, the slate should be placed on the iron slab to cool quickly.

"When cold, the selenium will be quite non-conducting. If a battery and a sensitive galvanometer are joined to the two uncoated side strips of graphite, no current should be indicated. If there is a current, it means that the grooving is incomplete at some point. The zig-zag groove should be one continuous line dividing the graphited surface into two entirely separate portions.

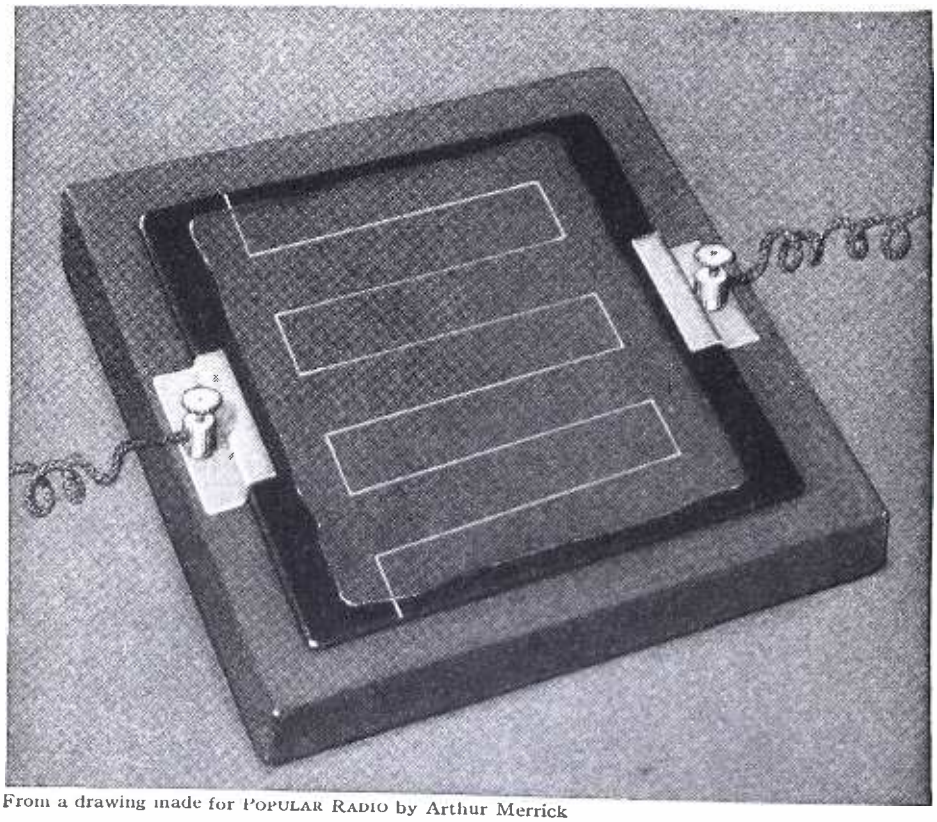
"If no current is indicated, we may proceed to 'anneal' the selenium. This is conveniently done on an iron slab one-eighth inch thick, heated with the Bunsen burner at one end. A steady gradient of heat can thus be obtained, one end being nearly red-hot while the other can still be touched.

"The annealing consists of two operations In the first operation the black lustrous selenium is converted into the gray crystalline variety by heating.

"This consists in bringing the selenium gradually as closely as possible up to its melting point, and keeping it there for at least half an hour.

"This can be done by putting it back on the former spot on the slab and gradually bringing it up to the hot end.

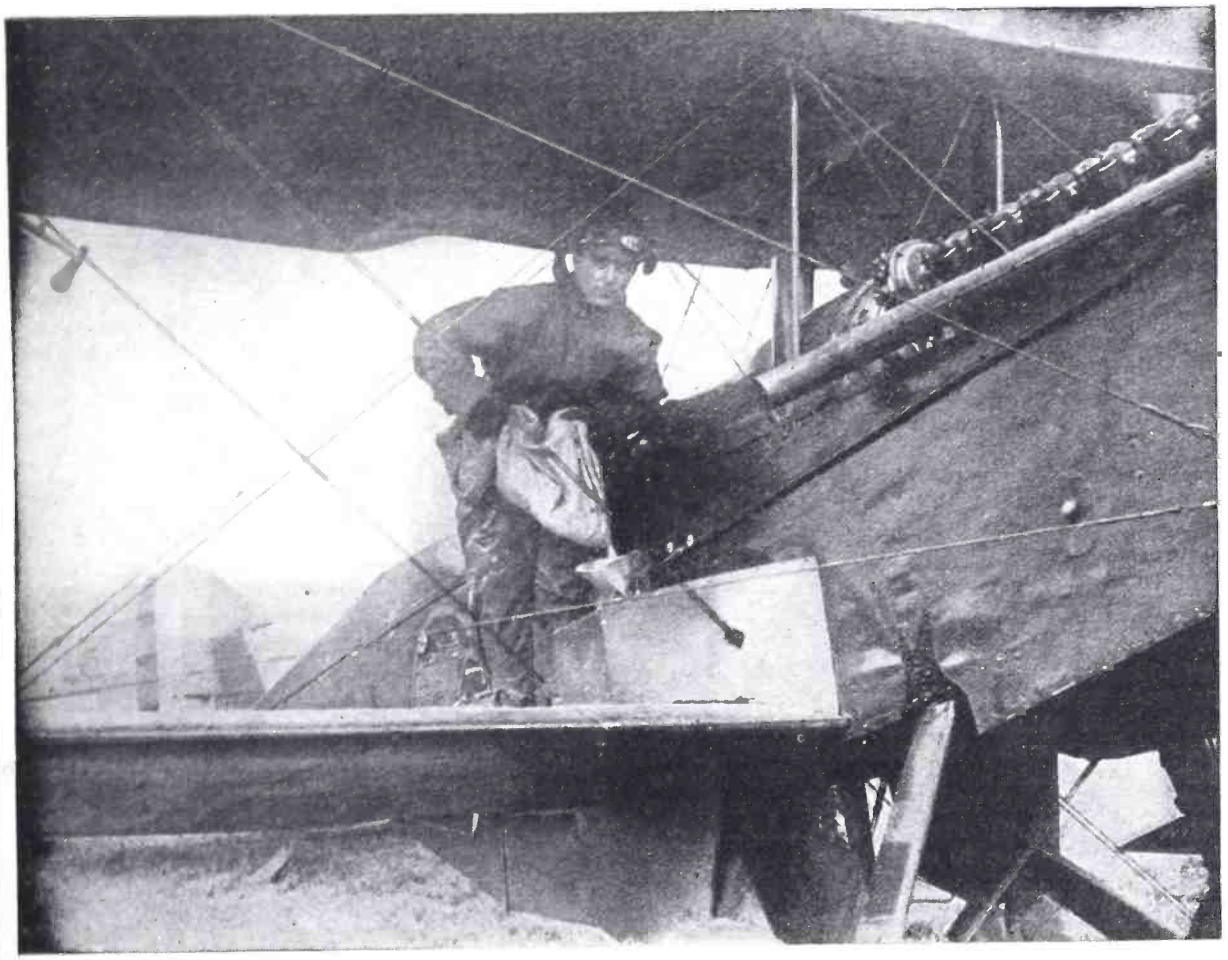
"Selenium melts at 217 degrees, Centigrade, and on cooling returns to the black, glassy, non-conducting state. Such melting must.



From a drawing made for POPULAR RADIO by Arthur Merrick

HOW THE SELENIUM CELL LOOKS WHEN COMPLETED

The gray surface is the selenium that covers the groove beneath as indicated by the white lines. The black surface is the graphite-coated slate divided into two insulated parts by the white line. The white strips of metal on both sides make contact with these two graphite surfaces.



Wide World Photos

CAN RADIO POWER CONTROL THE WEATHER?

According to the process of Dr. Warren and Dr. Bancroft, sand that is highly charged with electricity may be sprinkled from an airplane to help condense the clouds or fog below. The U. S. Army Air Service has been testing the process.

therefore, be carefully avoided. While making the slate gradually hotter, watch for the appearance of black spots in the gray selenium. If you see one forming, whip off the slate onto the cold slab. The black spot will then often disappear by re-crystallizing. In any case you will be near the melting point.

"The final cooling on the cold slab must be accelerated by moving the slate about on the slab, as otherwise the selenium is likely to become 'hygroscopic' and attract moisture.

"As soon as the slate is cool it is ready for mounting and testing. A simple mounting is shown in the figure. The lightest contact between metal and graphite is as good as the heaviest, so long as it is secure. The metallic leads should not touch the selenium coating."

Can Radio Power Control the Weather?

THE more or less startling suggestion that this may be possible has been made recently by Mr. G. H. Daly.* It is well known, Mr. Daly reminds us, that rainstorms are accompanied by powerful electric phenomena. The atmosphere is not merely a lot of air with some water vapor in it; it is also the seat of mighty electric forces and electric changes. Why not bring man-made electric forces, in the form of powerful radio waves, to bear on the electric phenomena of the atmosphere? Possibly thus man could make rain or prevent rain, at will.

It is a hardy prophet nowadays who will attempt to set any limit to what radio might do but the suggestion of Mr. Daly seems to stretch a good many points somewhat farther than they ought to go. It is quite true that the atmosphere is full of a vast number of electric charges, motions and fields. It is equally true that these electric charges have much to do with producing and preventing rain, hail, snow and other varieties of "weather." It is true, even, that Dr. Francis L. Warren, of Harvard, and Dr. Wilder D. Bancroft, of Cornell, have perfected a method of dissipating fog or cloud by means of highly electrified sand discharged from an airplane.

But this airplane attack on clouds has never produced more than a few drops of actual

* "Controlling the Weather by Wireless," by G. H. Daly, *Popular Wireless* (London), vol. 6, pages 647-653 (November 15, 1924).

rain, if that. Nor does it destroy a whole bank of cloud. It merely cuts a path through the cloud where the electrified sand particles actually hit it. In theory, such a small path might cause a general precipitation of the water in the cloud layer, but in practice this does not seem to occur.

The reason is, apparently, that the electric forces involved in the formation of raindrops from the droplets of a cloud, or in other atmospheric phenomena, are so incomparably greater than the amounts of electricity which man is accustomed to control that our puny efforts are of no real effect at all. In a series of interesting articles on the relations of atmospheric electric charges to balloons, Mr. A. Baldit has pointed out that millions of volts and hundreds of thousands of kilowatts are the units we must use if we wish to discuss the vast — although widely diffused — electric charges of the air.†

It is in the highest degree unlikely that the feeble energy of present-day radio waves will have the slightest effect on these tremendous forces in the atmosphere. Indeed, from the psychological point of view, it may be unfortunate to have this viewpoint get into the public mind at all. There have been allegations in Europe that the present prevalence of radio is spoiling the climate. Public clamor against this or that scientific activity has arisen in the past from far less basis than Mr. Daly's suggestion, improbable as it is.

† "The Free Balloon and Atmospheric Electricity," by A. Baldit, *La Nature* (Paris), vol. 52, pages 209-213, 225-228, 241-246 (October 4, 11 and 18, 1924).

Stations for Checking Wavelength Standards

THE Bureau of Standards has issued another revised list of American broadcasting stations which hold to their specified wavelengths so accurately that they may be used for the standardization of radio receivers or of ordinary wavemeters. The list, as issued by the Bureau,* is given at the bottom of this page.

* *Radio Service Bulletin* (U. S. Department of Commerce, Washington, D. C.), number 91, page 26 (November 1, 1924).

Cracking the Atom

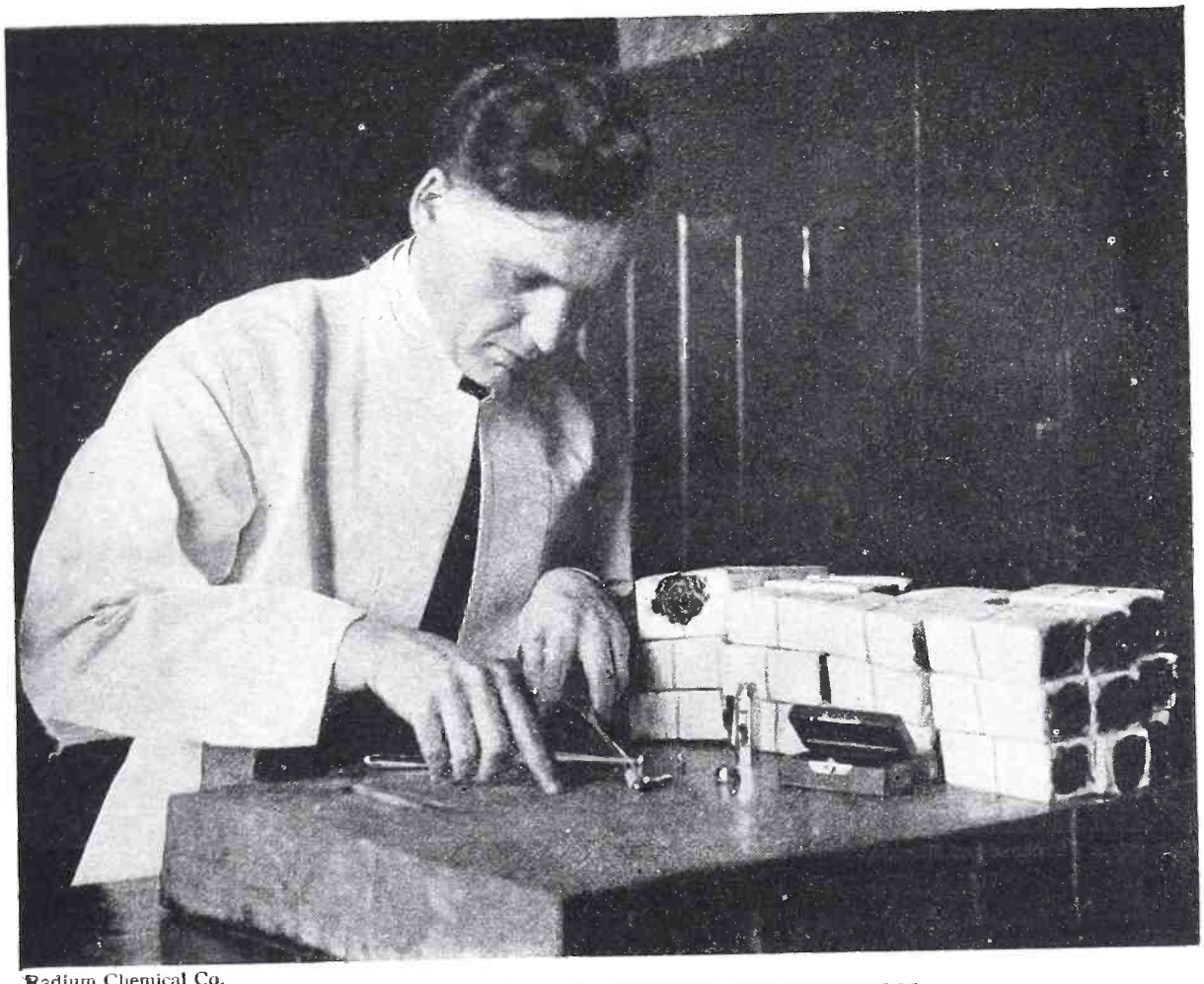
A FEW weeks ago Professor T. F. Wall of the University of Sheffield, England, announced in the newspapers that he was about to attempt to disrupt an atom. Instantly there spread over Great Britain so strong a feeling of alarm that many persons telegraphed to the newspapers and to Professor Wall himself begging that the experiment be not attempted. Someone had said that atomic disintegration might be contagious. If Professor Wall succeeded in disrupting one atom, *all* atoms might fly apart in consequence. The earth and everything on it might dissolve in one atomic holocaust into a cloud of electronic dust.

This, of course, was utter foolishness. There is no more reason to expect that atomic disintegration in the laboratory would extend to matter in general than there is to imagine that smelting some iron ore in a furnace would instantly turn all the iron ore in the world into iron. But back of this bit of public hysteria there is, it seems, a real and important piece of scientific endeavor. Professor Wall describes it in a recent issue of that admirable magazine of popular science, *Discovery*.*

The possibility of breaking down the structure of an atom has been apparent ever since the discovery of the nature of radioactivity opened our eyes to the real constitution of matter. We believe that all atoms are composed of smaller particles; the protons and the electrons. Separate these particles and we have disrupted the atom. All this is familiar

* "An Attempt to Break Down the Structure of the Atom," by T. F. Wall. *Discovery* (London), vol. 5, pages 289-292 (November, 1924).

Station	*Owner*	*Location*	*Assigned frequency (kilocycles)*	*Wavelength*	*Average deviation from assigned frequency*	*Greatest deviation from assigned frequency since Sept. 20, 1924*
				Meters	*Percent*	*Percent*
NSS	United States Navy.....	Annapolis, Md.....	17.50	17,150	0.2	0.6
WGG	Radio Corp. of America..	Tuckerton, No. 1, N.J.	18.86	15,900	.2	.2
WII	Radio Corp. of America..	New Brunswick, N. J.	22.04	13,600	.2	.1
WSO	Radio Corp. of America..	Marion, Mass.....	25.80	11,630	.3	.2
WWJ	Detroit News.....	Detroit, Mich.....	580	517	.1	.5
WCAP	Chesapeake & Potomac Telephone Co.....	Washington, D. C...	640	469	.1	.2
WRC	Radio Corp. of America..	Washington, D. C...	640	469	.1	.2
WSB	Atlanta Journal.....	Atlanta, Ga.....	700	429	.1	.7
WGY	General Electric Co.....	Schenectady, N. Y...	790	380	.2	.1
WBZ	Westinghouse Electric & Manufacturing Co.....	Springfield, Mass....	890	337	.0	.1
KDKA	Westinghouse Electric & Manufacturing Co....	East Pittsburgh, Pa..	920	326	.1	.1



Radium Chemical Co.

$75,000 WORTH OF ATOMIC DISRUPTION

Inside the tiny tube in front of the operator is radium worth $5,000. The packages at the left contain other tubes ready for shipment to hospitals and physicians. The value of this radium is due entirely to the fact that its atoms disintegrate and send out the curative rays.

to readers of POPULAR RADIO from the numerous articles on atomic structure that have appeared in these columns in the past two years.

About two years ago, indeed, two experimenters at the University of Chicago believed that they had succeeded in disrupting the atom of tungsten by exposing very fine tungsten wires to enormous electric currents. The wires literally exploded. Helium gas was found—or was believed to be found—in the space in which the wire had been. It was assumed that some of the tungsten atoms had burst apart, helium being one of the products.

Unfortunately, the careful repetition of this experiment at the University of Chicago† and at the Mount Wilson Observatory, in California,‡ led to negative results. It is still uncertain whether the tungsten atoms really were disrupted or not. But meanwhile Dr. Ernest Rutherford and his assistants at Cambridge, England, have succeeded in disrupting thirteen different atoms by bombarding them with the fast-moving particles that fly out of radium.§ One of the products of the disruption is hydrogen and this is the only product that has been identified. To this extent, at least, atomic disruption is an accomplished fact.

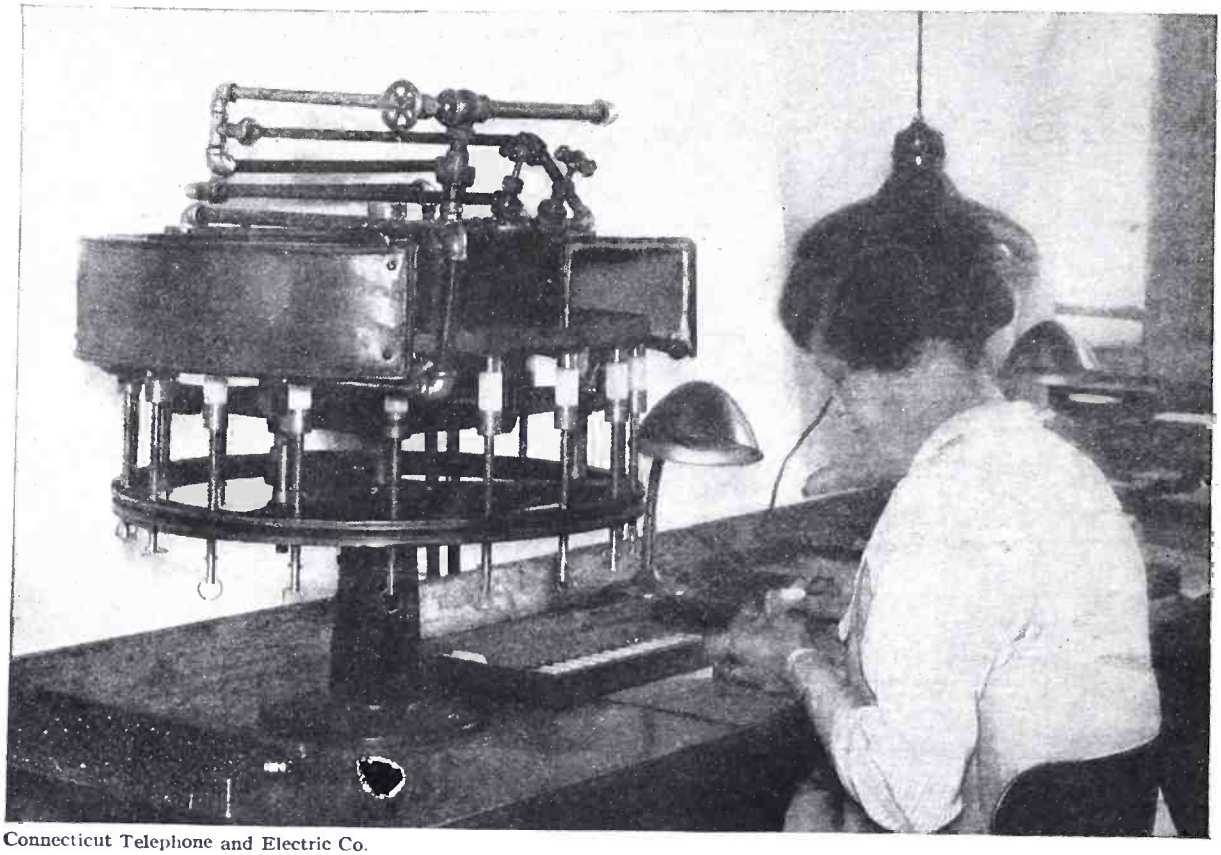
The disruptions accomplished by the aid of the radium particles occur on so small a scale that it is difficult to tell anything about them. More important, if true, is the atomic transmutation said to have been accomplished by Professor Adolf Miethe, of Charlottenburg, Germany. Professor Miethe, as every newspaper reader knows, believes that he has transmuted mercury into gold. In the mercury inside a mercury-vapor lamp, after some 200 hours of operation, Dr. Miethe¶ found traces

† "The Absence of Helium from the Gases Left After the Passage of Electrical Discharges," by S. K. Allison and William D. Harkins. *Journal of the American Chemical Society* (Easton, Pa.), vol. 46, pages 814-824 (April, 1924).

‡ Noted in a report of the Observatory in *Popular Astronomy* (Northfield, Minn.), vol. 32, page 152 (March, 1924).

§ POPULAR RADIO for January, 1924, page 88.

¶ Professor Miethe published a brief preliminary description of his experiments in *Die Naturwissenschaften* (Berlin) for July 18, 1924.



Connecticut Telephone and Electric Co.

WHERE THE SODION ION DETECTORS ARE MADE

This picture shows one of the stages in the manufacture of the sodion detector tube—the newest form of which will fit into standard sockets in radio receiving circuits.

of gold. He believes that the long exposure of the mercury atoms to electric stress converted some of them into gold atoms. It is highly desirable that this experiment be repeated by other scientists and this is now being done, in America, under the direction of Professor H. H. Sheldon of New York University.

Professor Wall proposes to attack the structure of the atom in still a different way. Instead of using heat plus electricity, as the Chicago scientists did, or electricity alone, as Professor Miethe did, Professor Wall proposes to use magnetism. The revolving electrons inside an atom probably behave, as all moving electric charges do, as though they were magnets. It ought to be possible, Professor Wall thinks, to bring to bear on these internal electrons of an atom, magnetic fields strong enough to drive the electrons out of their paths and cause the atom to fly apart.

In order to obtain the immensely powerful magnetic fields which he needs Professor Wall proposes to use condensers of large capacity. These will be discharged suddenly through a coil surrounding a magnetic core. This causes a momentary but enormously intense magnetic field at the point where the field of this coil is concentrated. Here the atoms to be disrupted are placed. It is hoped that some signs of breakdown will be obtained but none have been reported as yet.

Whether Professor Wall succeeds in this experiment or not, whether or not Professor Sheldon confirms the gold-making experiment of Professor Miethe, we are approaching step by step a better knowledge of how to attack and control these forces and particles inside the atom. We may be sure that atoms will be "cracked" successfully some day, even if not as a result of the experiments now under way.

An exclusive article by Professor Wall will appear soon in POPULAR RADIO.

The Sodion-Ion Detector in a New Form

THE sodion detector tube, a tube operated by atoms of metallic sodium each of which has lost one electron and become a sodium "ion," was described in this Department of POPULAR RADIO in March, 1924. The original form of this tube would not oscillate nor would it fit, without modification of the circuit, into most of the standard receiving hook-ups. To overcome these handicaps to public favor the makers of the Sodion tube have now devised a new type of the tube which will oscillate, may be inserted as a detector in place of the usual tube in any circuit and will fit into the standard tube socket. Three of the new tubes have

been tested by the technical department of *QST* and the results are now reported.*

One of the characteristics of the original Sodion tube was, it will be remembered, that it contained no grid, the usual function of the grid being carried out by a third, semi-cylindrical electrode called the "collector." In the new tube this collector appears to have been replaced by a grid-like cage of wire placed between the filament and another cage of wire which serves as plate. Otherwise the tube is not much altered. It is still necessary to run it hot in order to vaporize the sodium atoms upon which its operation depends. The heating is done, as before, by a coil of wire around the glass bulb which contains the vacuum. This bulb is contained, in turn, in an outer glass shield which is not airtight but which serves as a protection. The filament is novel in that it is made of tantalum wire instead of the more usual tungsten.

According to the tests reported the mutual conductance of the tube was 260 microhms, the plate impedence was 51,000 ohms and the voltage amplification was 22.36.

* "The New Sodion D-21 Detector," anonymous. *QST* (Hartford, Conn.), vol. 8, number 5, pages 23-26 (December, 1924).

Are the Blood Corpuscles Minute Condensers?

THE most important constituents of human blood, as well as of the blood of other red-blooded animals, are the tiny red corpuscles or "blood cells," many millions of which are contained in a single drop of the living fluid. It is these red cells that give the color to the blood; it is by their aid that the blood carries oxygen from the lungs to the tissues of the body; physicians use the number and character of these red corpuscles to assist their diagnosis of disease. Few parts of the human body are more essential or more interesting than these minute red-colored specks of living matter that float about in our arteries and veins.

It has long been suspected that these cells have electric properties that are important to the proper discharge of their functions in the body. All living matter is more or less electrical in its nature. It is a perversion of this idea that led to the exploded Abrams delusions which were mentioned in this Department last month. The Abrams ideas are wrong—perhaps purposely and fraudulently wrong—but that must not blind us to the fact that there exist some real electric properties of living matter which it is the task of orthodox science to investigate and, if possible, to put to use.

One interesting observation with especial reference to the electric properties of the red corpuscles of the blood has been published recently by Professor J. F. McClendon, a well-known physiological chemist of the University of Minnesota.* Professor McClendon has measured the electric conductivity of a mass of red blood corpuscles extracted from the blood of an ox, using both direct current, and alternating current of 1,000 cycles a second as well as a current of one million cycles a second. At 1,000 cycles the conductivity is about the same as for direct current, but at one million cycles (corresponding to a radio wave of 1,000 kilocycles or 300 meters) the conductivity of the red blood cells comes out about 40 percent greater than at the lower frequency.

As this is only a preliminary experiment, Professor McClendon is properly careful about committing himself to any specific explanation of this fact, but he suggests the one that will occur immediately to any radio engineer, namely, that each red blood cell is a tiny condenser, the wall of the cell being non-conducting while the interior mass of fluid or whatever it is, is a fairly good conductor. A simple analogy would be a small rubber sack filled with dilute sulphuric acid or with salt water.

If this is really the electric nature of the red blood cell it is apparent that a direct current cannot pass through the cells at all. It will traverse blood by way of the solution in which the red cells are floating, passing, as it were, through the chinks between the red cells. The same will be true, to an approximation, for alternating currents of low frequency, as, for example, the 1,000-cycle current that Professor McClendon used.

But for high-frequency currents the condenser action of the corpuscles will come into play. The electric alternations, analogous to radio "waves," will pass through the corpuscles themselves, just as a radio-frequency wave will pass through a low-capacity condenser.

If this conclusion is confirmed by later work and if such a condenser action proves to be a general property of the living cells elsewhere in the body as well as in the blood, we will have taken a long step toward understanding the mysterious effects of high-frequency currents and waves on the human body as well as the electric relations of life itself.

* "Electric Conductivity of Red Blood Corpuscles Using High Frequency Alternating Currents," by J. F. McClendon. *Science* (Lancaster, Penna.), vol. 60, page 204 (August 29, 1924).

The Next "How to Get the Most Out of Your Ready-made Receiver" Article

¶ *The third article of this helpful series will tell you how to get the most out of a Melco Supreme Tuned-radio-frequency Receiver. This receiver has five tubes and is one of the latest models with an inclined panel. In a near issue of* POPULAR RADIO.

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

JACKS

Jacks; Pacent Electric Co.
Jack, Saturn Mfg. and Sales Co., Inc
Union tip jack; Union Radio Corp.
Jacks; Yaxley Mfg. Co.

GRID LEAKS AND RESISTANCES

Cartridge resistances; Pacent Electric Co.
Grid leak and condenser; Pfanstiehl Radio Service Co.
Resistron; Temple Instrument Co
"Turn it" adjustable grid leak; Turn it Radio Sales, Inc.
Variable grid resistances; Walnart Electric Mfg. Co.
Royalty variable grid leak; Wireless Products Corp.
Royalty resistance units; Wireless Products Corp.
Resistance Unit; Yaxley Mfg. Co.

FIXED CONDENSERS

Condenser and grid-leak; Pfanstiehl Radio Service Co.
"Build-up" mica condensers; Charles Schindler.
Fixed condenser; Stafford Radio Co.
Fixed condenser; Walnart Electric Mfg. Co.
Fixed condenser; Yaxley Mfg. Co.

BATTERY CHARGERS AND RECTIFIERS

Rumbold battery chargers; P. C. Rumbold.
Portable rectifier; Sterling Mfg. Co.
Valley battery charger; Valley Electric Co.

BATTERIES

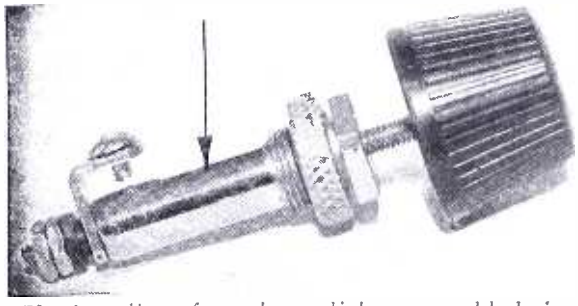
Jumbo battery; Primary Mfg. Corp.
Rabat rechargeable wet "B" Batteries; Radio Rabat Co.
Sidbenel "B" batteries (wet); Sidbenel Electric Co.
Fam dry batteries; Twin Dry Cell Battery Co.
USL radio "A" and "B" batteries; U. S. Light & Heat Corp.
KB "B" battery; Universal Battery Co.
Westinghouse crystal case "A," "B" and "C" batteries; Westinghouse Union Battery Co.
Willard radio batteries; Willard Storage Battery Co.
Wizard "A" and "B" batteries; Wizard Battery Co.
World storage "A" and "B" batteries; World Battery Co.

VARIABLE CONDENSERS

Thordarson variable condenser; Thordarson Electric Mfg. Co.
U. S. Tool variable condenser; U. S. Tool Co., Inc.
Variable condenser; United Scientific Labs., Inc.
Variable condenser; The Westwyre Co.

TUNING INDUCTANCE UNITS

Trurney's spider-web plex coils; Tristan Sales Corp.
Uncle Sam master tuning coil; Uncle Sam Electric Co.
Work Rite variometer; Workrite Mfg. Co.
Work Rite variocoupler; Workrite Mfg. Co.



Single pile of carbon disks assembled in a metal cylinder

A VARIABLE RESISTANCE ELEMENT OF CARBON

Name of instrument: Filament rheostat.
Description: A variable resistance element composed of a number of carbon-material disks. By adjusting the pressure upon the pile, the resistance is controlled. A screw and attached knob is used for this purpose. All exposed metal parts are nickelplated. The disks are held in a metal cylinder.
Usage: In a filament circuit for controlling the filament current.
Outstanding features: A single-pile rheostat, with pressure control. Single-hole mounting.
Maker: Marshall Electric Co.

SWITCHES
Filament lock switch, Walbert Mfg. Co.
Switch, Walnart Electric Mfg. Co.

SOCKETS AND ADAPTERS
U. T. socket, Union Radio Corp.
Safety rim socket, Walbert Mfg. Co.
Walnart socket, Walnart Electric Mfg. Co.

RHEOSTATS
Unity vernier rheostat, Unity Mfg. Co.
Rheostat, Wilcox Laboratories.
Work Rite vernier rheostat, Workrite Mfg. Co.
Rheostat, Yaxley Mfg. Co.

RADIO CABINETS
De Luxe radio cabinets; Utility Supply Co.
Radio cabinet furniture; Whaling Wood Products Co.
Windsor loudspeaker console, Windsor Furniture Co.

A RADIO FREQUENCY TRANSFORMER IN VACUUM

Name of instrument: Radio-frequency transformer.

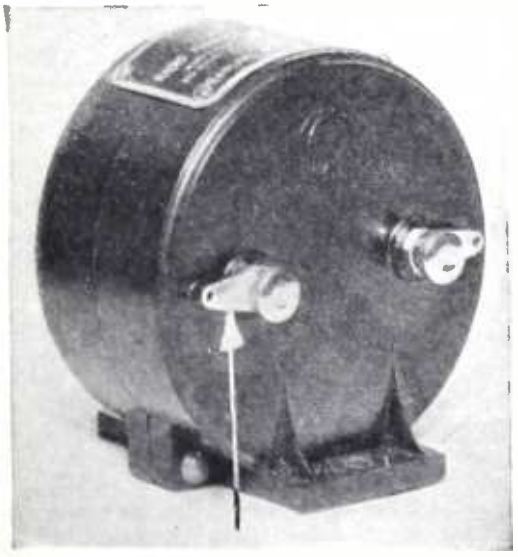
Description: A transformer designed for radio-frequency amplification on wavelengths slightly higher than those ordinarily used for broadcasting (about 1,200 meters). The transformers are matched up to the same frequency and have a sharp resonance curve. The coils are dry, and are demoisturized and retained in a vacuum tube. Neatly mounted on a bakelite base.

Usage: In a medium wave radio-frequency amplifier or in a superheterodyne receiver for inter-stage coupling.

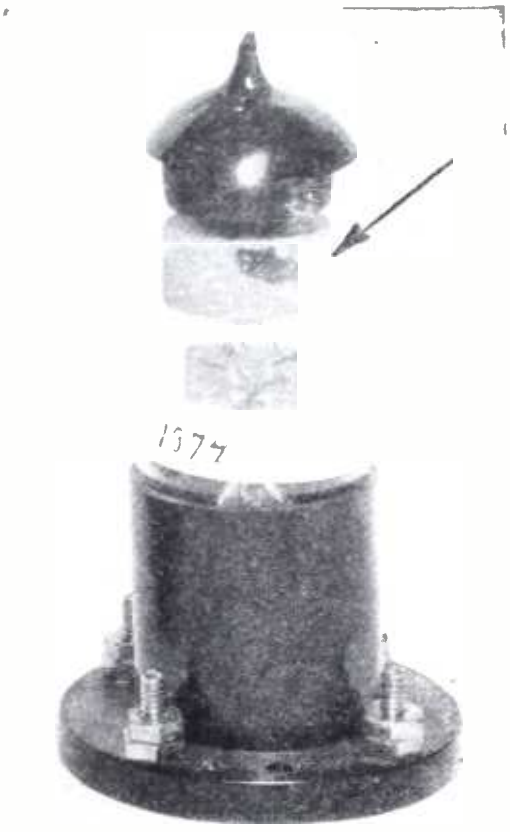
Outstanding features: Coils dry wound and dehydrated in a vacuum. Low distributed capacity windings. Sharply peaked resonance.

Maker: St. James Laboratories, Inc.

TUBES
Universal tubes; Universal Radio Laboratories.



Equipped with soldering lugs



Dry-wound and dehydrated coils in a vacuum

HEADPHONES
Tower's Scientific headset; Tower Mfg. Co.
Ambassador phones; Tower Mfg. Co.
Berwick Supreme headphones; Triangle Electro Trading Co.
Trimm headsets; Trimm Radio Mfg. Co.
Professional headset; Trimm Radio Mfg. Co.
Dependable headset; Trimm Radio Mfg. Co.
Amplitone phones; Union Fabric Co.
Warren phones; Warren Radio Phone Mfg. Co.
Work Rite concert headset; Workrite Mfg. Co.

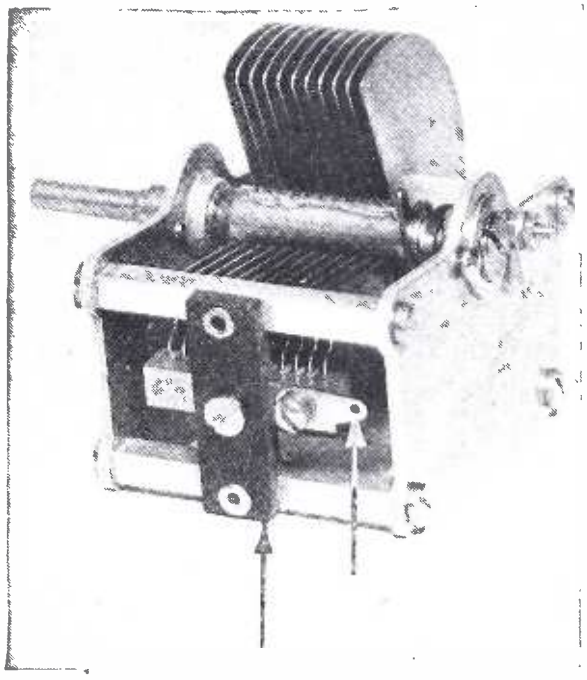
DIALS
Dial; Trufix Radio Products Co.
Knob and dial; Walbert Mfg. Co.
Dial; Walnart Electric Mfg. Co.
Work Rite E-Z-Tune dial; Workrite Mfg. Co.
Knobs and dials; Yaxley Mfg. Co.

A MEDIUM FREQUENCY TRANSFORMER

Name of instrument: Radio-frequency transformer.

Description: A transformer designed for radio-frequency amplification at a longer wavelength than that used for ordinary broadcasting. The workmanship on the coils, the general construction, and the design are of the highest order and make the instrument a suitable one to be included in the intermediate stages of the superheterodyne amplifier. The coils and leads are inclosed in a moulded bakelite shell, with the terminals brought out to soldering lugs.

Usage: In a high wave radio-frequency amplifier or in a superheterodyne receiver for inter-stage coupling.



Hard rubber insulating strip. Equipped with soldering lugs

MISCELLANEOUS ACCESSORIES

Insurtube, Terlee Electric & Mfg. Co.
Dial adjusters; Union Radio Corp.
Unity electric soldering iron; Unity Mfg. Co.
Soldering kit, Valley Forge Chemical Co.
Solder flux and rosen core solder; Valley Forge Chemical Co.
"Cross Country" circuit (parts and instructions): Vesco Radio Co.
Univernier; Walbert Mfg. Co.
Lettered binding posts; Walnart Electric Mfg. Co.
Adjuster; Walnart Electric Mfg. Co.
DX-10-Point antenna wire; Xandell Corp.
Westwyre soldering iron, The Westwyre Co.

LOUDSPEAKERS

Thompson Magnaphone, R. E. Thompson Mfg. Co.
Timbretone loudspeaker; Timbretone Mfg. Co.
Timmons Talkers; J. S. Timmons.
Berwick Supreme loudspeaker; Triangle Electro Trading Co.
Concert model speaker; Trimm Radio Mfg. Co.
Homespeaker; Trimm Radio Mfg. Co.
Trinity loudspeaker; Trinity Radio Corp.
Black Beauty reproducer; United Radio Corp.
Van-Le reproducer; Van Le Corporation.
Professional reproducer; Voluma Products, Inc.
Moon loudspeaker; Wilson Utensil Co.
Work Rite concertrola; Workrite Mfg. Co.

KITS

Superheterodyne kit; Victoreen Radio, Inc.

Outstanding features: A well-made instrument with a good amplification factor and suitable resonance curve.
Maker: Rauland Mfg. Co.

A NEW MODEL OF AN OLD FAVORITE

Name of instrument: Variable condenser.
Description: A condenser of the grounded-rotor type with the insulation spaced so that it is not in the dense part of the electrostatic field. Only two insulating pieces are used. The design of the bearing is excellent and the rotation so smooth that a good regular capacity curve is assured. The losses at high frequencies are negligible.
Usage: In any radio-frequency circuit for tuning.
Outstanding features: Rigid construction and careful workmanship. Low loss. Good connections.
Maker: Hammarlund Mfg. Co.

AUDIO-FREQUENCY TRANSFORMERS

Interstage power amplifying transformer; Thordarson Electric Mfg. Co.
Thordarson super audio-frequency transformer; Thordarson Electric Mfg. Co.
United audio-frequency transformer; United Mfg. & Dist. Co.

CRYSTAL DETECTORS

Velvetip Crystal detector; Wholesale Radio Equipment Co.

RECEIVING SETS

Thompson neutrodyne receiver; R. E. Thompson Mfg. Co.
Sectional radio outfits; Tresco Radio.
Tuska receiver: C. D. Tuska Co.
Radiodyne receiver; Western Coil & Electrical Co.
Elf crystal receiver; The Westwyre Co.
Zenith receivers; Zenith Radio Corp.

POTENTIOMETERS

Potentiometer; United Scientific Labs., Inc.
Potentiometer; Yaxley Mfg. Co.

PHONOGRAPH ATTACHMENTS

Dulcetone; Teagle Co.
Trimm phonograph attachment; Trimm Radio Mfg. Co.

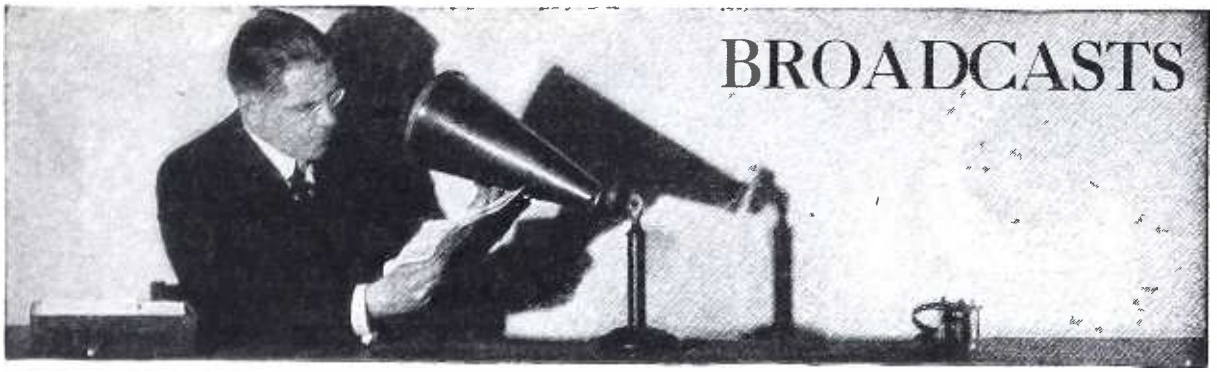
PHONE PLUGS

G. W. 5-circuit plug; G. E. Walker Co., Inc.
Plug; Yaxley Mfg. Co.

PANELS

Celesto shadow black panels; Triangle Rubber & Supply 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 through the letters T and Z. Next month the department will begin listing manufacturers whose names begin with the letters A to C. This list will also include new apparatus and parts that have been tested in the laboratory since the first installment appeared.



CONDUCTED BY DAVID LAY

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

DX Stamps to Verify Reception Claims

HEREAFTER, the radio listener will have to exhibit proof of his claims of long-distance reception by presenting a "verification stamp." Some of the principal broadcasting stations in the country have launched a plan that promises to furnish a new hobby to the radio public and the DX fan. Each station has a supply of steel engraved stamps, printed in different colors for the stations on different wavelengths. To receive one of the stamps the fan must write in to the station giving the time he heard it broadcast and the numbers he picked up. The station staff will then check back on its records to verify the numbers reported. If the report is correct the fan will receive a stamp that bears the call letters of the station.

* * *

Metronome Helps Listeners to Tune In

THE Breslau broadcasting station in Germany has established a loud-ticking metronome in its station. This is operated for some time before the regular program is broadcast. The ticks enable listeners to distinguish clearly the loudness of the signals and to tune in before the programs are broadcast.

* * *

Fans Offer to Buy CW Set for Government Ship

A GROUP of broadcast listeners around New York City has offered to purchase a CW transmitting set for one of the Government ships that has been creating havoc with amateurs through its spark transmitter. They have forwarded a letter to the Postmaster-General, requesting that the Post Office Department get rid of the obsolete spark transmitting equipment on the U. S. mail boat *President*. This is a matter of concern to radio listeners along the vast coast lines and the Great Lakes region of the country, for a large percentage of ship-to-shore traffic is carried on almost altogether by the spark transmitting system.

Radio a Government Monopoly?

A PROPOSAL for making radio broadcasting in France a government monopoly was announced in the Chamber of Deputies a short time ago by one of the secretaries of the government bureau that controls the post office, and the telegraphs and telephones. The Chamber has passed a bill covering this proposal and has sent it to the Senate. This is particularly significant to Americans, coming as it does at the same time as the decided stand assumed by Secretary Hoover against government operation.

* * *

Ship at the Pole Hears 'Frisco

IN the early part of December, a Norwegian ship 15 degrees from the South Pole reported hearing station KFS at San Francisco. Unsuccessful attempts were made to establish two-way communication. This is one of the longest north-and-south records made.

* * *

A Gong Announces Radio Programs

THE crash of a big brass gong is sounded by the Hamburg station in Germany for introducing its programs. After each number two-minute intervals are recorded by two strokes on the gong, to assist listeners in tuning. These are followed by a single stroke that announces the beginning of a new selection. A news bulletin in English is broadcast every night at 10.50 Greenwich time (about 6 P.M. Eastern time) on a 387 meter wavelength.

* * *

"Radio Pistol" Summons Aid

A MINIATURE transmitter has been invented by an Englishman who designed it to be carried on the person and operated like discharging a pistol in the event of a hold-up or an emergency. The signal thus transmitted can be received at short distances so that the police could recognize the characteristic note of this type of set at listening-in stations.

Musical Tryouts by Radio

MR. PAUL SPECHT, an American musician who recently completed an English concert tour with his band, has recommended some additional American bands and orchestras for English engagements. In order that the British agents may hear these bands and judge them without the necessity of crossing the ocean Mr. Specht will arrange, it is announced, that the performance of these bands will be broadcast in New York, picked up in England, and submitted to the agents in that way.

* * *

New Telephone Receiver Hangs on the Ear

A NEW form of telephone receiver for radio use has appeared on the market in Germany. It is very light and the receiver proper is surrounded by a thin cap of rubber, the opening in which is large enough to permit the whole contrivance being hung on the ear.

* * *

American Concert is Relayed to South Africa

A NUMBER of American broadcast programs have been picked up recently in England and re-radiated by the British stations to their local audience. One of these seems to have reached across the equator to South Africa. A listener in Capetown writes to the *Wireless World* (London) saying that he heard it.

* * *

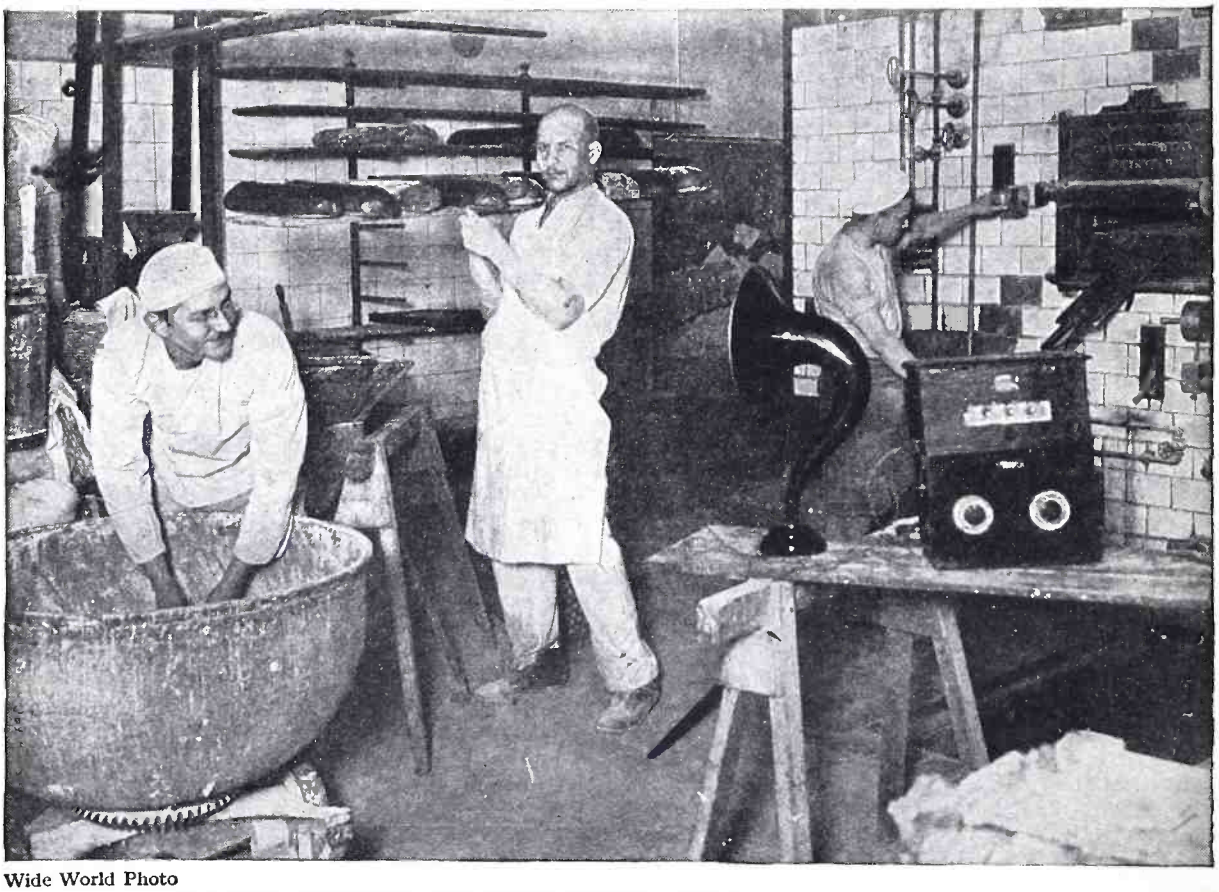
Radio Has Tallest Concrete Structure in the World

THE distinction of being the tallest masonry structure in the world, long possessed by the great smokestack of the copper smelter at Tacoma, Washington, has been lost, says the *Engineering and Mining Journal* (New York) to the concrete tower of the radio station belonging to the Japanese Government, the station that did such good service after the recent earthquake. This tower is 660 feet high. The Tacoma smokestack is only 573 feet high.

* * *

Spain Joins the Radio Procession

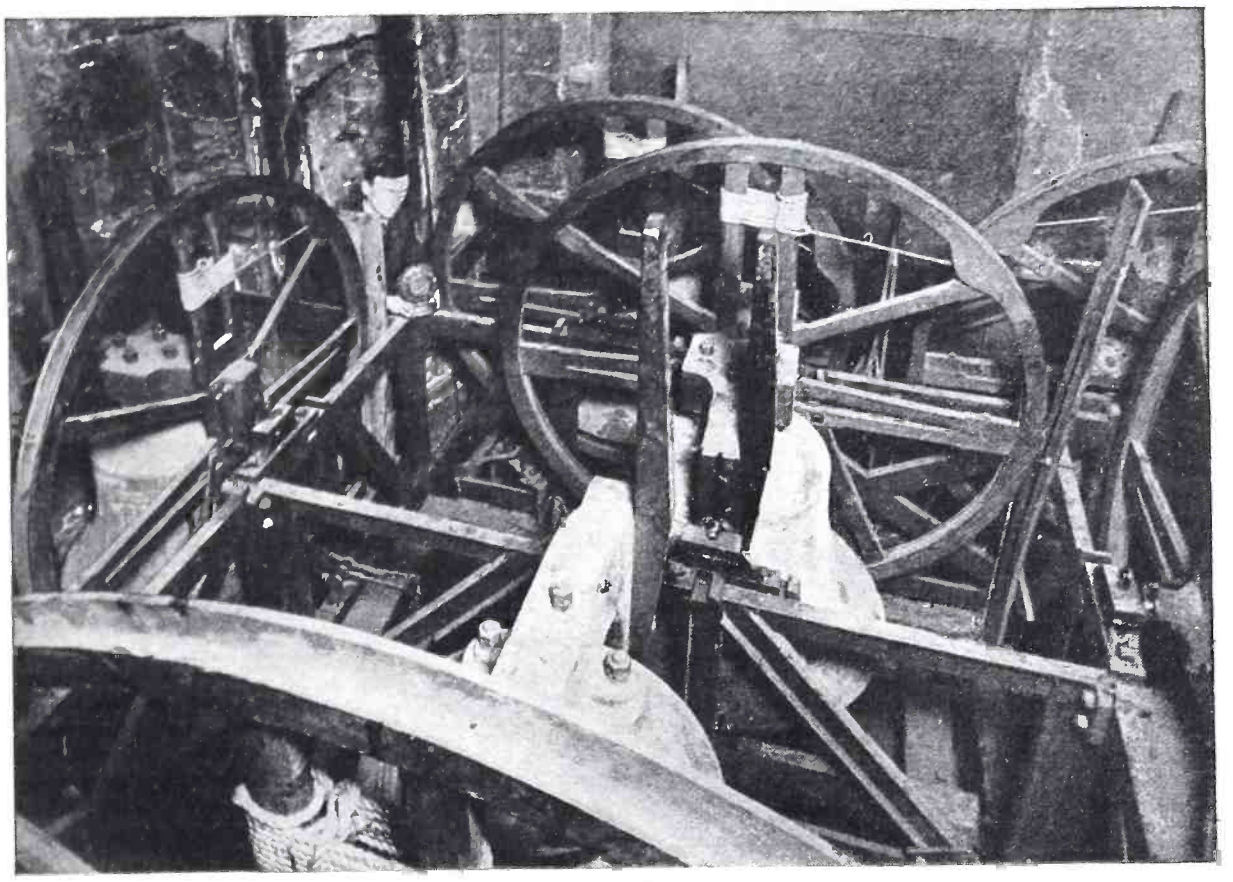
SPAIN has given a concession for radio broadcasting and for the manufacture of radio apparatus. As soon as the necessary transmitting stations can be erected local programs will be broadcast from a studio near Madrid and British concerts will be picked up and relayed. PTT (Madrid) is already operating.



Wide World Photo

RADIO SPEEDS UP THE WORK IN A BERLIN BAKERY

Music has long been recognized by efficiency experts as a factor in making lighter the burdens of those who labor with their hands. Here is a snapshot in a workroom in which a radio receiver is part of the equipment.



Underwood & Underwood

BROADCASTING THE BELLS OF ST. CLEMENT

For the first time, the old nursery rhyme, "Oranges and Lemons," was broadcast by the bells of St. Clement Danes Church, Strand, London. It was quite a problem to locate the microphone so as to get clear reproduction of the bells and yet eliminate the vibration of the woodwork and the mechanical noises.

Harnessing the Short Waves

STEP by step the scientists are completing the conquest of the radio waves that are shorter than one meter. From France comes the report that the cathode-ray oscillograph has recently been used successfully to detect and examine waves down to 30 centimeters long, a trifle over one foot. This means a frequency of one billion cycles a second.

* * *

Texas Has the Greatest Number of Broadcasting Stations

THE number of broadcasters in each state seems to be determined by a combination of population and area. Texas, which is the largest state though by no means the most populous, has the largest number of broadcasting stations, 42. But the second state is Pennsylvania, which is populous but not especially large. It has 41 stations. California, again a large state, is third, with 39; and Ohio, a populous one, is fourth with 30.

* * *

Ban on the Broadcasting of News

THE issuance of the first private transmitting license in India has just been announced. It has been granted to the Radio Club of Bengal. The broadcasting of concerts and weather reports is permitted, but it is expressly forbidden to broadcast anything in the nature of news.

* * *

An Effect of the Ice Age on Radio

"THE Ice Age was over, in this part of the world at least, some 30,000 or 40,000 years ago. Yet it has greatly influenced radio in the Chicago district." A recent statement issued by the U. S. Geological Survey remarks that the zones in and near Chicago where radio fans get good ground connections easily, as compared with other zones where ground connections are very difficult to obtain, are delimited by the materials—sand, gravel or clay—laid down by the great ice sheet that covered that part of the country during the Ice Age.

* * *

Music from Vacuum Tubes

THE making of musical devices employing the principle of the oscillating audion seems to have absorbed the energies of many experimenters this summer. At least five such outfits have been described in print and several others have been exhibited. All this was done by Dr. Lee de Forest years ago. His results and methods were described in POPULAR RADIO as long ago as November, 1922.

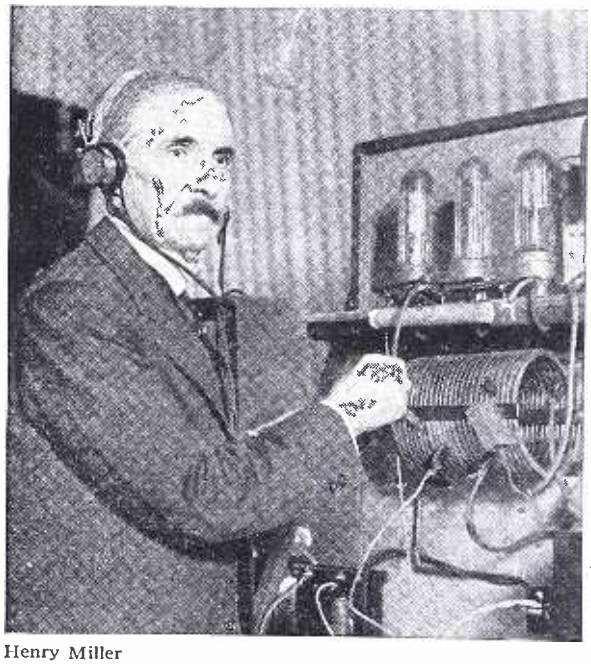
The Helping Ham

A HAPPY example of that kind of co-operation that has distinguished American radio amateurs was demonstrated on Election Night when a New York City fan copied election returns from WEAF and telegraphed them to station KGO at Denver. In announcing these gratuitous reports KGO publicly thanked the New York amateur for his assistance to Rocky Mountain listeners.

* * *

Does Change in the Tide Affect Wavelengths?

THE amateur radio station 1MO at Wiscasset, Maine, installed for the purpose of establishing communication with the schooner *Bowdoin* that brought back Captain Donald MacMillan from the arctic last fall had not been in operation more than twenty-four hours before mysterious changes were observed in the wavelength of the transmitter. The adjustments of the station were inspected, and a wavemeter was employed frequently to check the oscillations. Finally it occurred to the operator that, as the antenna and counterpoise had been suspended from the dock over the water, the tide might have something to do with the condition. Wavemeter readings taken at the ebb and flow of the tide, when compared, showed that in every case the wavelength increased with the rise of the tide and decreased with the fall. The operator believes the tide affected the capacity of the station's counterpoise.



Henry Miller

INVENTOR WINS IMPORTANT RADIO PATENT SUIT

After four legal battles with the Government, Dr. James H. Rogers of Hyattsville, Md., discoverer of an undersea radio communication method, won his rights to his patent. He is shown above with his submarine radio transmitter that was used during the war.

Thunderstorms Come in Cycles

A FRENCH scientist, M. l'Abbe Gabriel, has established to his own satisfaction the theory that thunderstorms, the bugbears of the radio fan, have a definite cycle of maximum and minimum activity. He has found that for a period of seven years electrical storms will be at a minimum; for the next twenty years they will appear at an average rate, followed by ten years of exceptionally heavy rain and electrical disturbances. To reassure radio amateurs he announces that we are just starting on the minimum period of this cycle, which should mean decreased static discharges for some years to come.

* * *

Where Are the Wild Wives Straying?

HAVE you lost either a wife or a bulldog? If so, you may apply for help to your local broadcasting station. According to an announcement from one of the largest stations, such appeals are numerous. Requests, indeed, for the return of lost dogs and lost wives at present are running about even. Husbands are either less prone to stray from the fireside or else they are not considered worth retrieving in this age of feminine independence, for so far no requests have been made to locate missing husbands.

* * *

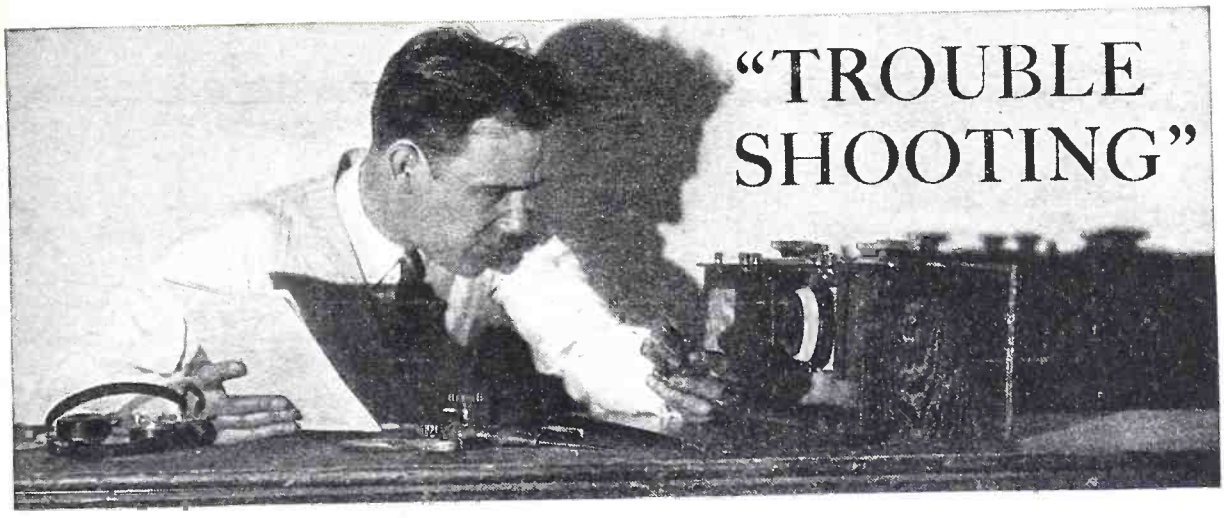
France Puts a Censor on the Air

RADIO communication in France will be subject to police supervision following a recent order of the Minister of the Interior. A special service has been organized at the Sureté General (which corresponds to our Department of Justice) whereby future air conversations and messages will be censored by the officials who will "listen in." The reason given for this movement is the possibility that the enemies of the country may use radio stations to spread harmful propaganda, as groups of foreigners have used various means to spread reports detrimental to French finance and credit, which has reacted on the Bourse.

* * *

Radio Race Around the World Won in Five Seconds

RADIO signals were sent around the earth in five seconds recently in a test that originated at high-power stations near New York City. The letter "S" was sent three times in a westerly direction and the letter "C" three times toward the east. The westward signals that started at Tuckerton, N. J., were relayed through San Francisco, Honolulu, Malabar, on the island of Java, London and Riverhead, N. Y. The eastward signals were sent out from Marion, Mass., through St. Aisse in France, Saigon in Indo-China, San Francisco and Riverhead, N. Y. The operators working the eastward signal won the race by a second. The race started in New York where keys controlled the distant transmitters.



"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.*

Hook-up Changes in the Pressley Superheterodyne Receiver

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

IT will be noted that there are some discrepancies between the text, the schematic diagram on pages 580 and 581, and the picture wiring diagram on page 582 in the December issue. While the connections as given in these three portions of the description will all work, best results will be found with the connections as shown in the picture wiring diagram on page 582, or on the picture wiring blueprint which is an exact duplicate of the diagram on page 582 but much larger in size. Therefore the builder of this receiver is advised to follow the picture diagram or the blueprint in wiring up the receiver. These are correct except that the numbers 1 and 2 on transformers L_1 and L_2 should be reversed. The instrument and panel layouts as shown in the descriptive article are correct, as are the panel and instrument layout blueprints.

The Use of UV-201-a or C-301-a Tubes in Place of the WD-12's

For those who wish to use six-volt tubes in place of WD-12's in the first five sockets of the Pressley Superheterodyne Receiver the hook-up is given in Figure 1. The only change required is to place the filaments of the tubes in parallel and to substitute 6 or 10-ohm rheostats for J1 and J2. Incidently, this is the correct schematic diagram of this receiver when used with 201-a tubes.

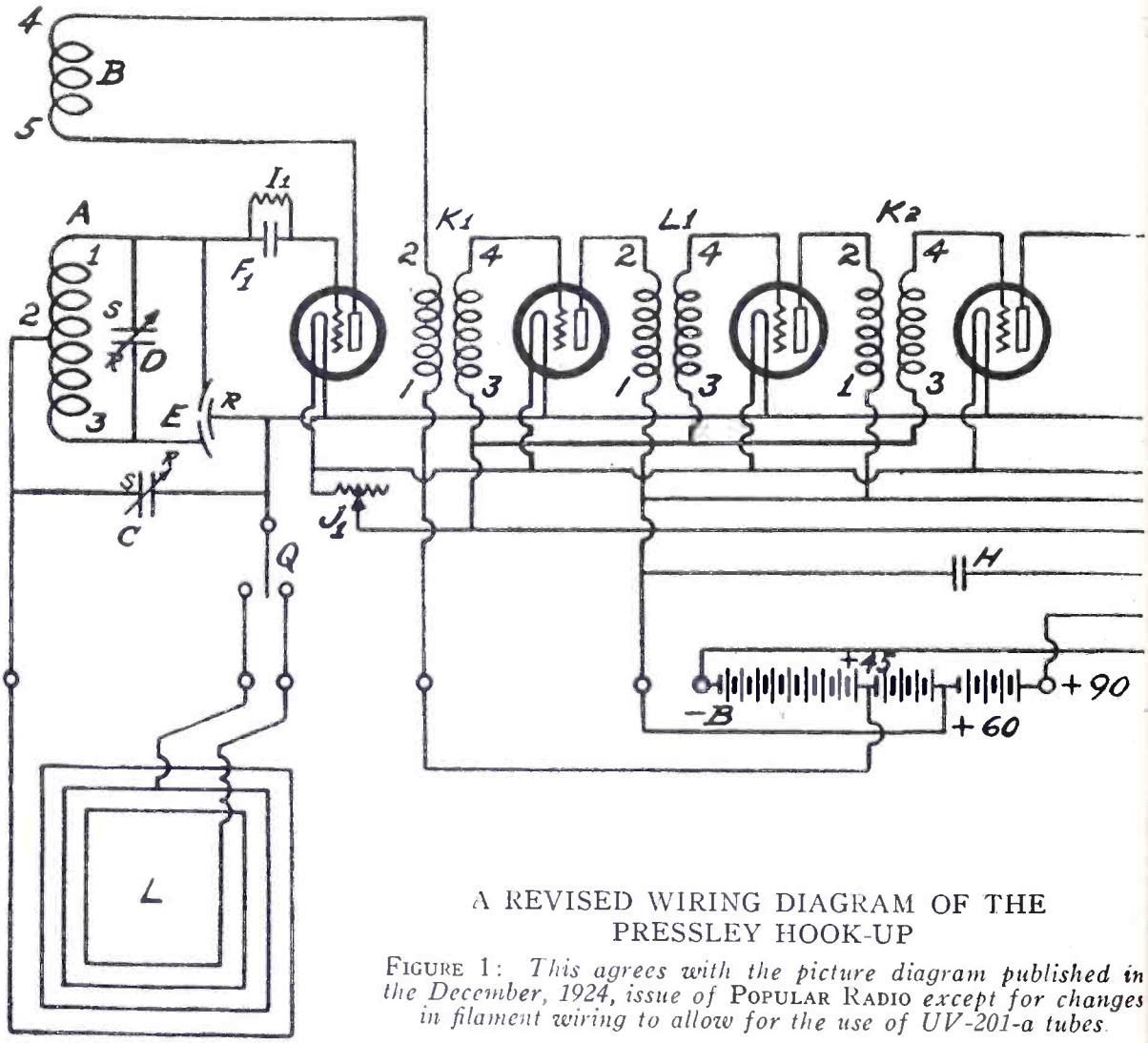
Resistance-coupled Four-circuit Tuner

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

As a result of investigations made of four-circuit receivers constructed by readers according to the description in the October issue, the following suggestions are offered in the hope that they may help other constructors of this receiver who are not getting the results that they are justified in expecting.

It is well to start with a repeated assurance that this receiver should prove excellent in selectivity, tone quality, volume and distance reception. If the owner does not find this true of his receiver, then it is not working properly and the following ideas should prove helpful in eliminating the trouble. Incidently, if any of the readers of POPULAR RADIO, in experimenting with this receiver, should discover any remedies for troubles which they may have encountered and will inform this department of same, we shall be glad to pass the information along to other readers.

The single turn of bus wire which comprises



A REVISED WIRING DIAGRAM OF THE PRESSLEY HOOK-UP

FIGURE 1: *This agrees with the picture diagram published in the December, 1924, issue of* POPULAR RADIO *except for changes in filament wiring to allow for the use of UV-201-a tubes.*

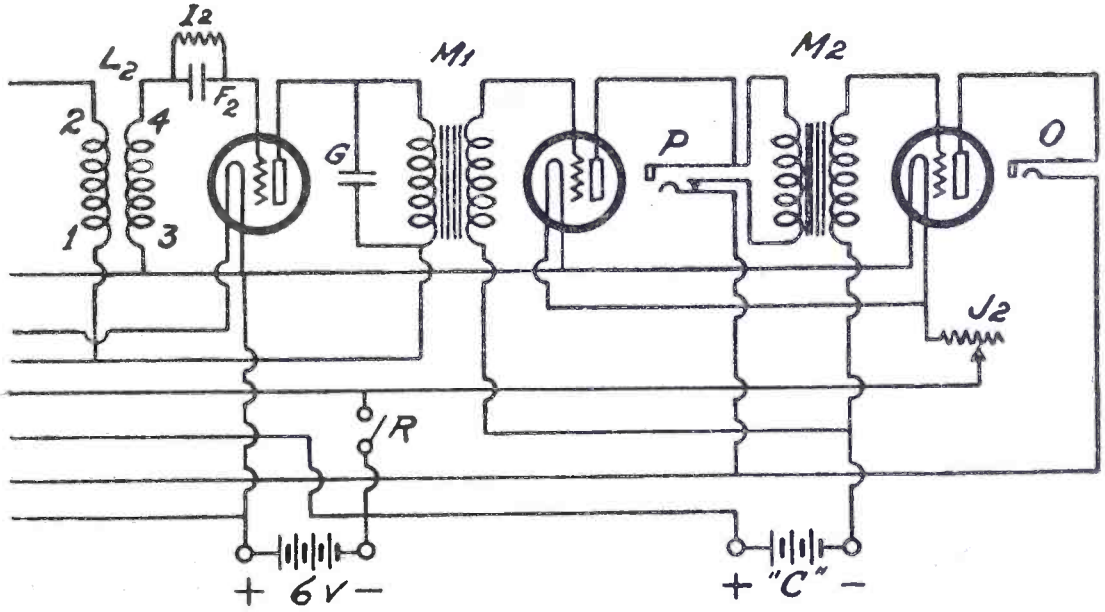
coil "A" should be shifted to different positions on coil "C." If it is moved to the left (further from coil "B") selectivity will be improved because of the looser coupling between coils "A" and "B." On the other hand volume is sometimes increased by moving it closer to coil "B." A little experimenting will show just what position is best for any particular receiver.

Be sure that the Gridenser across the primary of the audio-transformer is of .0005 mfd. maximum capacity. This instrument is also made with a maximum capacity of .001 mfd. maximum, but the minimum capacity of this latter type is too large for satisfactory use in this receiver.

If one is in doubt as to whether he has the proper Gridenser, a fixed condenser of .00025 mfd. may be substituted and if general results, and especially the selectivity, are improved it will be an indication that the Gridenser was the wrong size.

A little study should be given to the proper adjustment of the detector rheostat and the potentiometer to determine just where the point of maximum efficiency lies. The way to go about this is first to set the rheostat at a high value; about ¼ turn in a clockwise direction from the "off" position. Next turn the potentiometer knob to a point where the detector tube becomes noisy (a continuous hissing or roaring sound), then turn the potentiometer back until this noise just stops. Note the volume and quality of signals at this combined setting. Repeat this procedure, starting with the rheostat turned a little further in a clockwise direction and readjusting the potentiometer just below the hissing point. Continue this with the rheostat in several different positions until just the right point for best results is obtained. In some cases the hissing sound will not be produced until the rheostat is turned on halfway or more. In that case start the experiments at this point instead of ¼ way on as mentioned above. Usually the 18-volt tap on the detector "B" battery is best to use but 16½ volts sometimes proves better for distance reception. It is true also that some detector tubes require much higher or lower connections to the "B" battery.

Another condition which will cause the potentiometer winding to smoke is the use of



the same "B" battery for both detector and amplifier. When this is done the potentiometer will heat up when the arm is near either end of the winding. With the Four-circuit Receiver, when a potentiometer is used, therefore, *a separate "B" battery should always be used for the detector* (this is the battery which is connected to binding posts 5 and 6 at the back of receiver in the diagram in the October issue).

Proper Detector Tube

If 6-volt tubes are used the detector should be either a UV-200 or C-300. UV-201-a tubes should not be used as a detector in this circuit as the tuner is designed for a soft tube and *a tube such as the 201-a does not have the proper characteristics to adapt itself as a detector in this tuner.* When dry-cell tubes are used they should be UV-199 or C-299 as both detector and amplifiers. The use of WD-11 or 12's and the C-11 and 12's is not advised.

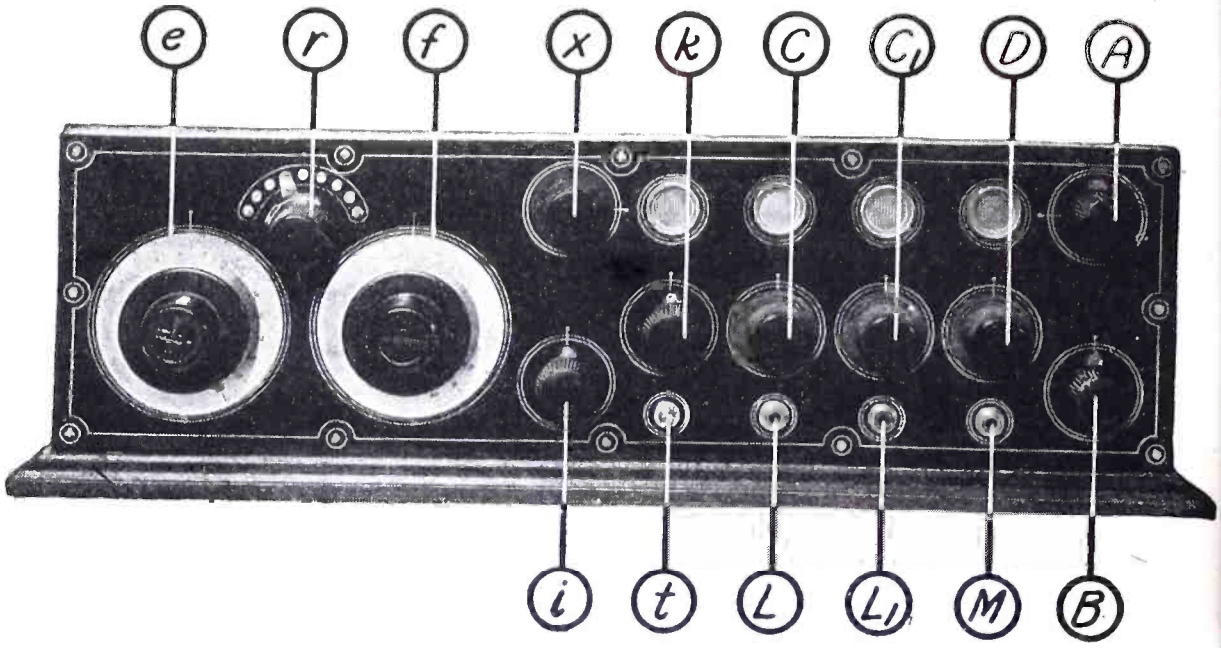
Some builders of the resistance-coupled Four-circuit Receiver report that their receivers repeat; i.e., the same local low-wave station can be tuned in at two separate settings of the dials. That is, a 360-meter station may come in with both dials set at 28, and again with both set at a higher setting around 70. While this is not true of the model receiver constructed in the laboratory, it is evidently due to the stabilizer coil and condenser being tuned to the wavelength of the transmitter, which brings the station in at the higher setting. In that case the stabilizer circuit acts as the secondary and simply forces the signal through the secondary proper. Just why this should occur in some receivers and not in others is a mystery. However, this difficulty can be overcome by avoiding settings with the first dial which may cause the repeating. Thus in the example given above, when it is desired to tune in a high-wave station which comes in at about 70 on the dials, keep the first dial about 10 points below the second dial setting. This will permit tuning in the station which rightly should come in with the dials set at 70 but will prevent the low-wave station from repeating.

Four-circuit Tuner with Distortionless Amplifier

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

DESPITE the October article describing a four-circuit receiver using resistance-coupled amplification, much interest is still evident in a combination of the four-circuit tuner and the distortionless amplifier such as is described herewith.

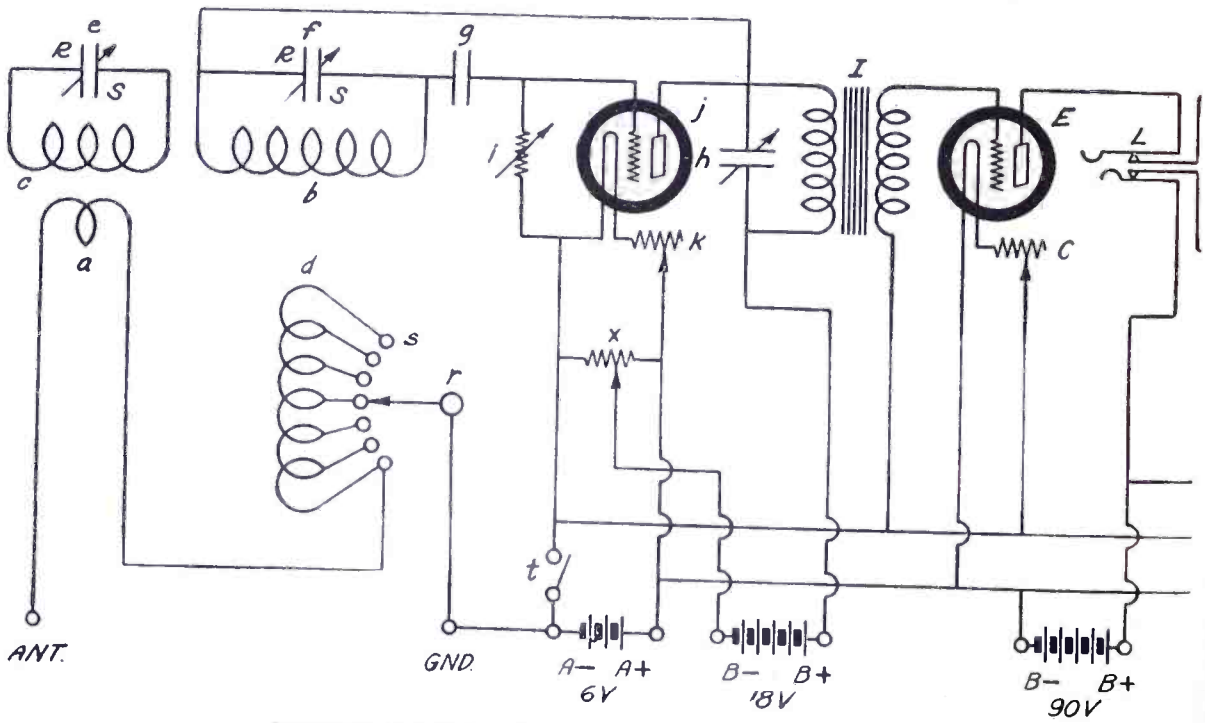
The complete hook-up of this five tube combination is given in Figure 2. The tuner-detector layout is practically identical with that shown in the tuner of the four-circuit receiver described in the October issue, except for the location of the variable grid-leak on the panel,



PANEL VIEW OF THE FOUR-CIRCUIT TUNER

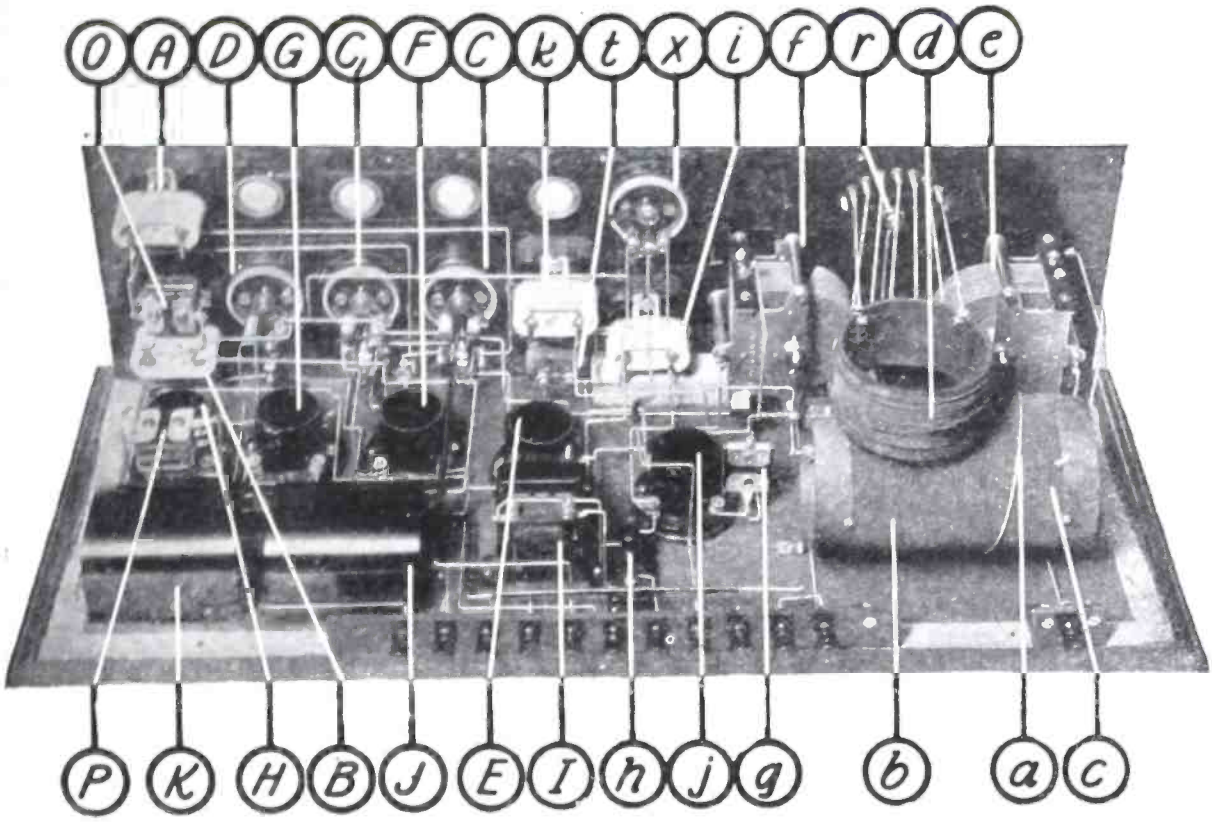
FIGURE 3: *The lettering above indicates the panel layout for the tuner described herewith that is a modification of the set described in the October, 1924, issue of* POPULAR RADIO.

the use of separate rheostat and potentiometer, and the use of a .0005 mfd. variable condsener across the coil "B," instead of the .00035 condenser mentioned in the October issue. (It might be added that this .0005 mfd. condenser was later replaced with one of .00035 mfd capacity.) The arrangement of instruments is shown in Figures 3 and 4.



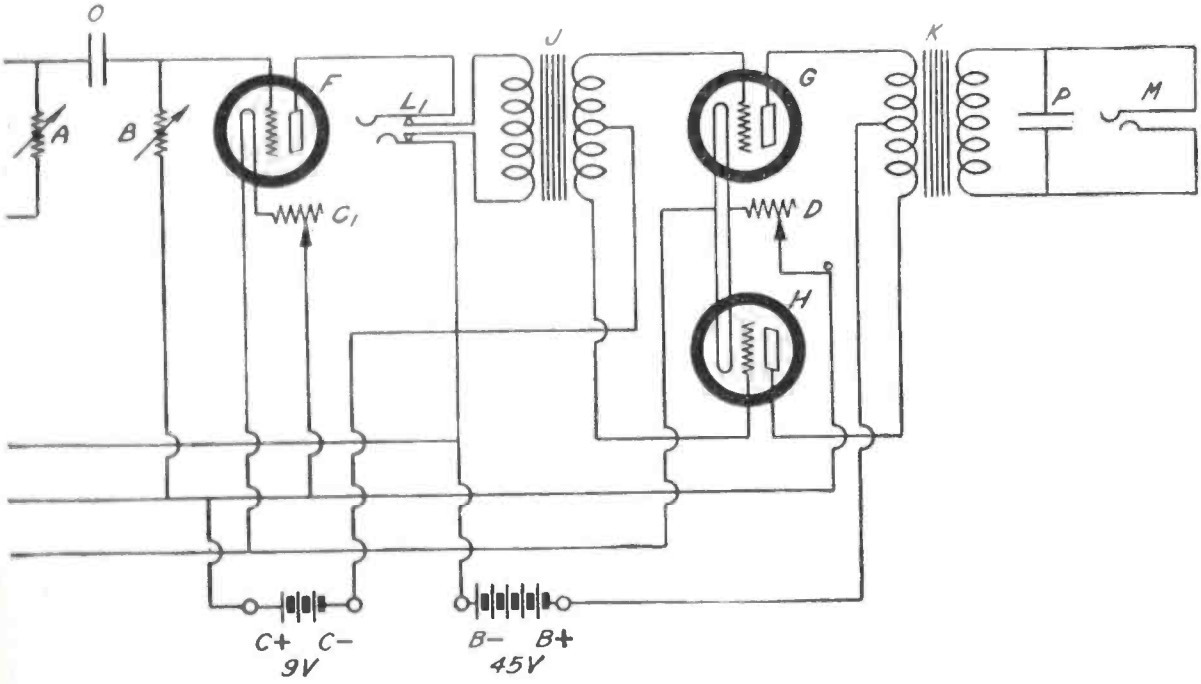
REVISED WIRING DIAGRAM OF THE FOUR-CIRCUIT TUNER

FIGURE 2: *This shows the complete hook-up of the five tube combination. The letters correspond with those in the May, 1924, issue with the following exceptions: L and L1—"Improved" jacks, double circuit; M—"Improved" jack*



REAR VIEW OF THE FOUR-CIRCUIT TUNER SHOWING INSTRUMENT LAYOUT

FIGURE 4: *Note that the instrument layout in the amplifier does not follow that given in the October, 1924, issue. However, this revised plan permits a better balance of panel controls without reducing the efficiency of the set.*



THAT EMPLOYS THE DISTORTIONLESS AMPLIFIER

small letters correspond with symbols used in the October, 1924, issue. The large b—Bradleystat; x—Amsco 400-ohm potentiometer; C_1—Amsco 20-ohm rheostat; single circuit. The diagram corresponds with the pictures on these pages.

The Maximum in Volume and Tone Quality

The tone qualities and volume of the Four-circuit Receiver described in the October issue were so far above those of the ordinary receiver that they apparently left little to be desired in these directions. However, in experimental work in the POPULAR RADIO laboratory these qualities have been carried still further and the ideas adopted are now passed along for the benefit of readers.

It is generally acknowledged that the resistance-coupled amplifier is the best for true reproduction of voice or music. However, the type of coupling is only one element in the accomplishment of good reproduction. The vacuum tubes and the loudspeaker are of great importance also. The use of resistance-coupling amplifies all tone frequencies in proper proportion but the average loudspeaker does not; and the ordinary six-volt vacuum tube is incapable of handling properly the last two stages.

To surmount these difficulties two changes were made, as follows: (1) Western Electric power tubes (216-A) were substituted for the UV-201-A tubes in the last two stages. This required no change in the receiver except to change first, the No. 1A Amperites for two of the No. 1 Amperites, as the power tubes require 1 ampere filament current; and second, the new type Western Electric loudspeaker No. 540-AW was used. This is the "cone" type which does not have a horn but instead is so arranged that a large diaphragm distributes the sound directly. This loudspeaker has much the same qualities as a resistance-coupled amplifier, in that it is free from frequency discrimination in amplifying.

The Amplifier Grid-leaks Must Be Carefully Selected

When the plug is inserted in the different jacks the tone quality should remain unchanged with resistance coupled amplification such as employed in the Four-circuit Receiver. If such is not the case it is an indication that the resistance of the grid-leaks is not correct. If signals are clear when plug is in the third jack but distorted when plug is inserted in the fourth jack, the grid-leak of the last tube should be replaced with one of ¼ megohm resistance. If there is distortion in the third jack a ¼ meghom leak should be used with the next to the last tube and either ¼ or 1/10 megohm leak with the last tube. Another way of telling whether the leaks are of the correct value is to place the thumb and forefinger on the terminals of the leak mounting while the leak is in place. If the tone quality is better with the fingers so placed it is proof that the leak resistance is too high.

Numerous other helpful suggestions regarding this particular receiver and the Four-circuit in general will be found in the "Trouble Shooting" department of the July, November, December, 1924, and January, 1925, issues.

Proper Connections for the Potentiometer-rheostat

Since the article in the October issue was prepared the form of the "Dubl-Wundr" has been changed, necessitating somewhat different connections from those shown in the October issue and on the POPULAR RADIO blueprints. The original instrument had three binding posts on the back and one on the side. The new type has three binding posts on the back and a spring lug below the center binding post for the other connection. This spring lug corresponds with binding post No. 3 in the diagram in the October issue and binding post No. 3 of the new type corresponds with binding post No. 4 of the old. Therefore the connection which was shown going to binding post No. 3 in the diagram should go to the spring lug and the connection which went to binding post No. 4 should go to No. 3 of the new type. Connections to binding posts No. 1 and No. 2 remain the same on both old and new types.

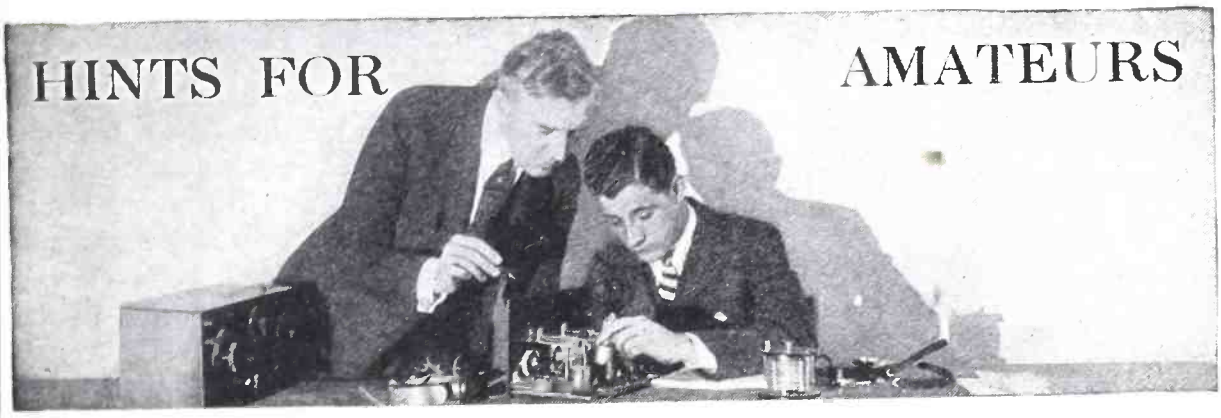
It is important that this instrument be correctly connected. Otherwise the receiver will not be selective. The "A" battery will be short-circuited when the potentiometer arm is set near one end of the potentiometer winding. This will make the instrument smoke and in all probability burn out the fine resistance winding of the potentiometer.

While the manufacturer has placed a slip in each "Dubl Wundr" container, calling attention to the changes made, apparently many users failed to follow the manufacturers instructions, with results as mentioned above. It may be added here, however, that all connections shown in the October issue and the blueprints, other than the two mentioned above on the "Dubl Wundr" are correct. Therefore the other changes shown on the slips which come with the "Dubl-Wundrs" are neither necessary nor advantageous.

If the "Dubl-Wundr" was incorrectly connected in the first place but was later changed the potentiometer winding should be carefully tested to make sure that it has not been burned out while incorrectly connected. If moving the potentiometer knob seems to have comparatively little effect on the volume of signals it is an indication that the winding is broken or burned out. In such a case the instrument should be replaced because this condition will prevent the receiver from working as it should.

It has come to light that some dealers are furnishing the "Dubl Wundr" with 20 ohm rheostat windings and 400 ohm potentiometer windings for use in this receiver. *This rheostat resistance is incorrect and should not be used.* The proper resistances are: 6 ohms for the rheostat winding and 400 ohms for the potentiometer.

HINTS FOR AMATEURS



CONDUCTED BY ALBERT G. CRAIG

Clips Are Handy for Experimenting

IN attempting to try out some new hook-up the fan often makes connections rather hurriedly with any scraps of wire that may be lett over from some previous experimental work. Frequently one or two connections in the circuit hooked up in this way are so poor that they affect the working of the circuit. If you have much experimenting to do, it is wise to cut a number of pieces of wire, varying in length, and solder clips on the ends. Then when you want to make up a new circuit it is easy to clip the wires on where they belong with the assurance that all connections are tight.

Smooth Holes in Your Panel

THE next time you have a radio panel to drill try a ⅛ to ½ inch standard taper reamer for the larger holes. First drill the panel with a ⅛-inch drill and then run the reamer through till the hole is large enough for the shaft of the instrument or the jack which you are fitting to the panel. The reamer will work just as easily in tough bakelite as it does in hard rubber and the hole will be perfectly clean with no chipped edges.

One Rheostat for All Tubes

IF the tubes in the receiver you are building are all of the same type, you can get satisfactory filament current regulation by placing the tubes in parallel with each other and in series with one rheostat which should be in the negative lead to the battery. The only drawback to this arrangement is that all the tubes must be kept burning even when you need only one or two for the local stations.

Be Careful of the Phone Cord

ONE drop of acid from the battery will ruin a phone or loudspeaker cord. The acid eats its way into the fabric covering and finally weakens the cord so that it breaks at that point. It would not be so serious if it ruined the phone cord at once for a new cord does not cost much. The trouble is that it usually causes sizzling and crackling noises and weak signals for weeks before the source of the poor reception is discovered.

A Gasket for Your Loudspeaker Unit

IN fitting the loudspeaker unit to the horn part of the apparatus which is often purchased separately, the unit sometimes does not fit tightly. A ring cut from an old automobile inner tube that has outlived its usefulness makes an ideal gasket because the rubber is springy enough to make an airtight and soundtight joint. Select the thickest part of the tube to cut.

When to Use Loop or Indoor Antenna

AN indoor antenna is more efficient for receiving radio signals than a loop but the latter has directional properties which make it exceptionably valuable in some locations. If you live in a steel framed building in which metal lath has been used on the walls, the efficiency of either a loop or an indoor antenna will be low. The only way to overcome this difficulty is to use an outdoor antenna or else to use at least a five-tube set. But, even the most powerful receiver cannot be expected to bring in distant stations on a loop or indoor antenna when the whole room is practically a metal box.

Put a Condenser in the Ground Lead

THE instruction sheets which accompany many types of chargers for use on storage "A" and "B" batteries direct that the battery be disconnected from the receiving set while the charger is in use. This is because there is a chance that a short-circuit may occur through the grounded circuits of the receiver. The antenna circuit is, of course, insulated from the ground and if you connect a .5 mfd. condenser in series with the ground lead, your whole set will be insulated so that you will not have to disconnect the batteries while you are charging them. The condenser will not effect your reception.

A Simple Switch Stop

MOST radio dealers carry regular switch stops which can be placed at each end of the row of switch points to keep the lever from moving too far. Sometimes there is not room on the panel for these regular stops. An easy way to make one is to cut a small rectangle from a piece of sheet brass and drill a hole near one end, large enough to pass over the stem of the switch point. After you have bolted the switch point to the panel, it is a simple matter to bend up the end of the brass against the side of the switch point to form a stop for the lever.

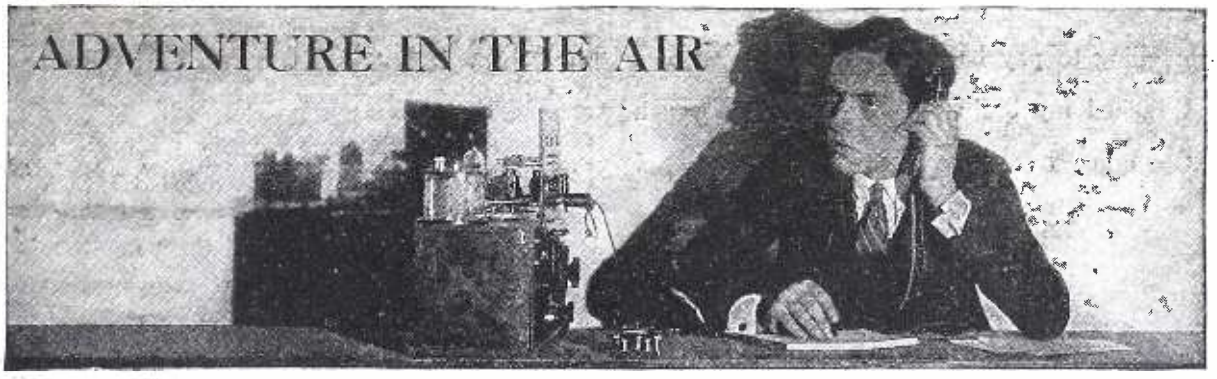
Wire Your Detector Tube Correctly

THE best arrangement for the wiring of a soft detector tube is to connect the filament side of the secondary circuit to the negative terminal of the detector tube socket. When a hard tube such as the UV-201-a is used as a detector, the filament wire from the secondary circuit should be connected to the positive socket terminal. Remember this point as well as the resistance of the rheostat when you change from one tube to the other.

Brass Angle Brackets Are Useful

SHORT brass strips bent in the form of a right angle and with screw holes bored near each end are now in stock in most radio supply stores. Such brackets can be made at home by the radio fan but the stores sell them so cheaply that home construction is not worth while. They are useful for mounting a subpanel on the front panel or for mounting the panel in a vertical position on the baseboard.

¶ In constructing and putting into operation the receivers described in POPULAR RADIO *readers frequently run across kinks which, if passed along, would be helpful to others. The "Trouble Shooting" department is maintained to assist experimenters in ironing out their troubles.*



WHAT *is the biggest thrill YOU ever got over the radio? Have you ever picked up a call for help? Or located a lost friend—or helped to run down a fugitive, or listened in on a conversation of peculiar personal interest to yourself? For every anecdote, humorous or grave, ranging from 50 to 300 words in length, the Editor will pay upon acceptance. Address contributions to the Editor,* ADVENTURE IN THE AIR DEPARTMENT, *627 West 43d Street, New York City.*

Snake Charming by Radio

THAT many animals and reptiles are peculiarly sensitive to sounds—particularly to music—is generally known. Indeed, the secret of the snake charmers of India is said to lay in the noise made by the musical instruments which are played during the performances. The following Adventure induces one to speculate to what extent these hypnotic sound waves may be transmitted by radio:

I couldn't call such a sweet-voiced little lady a snake charmer, so I must leave her name out of this story—and anyway she is not as important as the snake. When she sang "The End of a Perfect Day" at station WAAC, New Orleans, no doubt she looked into the microphone and saw a vision of tired sons of toil gathered at the evening fireside, faithful negroes in from their cotton picking listening to massa's black box, but—

My pal and I were north of the city in the woods, barely out of the swamp country, making an overnight stop on a three-day hunting trip. We had run our car some distance from the road to reach an ideal camping spot. With supper out of the way and our campfire and our pipes glowing brightly, we tuned in our radio set and reclined on the ground to blow smoke clouds and end what had been a really perfect day of outdoor life.

After the first few numbers the daylight left us, leaving only a few rays of light to penetrate the dense foliage, and our fire of soft wood had dimmed to embers. "When you come to the end of a perfect day," the little lady then sang in a voice full of pure melody. It caught us, I guess, just as the composer intended it should, and cast something of a spell upon us.

The fire was low and the stars were out when the song was over. I looked about me for fresh wood and reached for a branch a few feet away. Most of the branches had been straight at that camping spot, but this branch curved at the very end, which was raised some six inches above the ground. I recall the facts now, but was not alert enough to ponder over them at the time.

I took hold of the branch. It was smooth and cold—and a needle in its end suddenly seemed to run through my arm to my shoulder. In an instant the heel of my boot was on the "branch" while it squirmed its last.

A rattlesnake's pilot it was, a poor harmless little mootcher. Its vivid bands of orange and black were beautiful before our flashlight. It had met death, beguiled by the voice of a woman. Although the rattlesnake may have been more than a day's journey behind the pilot, we took the radio's warning and moved on.

—SAMUEL A. CRAWFORD

I Get a Dun by Broadcast

TO dun a man by postcard is contrary to law—as it should be. What should be the penalty of dunning by radio, which is infinitely more public? Presumably the operator took the law into his own hands in the following instance:

To start at the beginning, I must explain that our test buzzer for use with the old crystal apparatus has a note similar to that of the five-hundred cycle transmitters that are now so widely in use, and that it is silenced in a box of waste.

One morning, shortly after ten o'clock, a station signing KZLZ called me. Giving him "K" (go ahead) I copied:

"This is senior operator KZLZ. When are

you going to pay back that ten-spot you owe me?"

I racked my brain but could recall no such debt.

Changing over our send-receive switch, I asked:

"Who are you, please?"

Next I copied, "You know who I am."

Believing that to be the end of that transmission, I changed over to "send" position to ask another question, when I heard the sender continue:

"You borrowed it last month in Halifax."

Then I noticed that the aerial switch was in send position.

I tumbled. I am getting used to this sort of thing.

Quietly pushing open the door to our sleeping quarters, I found the aggravating second operator, Bert Lane, with one hand over his mouth and the other manipulating a small telegraph key, which, investigation revealed, was connected across the test buzzer push button under the operating table and leads run through a drill hole in the partition.

I have asked the steward to cut down on his meat orders.

—Canadian Operator

I Listen In on a Consultation That Saves a Man's Life

NO more persuasive argument for learning the code can be offered than is put forward in the following Adventure from a former ship operator. Once learned, the code is never forgotten. Indeed, Thomas A. Edison, who started his career as a telegraph operator and who since his boyhood has had little or no time to bother with code practice, can still walk into any telegraph office and read what is coming over the wires, even though the speed of the message is so great that his hand is no longer able to write down what his mind actually receives:

While I was exploring the ether one evening, I picked up a ship, evidently a good distance from the coast (judging from the weakness of his signals), trying frantically to establish communication with the shore station at New York through a hopeless barrage of interference. Radio traffic on 600 meters was particularly dense at the time, but in a moment when reception was clear, I was startled to read:

. . . for God's sake hurry, the man is dying . . . can't get his breath . . . unable to take any food or drink for . . . days."

The message was signed "KICP"; upon investigating the call book I found the S.S. listed under those letters.

Shortly the New York station answered: "QRM" (interference) "QTA" (repeat).

Again the vessel tried to get that urgent message through, but it was of no use; the ether was so crowded with radio messages on 600 meters, that it was impossible for the two to establish communication. Finally, after several unsuccessful attempts, the New York station advised the vessel to "QSY 450"; in other words to change to 450 meters wavelength. I also re-tuned, and soon heard the vessel again, as he repeated the message, sending each word twice to insure correct reception.

In a moment, New York answered him "R R R" (received OK), and told him to "stand by" a moment for an answer. Then New York, having consulted the Marine Hospital, sent this message to the master of the vessel; my own hand trembled with excitement as I copied:

"Be quick; run small rubber tube past tonsils; through this tube man can take water or milk; give him five grains asperin tablet every three hours. Where are you bound for and what is your distance?" It was signed "Surgeon in Charge, Marine Hospital."

Moments passed that seemed like hours as I wondered if that vessel, away out there somewhere on the wide Atlantic, had been able to get the message which might be the means of saving a life. I kept my receiver right on 450 meters and anxiously awaited results. Suddenly the silence was broken by a faint:

"R R R . . . OK KICP OK. We will follow instructions. We are bound for Boston and we are still 800 miles out. Will call you later."

Eight hundred miles from Boston! That probably meant 1,000 miles from New York, and the message had been received through all the interference! And still I listened for him on 450 meters. It was fifteen minutes later when I heard him call New York and then he signalled:

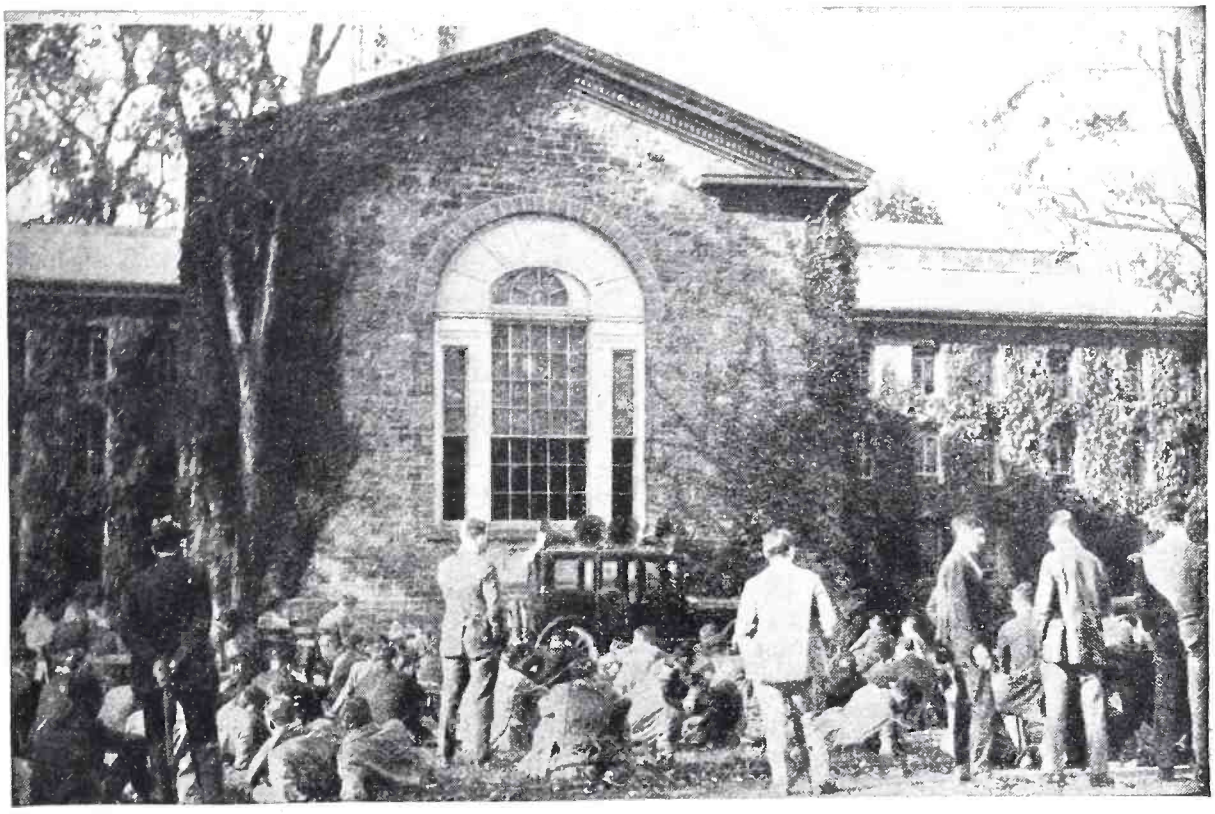
"Directions followed. Patient resting quietly. Think we can save him. Thanks a thousand times over. KICP."

—E. J. Quinby

The Radio Command That Never Came

THOUGH the Royal Air Force testing station at Farnborough, England, may still contain skeptics, a recent experience there of a young flight commander has doubtless converted several members of the British army to a belief in the kindness of fate. Here is a report of his experience:

The camp was in a high state of excitement over the arrival of a visiting general who was noted for his sharp tongue and disciplinary actions—especially when he descended upon the commissioned personnel and demanded a demonstration of the efficiency of their radio communication with the flight squadrons in the air. Things simply had to move—especially



Western Electric

BASEBALL SCORES BY RADIO

By means of a cluster of four loudspeaker horns adjusted to the top of a sedan that carries the receiving set, this mobile radio station can collect a crowd anywhere by merely tuning in. It is shown here entertaining the students at Princeton University.

when he told me just before I slipped the headphones over my ears and "took off," that all orders would be given by himself.

The planes went into the air splendidly, the radio men came onto the field, set up their one-wire antenna pole and "tuned in" in unusually short time, and the squadron leader could see the general pick up the microphone to start the drill.

"Turn right, turn—" came the monotone. Nervous and tense, I wheeled away before the third command. (All commands are supposed to be repeated three times before execution.) Again the order flashed.

"Turn left, turn—" the planes were off toward the western horizon like a flock of pigeons swinging over the roof tops.

Suddenly a cold chill fled down my spine. The angry voice of the general came clear through the headphones, as the camp grew smaller behind me.

"Attention, there," it barked. "Wait for the third command before execution or I'll jolly well crash you out of the service, sir! Now, stand by!"

I braced myself to count the forthcoming commands. None came. I looked back, but could see only trees and farmhouses. On we roared, over villages and towns, fields and woods; still no orders. Perhaps something was wrong; perhaps the general was only waiting to see what I would do; I dared not return to investigate now. The sun dropped lower on the horizon, took on a reddish tinge. Ahead squatted a city, fringed by masts and smokestacks, ships, piers, and the green sea lying flat beyond. I soared to pass over it at proper height, calculating that it was Bristol, and that we were headed out into the Irish Sea.

Stubbornly, smarting still from the reprimand, I drove on, despite a vague wonder as to how far we would get into the open sea before our petrol gave out. Once more I checked up my headphone and radio connections. Everything was sound; my antenna, leading out from the fuselage, was intact. I flew on toward the vast expanse before us.

Suddenly my engine choked, roared, coughed, and died. I was out of essence. Giving the signal, I hunted a place to land and volplaned down, out of one danger into another. Upon landing I demanded the nearest telephone and braced myself for the interview by wire with the camp commander.

"Well, hello, old man," came cheerily to my astonished ears. "Bristol, eh? Devilish glad to hear from you. Didn't know how to keep you from heading for North America. Trouble was on our end. Young Jones, out on patrol, didn't know about the test, came in without seeing the aerial pole and carried it away on his landing gear. . . No, no one hurt—except the feelings of the radio men. The general

was in a bit of a pet, but he took it out on them. Threats only. Report in the morning. . . Good-night."

Slowly I returned to my plane, threw the headphones aside, and almost caressingly rapped my hollow-sounding gasoline tank.

—LIEUTENANT

Putting the Cat Out by Radio

IT may be possible, soon, to turn over a few household tasks to radio broadcasting stations. For example, it is conceivable that the cat may be put out at night by an order delivered at a given hour by a radio broadcasting station:

When Station WGY in Schenectady recently broadcast a "Farmers' Program" numerous numbers were introduced as part of a celebration of the fiftieth wedding anniversary of Josh Quinby and his wife Samanthy. The announcements were all informal and instead of signing off in the usua, formal manner "Josh" after speeding the departing guests called to the cat preparatory to locking the kitchen door and blowing out the lights. His call, "kitty, kitty, kitty," was carried to a great many homes with the following result as related in two letters received by WGY:

"To convince you how perfectly we received your program," wrote Mollie Chesbrough of Addison, N. Y., "I will tell you that our pet kitty was lying on the sofa asleep. When the groom of fifty years ago was calling kitty to put her out, our kitty immediately got up to see who was calling him and for two or three minutes did not remove his gaze from the magnavox."

Charles J. Chase who runs the general store at Sebec Station, Maine, writes "Our cat heard you call and knew it was bedtime and hid away and did not want to be put out."

—C. D. WAGONER

Music from a Weak Battery

HAVE you ever explained weak reception on your set on the ground that your "battery is weak"—particularly when you are showing off your receiver to some one who is listening in for the first time? The next time you do we'll wager that you will think of this story:

Bones White had been a corporal in the 16th U. S. Infantry regiment—one of the first of the colored troops to see overseas service—and he never ceased telling of how the infantry in general and the 16th Infantry in particular had won the war. Indeed, he was so engrossed in his war stories that he could not find time to work, so his wife Sarah took in washing to keep the wolf away from the door.

One evening as Bones was collecting wash at the home of one of Sarah's customers he was invited to listen in on the radio for the first time. He sat in amazement as a band concert came in, very faint though clear. Finally, as he bowed to go, his host invited Bones to call again—and like all radio fans, he made the excuse of "the battery being weak."

"If it's all de same to you, ma'am," Bones replied, "would you-all mind if I'd call again when de *infantry* am aplaying, 'stead o' dat weak bat'ry?"

—ANDREW SESSELMANN

I Give My Guests a "DX" (?) Treat

EVERY experimenter in radio sooner or later runs across some startling phenomenon that is generally easily explained. Here is one:

A short time ago I decided to try the sound chamber of my phonograph as a loudspeaker in conjunction with a radio-telephone receiver. Rather than move the phonograph upstairs where my apparatus was, I ran two wires from the set to connect the phonograph to the telephones. I then connected in series with this headset another pair of telephones at the receiver upstairs to enable me to tune in. After experimenting I turned out the tubes but did not immediately remove the headset.

A few minutes later I heard clearly a piano selection, which I recoguized as a favorite of my brother. I had a hunch and went downstairs. Sure enough my brother was at the piano in the parlor playing the selection himself; the headset in the phonograph there was acting as a telephone transmitter. From this I conceived what I thought was a grand idea.

Some friends were coming in the next evening to listen to my set and I determined to give them a surprise. I brought them upstairs, but left Bill down in the parlor. After we had heard several selections from WGY I put all the headsets in series with the pair downstairs, thus disconnecting them from the radio set. Bill rendered a couple of selections on the phonograph and then announced in regulation broadcasting fashion:

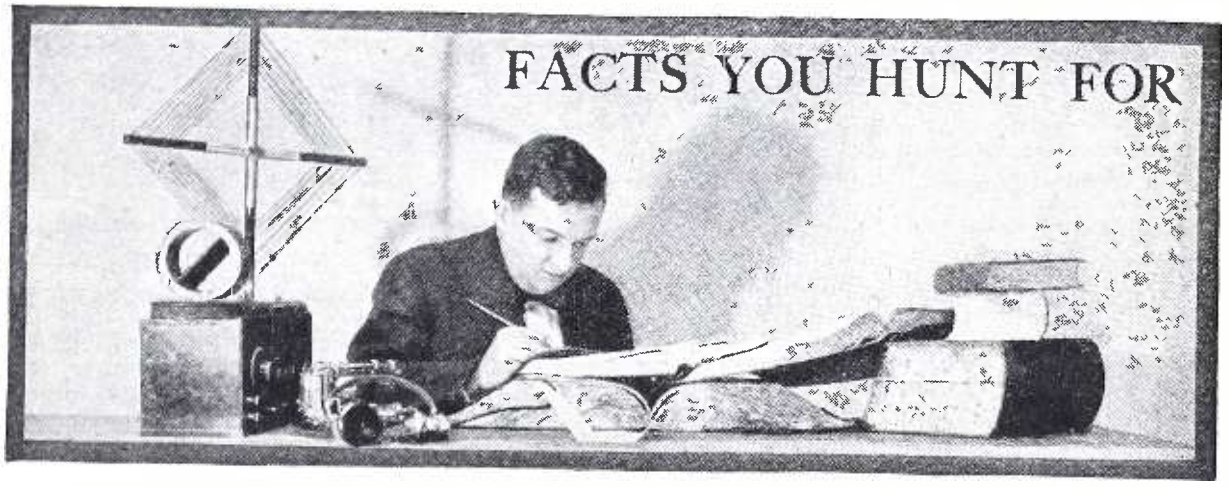
"This is station XYZ at San Francisco. Our next selection will be *Souvenir* by Drdla." The visitors were amazed; they had not expected to hear such a far-off station.

However, a few minutes later Bill, who was evidently getting tired of being a broadcasting station, piped up:

"Say, Gordon, I think I'll go home now." Whereupon I had to get out.

—G. E. PIPE

¶ *Questions about articles will receive prompter replies if the correspondents will specify the issues and page numbers of the subjects of their inquiries.*



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.

What is a Wheatstone Bridge?

THIS is an arrangement of circuits devised many years ago by the great English physicist, Wheatstone, and used to compare two resistances with each other. The arrangement permits the circuits to be so adjusted that the same voltage exists at the center points of two branches of the circuits, each of which contains one of the resistances to be compared.

Does the so-called "ratio" of a transformer mean the ratio by which the voltage is increased or merely the ratio of the amount of wire in one coil to the amount in the other coil?

BOTH. The amount of wire in the two coils, expressed as the ratio of the number of turns of wire in the primary to the number of turns in the secondary, determines the ratio by which the voltage is increased. For example, a five-to-one ratio means that the secondary coil has five times as many turns of wire as has the primary. It also means, within the limits of practical work, that the voltage of an alternating current will be increased five times in passing through the transformer.

What is meant by magnetic hysteresis?

IF you take a piece of unmagnetized iron and subject it to a magnetizing force of known intensity, as, for example, by placing it in a coil of wire through which flows a known electric current, you will obtain a certain amount of magnetization of the iron. If you increase the current the iron will be more highly magnetized. Suppose, then, that you decrease the current. The iron will lose some of its magnetism, but not all of it. Also it will lose the magnetism more slowly than the electric circuit loses its current. The magnetic effect, both during the magnetization of the iron and during the loss of its magnetism lags behind the electric cause that is producing the magnetic behavior. This lag is called hysteresis. With alternating currents this hysteresis causes a loss of energy in iron cores exposed to the current, the lost energy appearing as heat.

Who invented the word "electron"?

IN its modern sense of the smallest known particle of electricity the word was first used by Dr. G. Johnstone Stoney, a distinguished Irish scientist, in a paper presented to the Royal Dublin Society in 1891. The word itself is, however, the ancient Greek word for amber, this substance having been distinguished in ancient times for its property of becoming electrified when rubbed. In languages still more ancient than Greek the word can be traced back to a very ancient root-word meaning to shine or to glitter. This fact is curious to recall in connection with the modern uses of electrons as producers of light.

How is a ground connection obtained for radio transmission on an airplane or an airship?

IT is not. Ground connections are impossible under such circumstances and the radio installation has to be designed to do without a ground. Sometimes a loop is used for transmission but more often the body of the airship or some of its metal parts are used as a counterpoise.

What is a hot-wire telephone?

If an alternating current, similar to an audio-frequency current, is passed through a very fine wire of platinum or some similar metal and if the size of the wire is such that the current heats it, the air in immediate contact with the wire will be heated too. If, then, the wire cools off a little during the periods between the alternate pulses of current, the air will cool too. This alternate heating and cooling of the air will set up—when the conditions are just right—a sound wave in the air. Thus an electric alternation may be converted into sound, much as it is in the ordinary telephone. This hot-wire telephone is, however, less efficient and dependable than the ordinary electromagnetic telephone and it has never been put to much practical use.

What were the old-fashioned wet batteries once used in telephone work, and would they make suitable "A" batteries?

The Daniel cell, formerly much used in telegraph work, consists of a zinc electrode and a copper electrode in a solution of copper sulphate. The cell was usually arranged in a glass jar. The copper electrode was a piece of copper in the bottom. The zinc was cast into the form of a crow's-foot and was hung at the top of the jar. The electrolyte was a saturated, slightly acid solution of blue vitriol. This cell gives about 1.1 volts per cell. It needs to be kept on closed circuit, as otherwise the zinc solution, which forms at the top of the jar by dissolution of the zinc crow's-foot, diffuses down into the copper solution and temporarily stops the operation of the cell. This cell can be used for "A" batteries, but is not advised, as the internal resistance is relatively high and a number of cells have to be used in parallel in order to produce much current.

What was the origin of the language called Esperanto, now advocated as an international radio language?

It was made up, as a purely artificial language, by a Polish scientist, Dr. L. L. Zamenhoff, of Warsaw. It contains a large number of word roots that are taken from Polish, Latin and other languages, but essentially it is an artificial product. It was proposed by Dr. Zamenhoff in 1887, since when it has been somewhat modified by numerous scholars. Several other artificial languages have also been proposed.

Why is static so much worse in the United States than it is in England?

It has never been definitely proved that it is worse here than on the other side of the Atlantic, although this impression seems to be prevalent among fans who have worked on both sides. If there really is less static in England we can only guess at the reason for it. Perhaps it is because England lies in a more northern latitude and has fewer thunderstorms.

Is there any metal that has an electric resistance great enough so that it can be used for grid-leaks and similar devices?

No. The metallic element called bismuth has a resistance about 70 times greater than the resistance of copper. This is the highest resistance of any metal known to us. But this is still far too small a resistance (too good a conductivity) for use as a grid-leak.

How many electrons are necessary to operate a vacuum tube?

This depends on what kind of a tube it is. For each milliampere of current flowing between the filament and the plate there pass across this space each second approximately 6,000,000,000,000,000 electrons.

What are the newly discovered "zeta rays"?

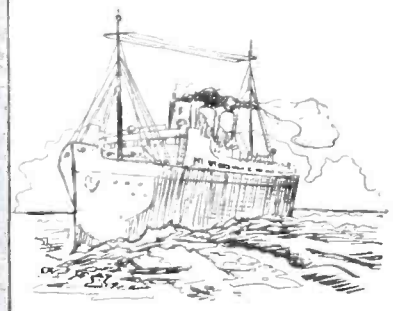
This is a name given to some "rays" observed recently in experiments on the collision of two atoms, or of an atom and an electron. The nature of these zeta rays is still unknown, but if they are real at all they are probably particles of some kind—electrons or fragments of atoms—rather than ether waves.

What is the meaning of an exponent like a square but with a minus sign; thus 10^{-2} ?

These negative exponents signify roots, not powers. For example, the one quoted means the square root of 10. The plus exponent means always a power, as a square, a cube, a fourth power, and so on. Similarly, there are minus exponents to indicate the cube root (10^{-3}), the fourth root (10^{-4}), the tenth root (10^{-10}), and so on.

What is the difference between an ampere-hour and a plain ampere?

The ampere is the unit of strength of current. When we speak of a current of one ampere we mean that a certain quantity of electricity is flowing in the circuit during each second so long as the strength of the current remains the same. The ampere-hour is another unit and indicates a definite quantity of electricity, not a rate of flow. It is the quantity that will have flowed through a circuit if a current of the strength of one ampere is maintained for one hour. Similarly, a current of one-tenth of an ampere for ten hours equals an ampere-hour, and so on.



The more you expect of your radio set the more you need Celoron

CELORON is the standard insulating material among radio manufacturers. It is the choice of nearly a million radio fans for radio panels and tubing.

In the face of such evidence, can you do better than to use Celoron for the building of your radio outfit?

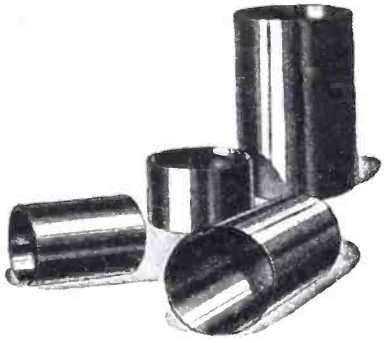
Celoron Panels and Tubing

Celoron is uniform, practically indestructible, and readily workable.

Celoron does not soften under heat or deteriorate with age as do rubber and composition materials. It does not chip or crack, even if worked near the edge.

The dielectric strength of Celoron is many times higher than the most severe insulating requirements.

Ask your dealer to show you his assortment of Celoron panels and tubing.



Celoron tubing has all the insulating qualities of Sheet Celoron. It comes in all sizes.

When you see this display rack you can be sure of getting genuine Celoron Panels.

Diamond State Fibre Company

the oldest and largest manufacturer of vulcanized hard fibre and laminated technical materials in the world

Wherever you see a factory chimney, there you will find countless electrical and mechanical uses for Celoron and Diamond Fibre.

Bridgeport, Pa., and Chicago, Ill.

CELORON RADIO PANELS

ATWATER KENT

RECEIVING SETS

ONLY a great receiving set can give you a true realization of the perfections attained in radio.

There are wonderful things in the air. The latest and best in music, plays, lectures and news are being broadcast from everywhere. An ATWATER KENT will give you perfect command of them all.

Night after night your ATWATER KENT will serve you faithfully, bringing in from where you will the programs you want to hear. It will give you the range to select what you want, the control to get it easily, and the volume and clarity to hear it perfectly.

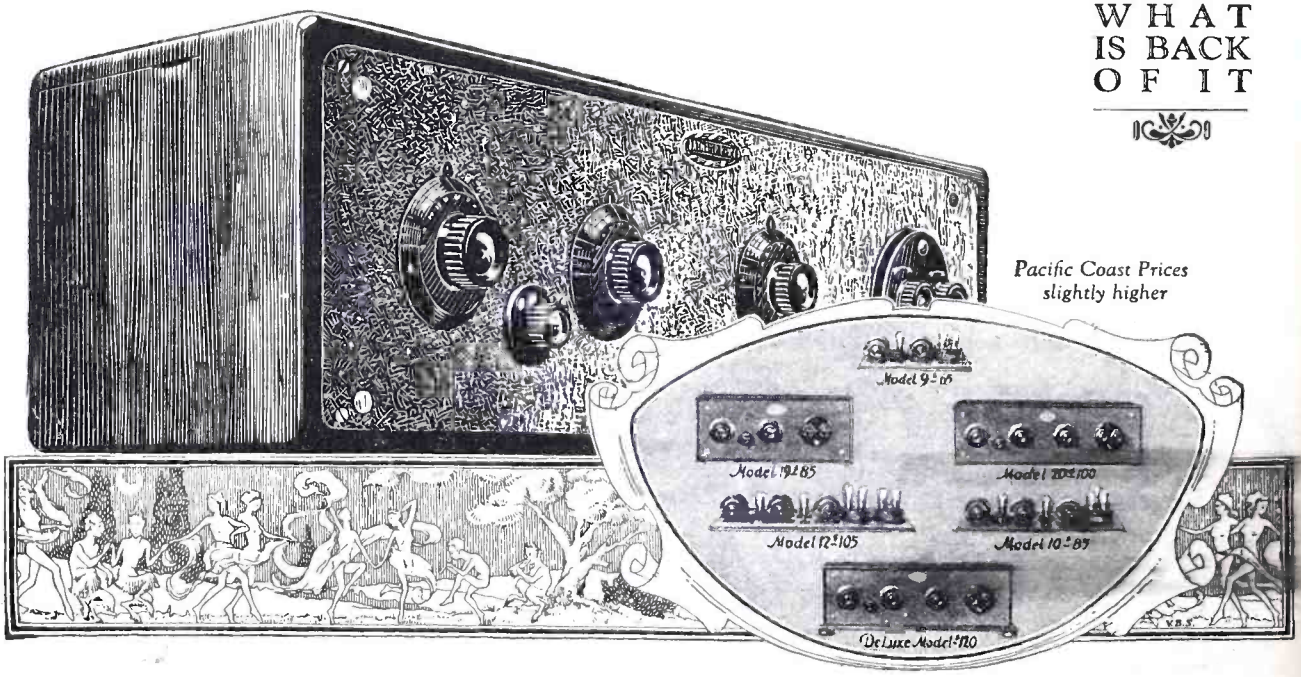
In ATWATER KENT Radio there is quality beyond question; there is scientific, precise design and master workmanship. Experience, skill and knowledge are built into every part, from the tiniest wire to the beautiful, polished cabinet.

Any ATWATER KENT dealer will gladly demonstrate and help in your selection.

Instructive literature on request

ATWATER KENT MANUFACTURING COMPANY
4712 Wissahickon Ave., Philadelphia, Pa.

THINK WHAT IS BACK OF IT



Pacific Coast Prices slightly higher

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ATWATER KENT

LOUD SPEAKERS

SET THE MUSIC FREE. There is a world of pleasure in the air. Set it free within your home. Let all your family share it with you through an ATWATER KENT Loud Speaker.

Here is the magic touch that makes your radio a living thing—that faithfully re-creates music with all the feeling of the artists who produce it . . . and adds a vivid realism to the plays, the sermons, the lectures and the daily news being broadcast every night.

Rich in tone, full and clear in volume, the ATWATER KENT Loud Speaker opens up for everyone a new source of fascination and delight.

This masterpiece;—this priceless contribution to radio enjoyment is the product of the makers of ATWATER KENT Receiving Sets. Back of them is the experience of more than a quarter of a century in the manufacture of scientific electrical instruments.

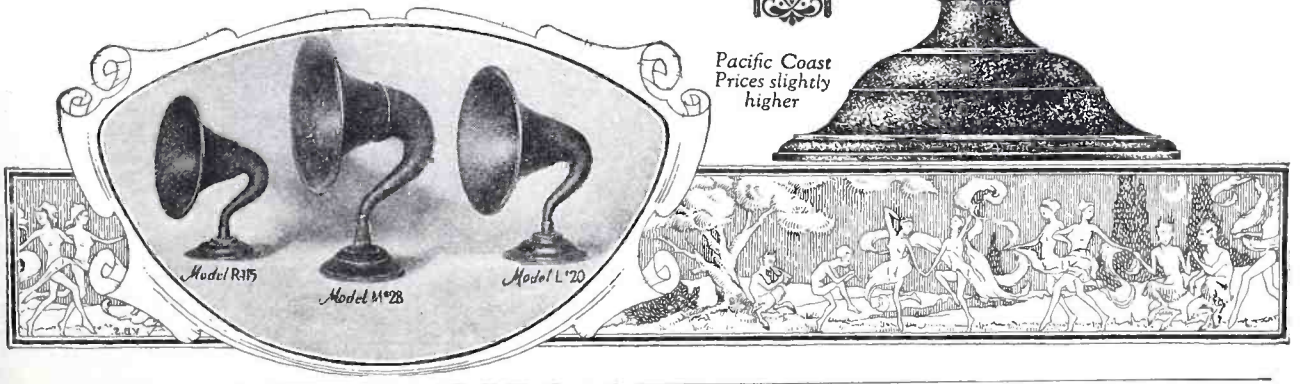
Your dealer has three models. Hear one today.

Instructive literature on request

ATWATER KENT MANUFACTURING COMPANY
4712 Wissahickon Ave., Philadelphia, Pa.

Bring Out the Best From Any Set

Pacific Coast Prices slightly higher



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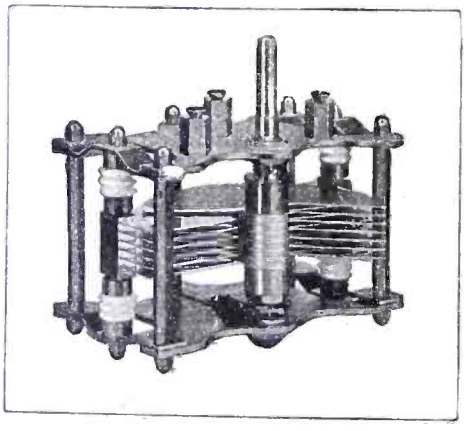
THE MASTER

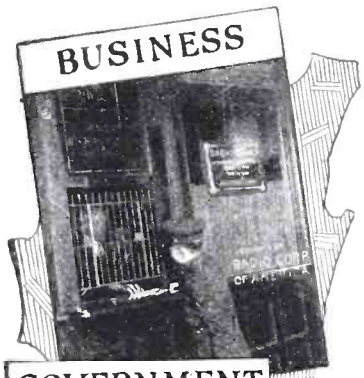
L. M. COCKADAY

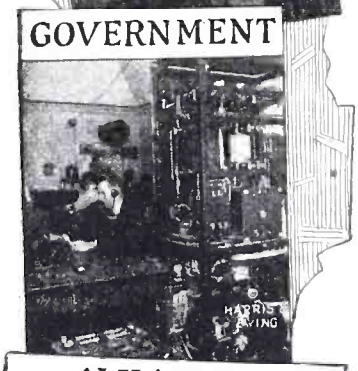
HAS CHOSEN

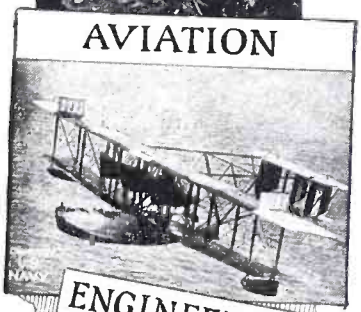
GENERAL INSTRUMENT
NO LOSS CONDENSERS
FOR HIS SUPERHETERO-
DYNE REFLEX RECEIVER

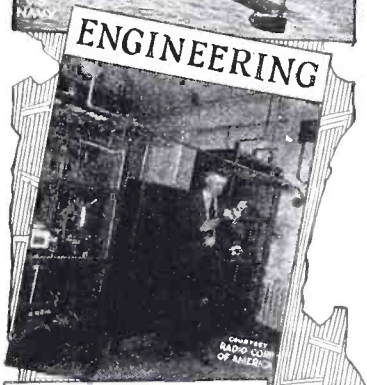


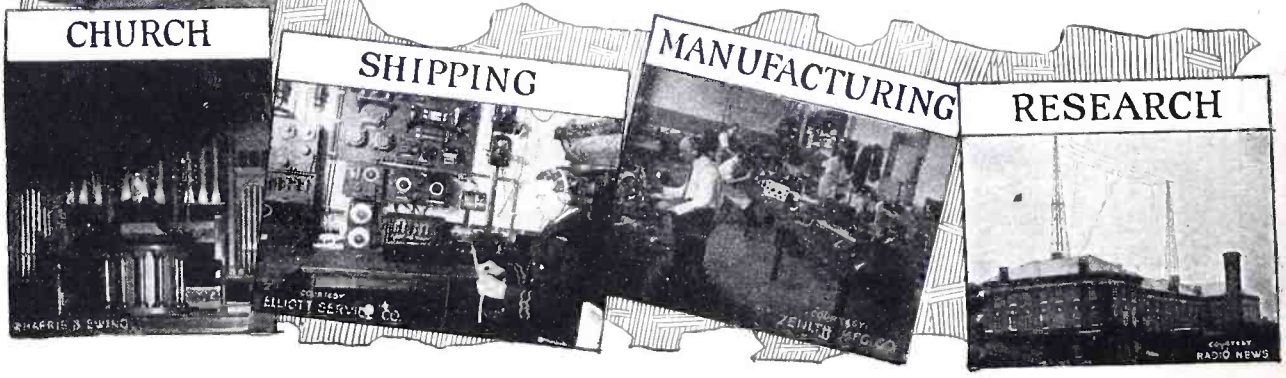
"Cash In" On These Amazing











You readers of POPULAR RADIO—you who are interested in Radio, and also interested in unusual money-making opportunities—let me send you, without the slightest cost or obligation, my new, interesting Free Book, "Rich Rewards in Radio"—a book which contains positive proof of the astounding opportunities in this great new industry and tells exactly how **you** can get your share of big money from it.

The pictures on this page give only the smallest indication of the scope of Radio today. Mail the coupon on the next page for my Free Book which gives full facts on Radio and what it can mean to you.

Earn $75 to Over $200 a week

You're interested in Radio—why not turn your interest into profit? Why not make big money in work you enjoy? No field today is growing so rapidly. No business offers such a rare variety of opportunities. Radio is a new, billion dollar industry in which thousands have already made far more money than they ever dreamed possible.

Radio can take **you** out of the rut of bare existence—into an enviable field of high salaried specialists. It can offer you unlimited opportunities for honor, wealth, power and satisfaction. It means a future filled with boundless promise!

Recognized Radio Experts In Urgent Demand

Readers of POPULAR RADIO know in part the story of how Radio has jumped forward with leaps and bounds. You know there are broadcasting stations all over the country—that radio is used on eve y ship—that it is used by newspapers, government departments, business houses, banks, railroads, factories and stores. Every day, some new use for Radio is announced. And this wonderful expansion of Radio has opened up hundreds of splendid positions on land and sea—positions which you can qualify for within a few months!

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

New Opportunities in RADIO!

There's **big money** in this wonderful new field for you. No matter what you are doing—no matter what experience you've had, you can step in and get your share of the astonishing rewards of Radio. Big salaries, fascinating, easy work, short hours, and a wonderful future—no other field of endeavor can offer anything to compare with what Radio can mean to the men who get into this work now.

Make Radio your career. Become a radio expert now!

E. R. Haas, Director, NATIONAL RADIO INSTITUTE (Founded 1914)

How We Place Graduates In Fine Radio Positions

Not a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer," writes a prominent radio firm. "Would appreciate your recommending any person who could fill position." "We want men with executive ability as well as radio knowledge to become our local managers," writes another firm. "We will require the services of several resident demonstrators," writes still another—and these are just a few small indications of the great variety of splendid opportunities open to our graduates!

Easy Now to Learn at Home

No previous training in electricity or radio is necessary. During your spare time at home, within an amazingly short time, you can get your National Radio Institute diploma, which is government recognized and accepted as license throughout the world by the employers of radio trained men. **To make the training more practical, circuits and parts for building latest receiving sets are now included FREE with the course.**

Send for FREE BOOK

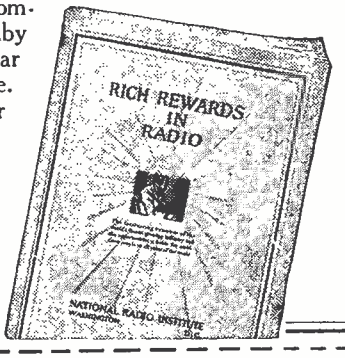
You have nothing to lose—and everything to gain. No matter what your plans for the future are—mail the coupon now for this new Free Book which tells all about the wonderful opportunities in Radio. Let it point the way to success and happiness for you. Don't delay. Mail the coupon **now.**

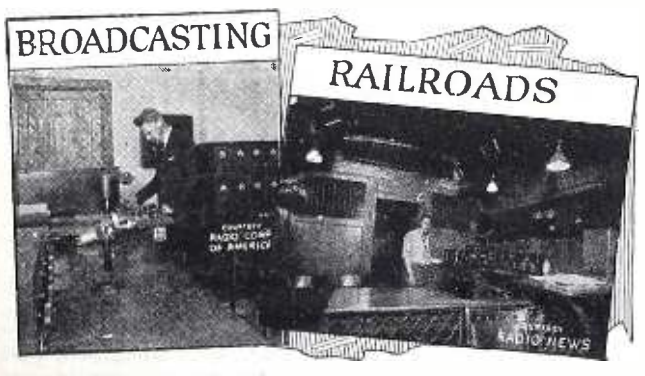
National Radio Institute, Dept. 32DB, Washington, D. C.

I Can Qualify You as a Radio Expert in a Few Months

If you want to earn far more money than you are earning now—if you want to be your own boss—if you want a profitable business of your own—if you want to travel the world over—if you want a field of endeavor where the opportunities are unlimited—Make RADIO your profession.

Hundreds of my students write enthusiastically of my training—and tell how it has helped them. Merle Wetzel now is making three times what he did before taking my training. Emmett Welch started at $300 a month after graduating. Michael De Marco makes $50 to $83 a week and commissions. L. A. Godby has made $1800 a year extra in spare time. J. P. Zinno, former buck private, now earns $3500 a year. Scores of others tell similar stories. Send for free book. No obligation. Mail the coupon **NOW.**





E. R. Haas, *Director*, National Radio Institute.
Dept. 32DB, Washington, D. C.

Without any obligation on my part, please send me a FREE copy of your book, "Rich Rewards in Radio." Also tell me how your Free Employment Service will help me secure a position, and send me details of your special short time offer. (Please write plainly.)

Name.....

Address.....

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

Occupation.....Age.....

(Copyright of Photo)

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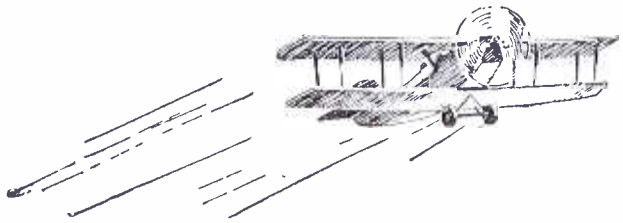


Bringing to earth the airplane type receiver

RADIO frequency transformers as designed by Jackson H. Pressley, Chief Engineer, Radio Laboratories, U. S. Signal Corps, Camp Vail, New Jersey, and manufactured by the Sangamo Electric Company, assure you of precision instruments.

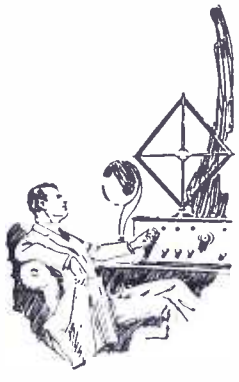
The essential needs for airplane use are:

First—Extreme compactness with maximum amplification per transformer stage;

Second—A transformer so designed that there is negligible coupling between stages no matter how they are spaced;

Third—Stability without the aid of manual controls.

SANGAMO



It was only after months of experimenting that Mr. Pressley was able to attain these results, and the adoption of his transformers as standard for airplane use speaks for itself.

A set of these radio frequency transformers and coupler coil will be delivered anywhere in the United State for $22.50 (Introductory price).

ASSOCIATED SANGAMO ELECTRIC COMPANIES

CAPACITY 3500 METERS PER DAY

SANGAMO ELECTRIC COMPANY
Springfield, Illinois

BRITISH SANGAMO COMPANY LIMITED
Pondersend, Middlesex, England

SANGAMO ELECTRIC COMPANY OF CANADA LIMITED *Toronto, Ontario*

ASHIDA ENGINEERING COMPANY
Osaka, Japan

8820-2

Domestic Offices—New York, Chicago, Birmingham, San Francisco, Los Angeles. *Radio Division*—50 Church Street, New York

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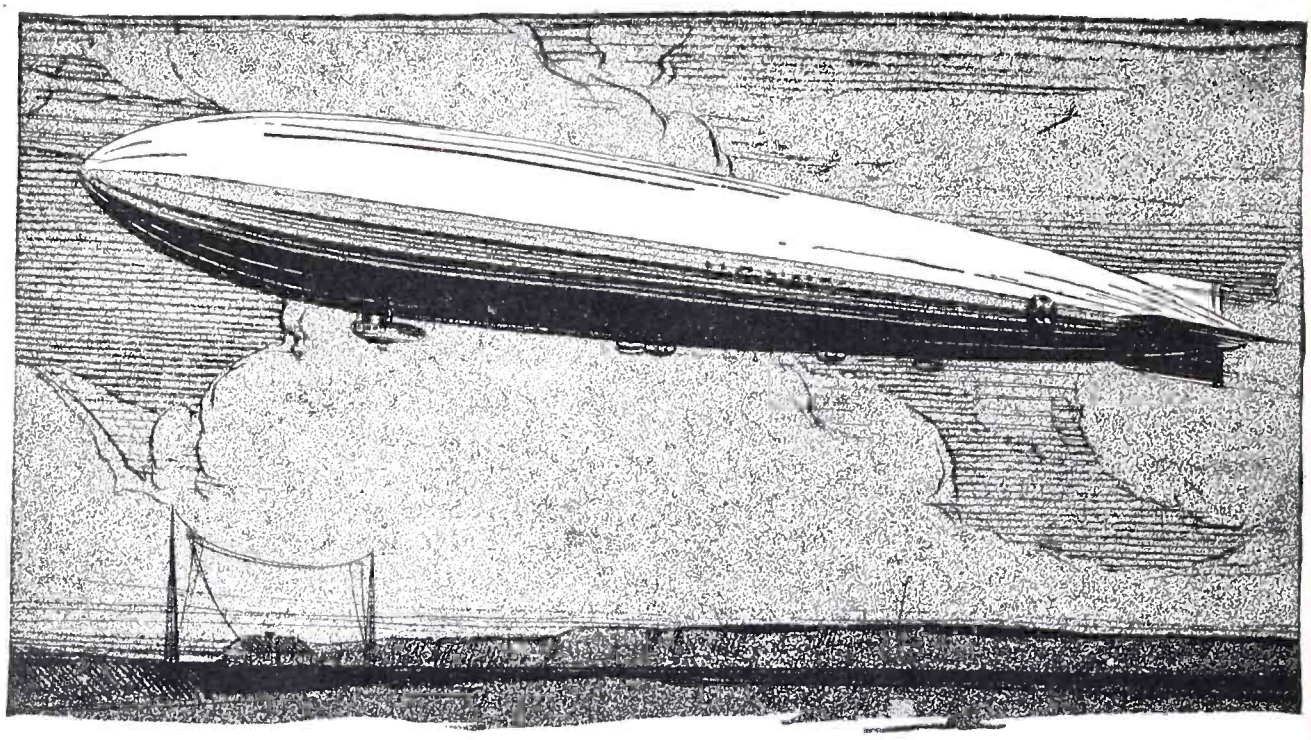


DUBILIER CONDENSERS

Important Links Between the Shenandoah and Land!

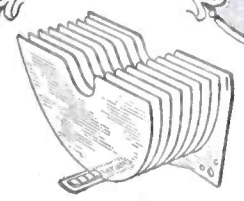
Communication with land—under all conditions—at all times—this was the imperative need of the Shenandoah on its experimental flight across the continent. Impressed with this need, army and navy engineers equipped both transmitting and receiving sets with Dubilier mica condensers—not specially designed condensers but the regular standard product. Only complete confidence in the supreme reliability and efficiency of Dubilier condensers can explain their use in this important and daring adventure.

Dubilier

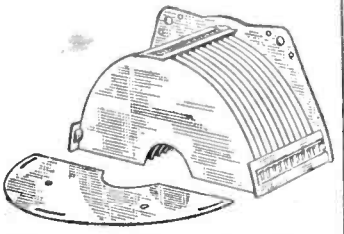
CONDENSER AND RADIO CORPORATION

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

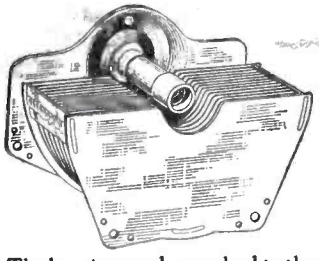
Making the New Bradleydenser



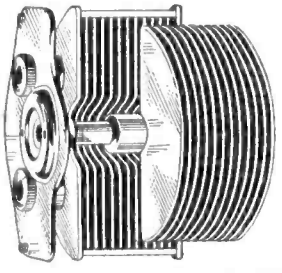
The brass stator plates are soldered to notched spacer bars that maintain perfect alignment.



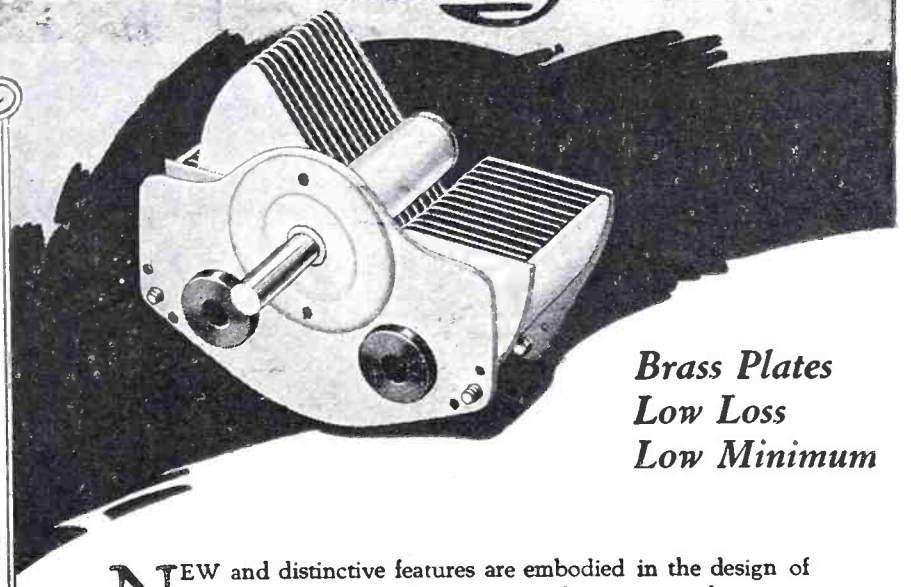
Plates, spacer bars and end plates are all soldered into a solid unit.



The bearing stud, attached to the stator mounting plate, supports the rotor. See illustration at bottom of this page.



Rotor revolves on a double bearing that is independent of the dial shaft.



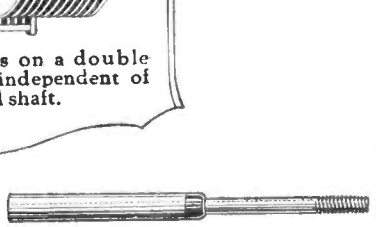
Brass Plates
Low Loss
Low Minimum

NEW and distinctive features are embodied in the design of the Bradleydenser. For instance, the rotor revolves on a long double bearing that preserves rigid alignment and yet eliminates the extra outer end-plate. This reduces the amount of di-electric material and increases the efficiency.

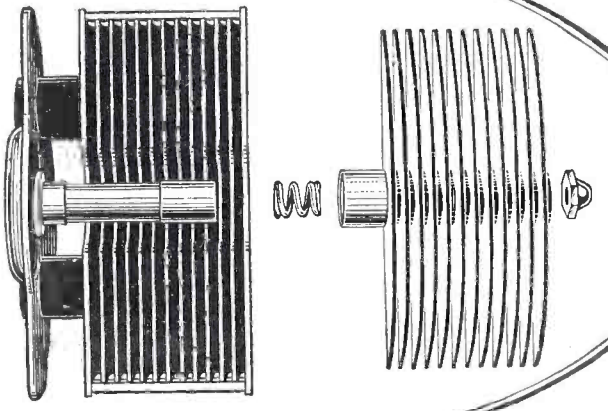
Every joint is soldered. This, combined with the use of brass plates, further increases the operating efficiency. Another feature is the dust cap over the stator plates; it is removable without tools.

The Bradleydenser is made in four sizes: 0.00025 M-f. at $4.50; 0.00035 M-f. at $4.75; 0.0005 M-f. at $5.00; and 0.001 M-f. at $6.00. Leading radio dealers are showing them, now.

Allen-Bradley Co.
Electric Controlling Apparatus
276 Greenfield Ave., Milwaukee, Wis.
Manufacturers of Electric Controlling Apparatus for Over Twenty Years



Disassembled view of the Bradleydenser, showing bearing construction, rotor assembly, and detachable dial shaft. The shaft does not carry the weight of the rotor.



A new Tungar!

The *new* Tungar does all the old Tungar did—and more. It will charge both radio A and B batteries, with no change except slipping the wire from one terminal to another. It charges 2, 4 or 6 volt A batteries—24 to 96 volt B batteries—and auto batteries, too.

It is simpler than ever to use. Just two clips and a plug. No need to disconnect your battery from your set, or make any change in the wiring. The Tungar charges overnight while you sleep. And it makes no disturbing noise.

It is more compact than ever. It has a new bulb, unchanged in principle, but more convenient in size and use. G-E research has made a good product better!

Keep your batteries charged with a Tungar—and get the most out of radio.

300,000 Tungars already in use!

The new Tungar charges both radio A and B batteries, and auto batteries, too. Two ampere size (East of the Rockies) . . $18

The Tungar is also available in five ampere size (East of the Rockies) . $28

60 cycles—110 volts

Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

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

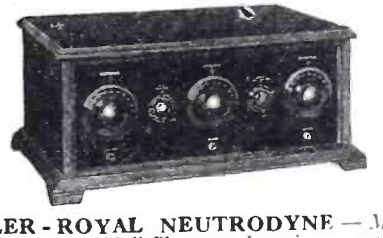
Merchandise Department, General Electric Company
Bridgeport, Connecticut

GENERAL ELECTRIC

The instrument for you--if you are particular

OYAL ELIZABETHAN—*Model 150. Com-nation phonograph and radio. Walnut or mahog-w. Price $350 with loud speaker, less accessories.*

DLER-ROYAL NEUTRODYNE—*Floo ype No. 1 Elizabethan. Dry cells or wet "A" Bat-ies. 5 tubes. Walnut or mahogany. Price $350, cluding loud speaker, without tubes or batteries*



.DLER-ROYAL NEUTRODYNE—*Model 01A operates with "A" storage batteries. 5 tubes. Walnut or mahogany. Price $160. Complete with accessories $215.*

ADLER-ROYAL NEUTRODYNE—*Model 199 Table Type used with dry cells. 5 tubes (199). Cabinets walnut and mahogany. Price $165. Complete $205.*

Licensed by Independent Radio Manufacturers Inc. 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 and manufactured for us by King-Hinners Radio Co.

You will surely find it in this beautiful line of Royal radio and phonographs

THERE is an instrument in the Royal line of radio and phonographs that will not only meet your wishes for better home entertainment but also give you exactly the enjoyment you desire. Whether you want to hear the programs of the radio broadcasting stations or the most beautiful records, a Royal instrument will reproduce the tones perfectly.

Royal gave to the public a better phonograph which thousands welcomed for its superior tone and beautiful cabinet designs. Now in Adler-Royal Neutrodyne it has simplified radio so that any one can operate it. Merely by setting the dials at certain numbers the radio stations are brought in without the discordant noises that have been associated with some types of radio. You have your choice of two different styles. Set 201A operates with the usual "A" storage battery. Set 199 operates on dry cells.

Adler-Royal is on exhibit only at the higher class stores whose reputation is an additional guarantee of the quality of the Royal line.

You will be only fair to yourself if you examine the Royal line and compare it with all others in quality of workmanship, tone reproduction, and price.

ADLER MANUFACTURING COMPANY, INC.

General Sales Office: **Dept. B2, 881 Broadway, New York City**

Factories: **Louisville, Ky.**

ADLER-ROYAL

Phonograph and Radio

Adler Manufacturing Company, Dept. B2,
881 Broadway, New York City.

Please send me the Adler-Royal illustrated booklet and log.

Name .....

Address .....

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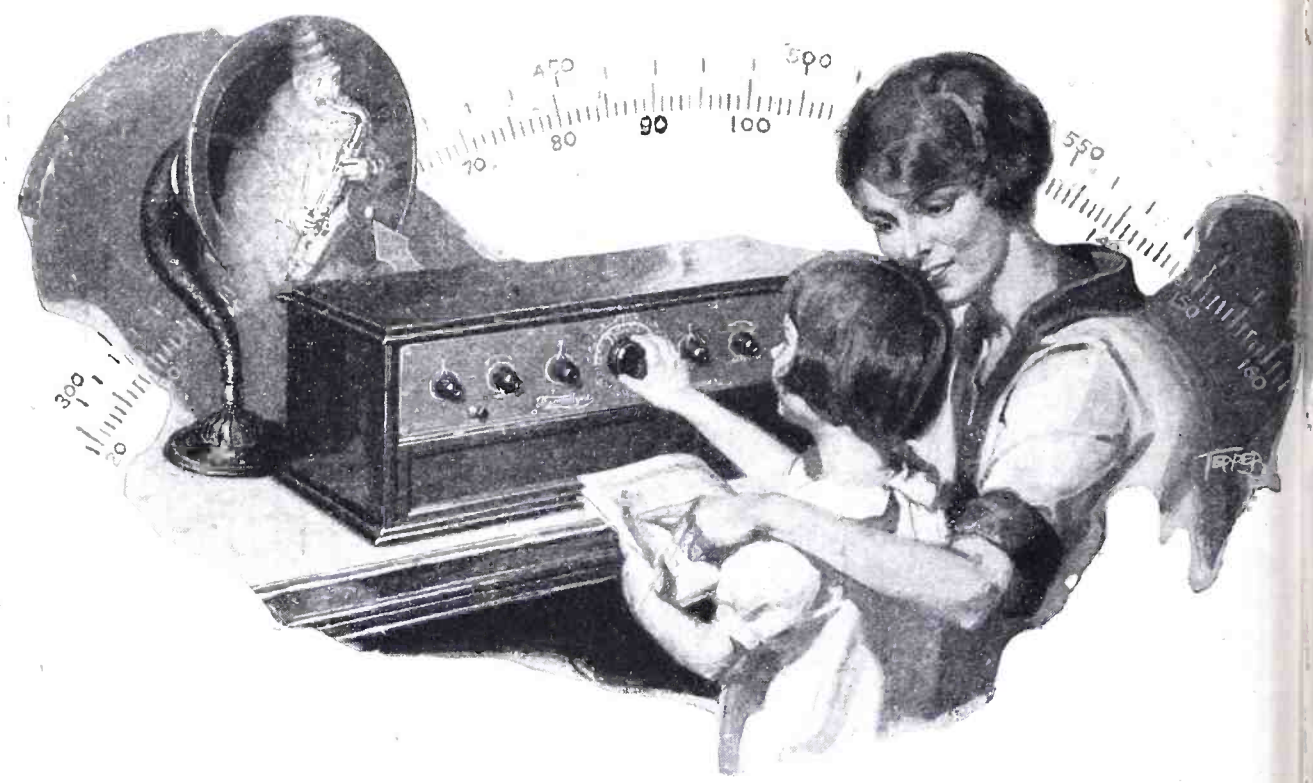


One Master Control

with three stages of Thermionic Frequency

Outboast your fan-friends with a Thermiodyne! Three stages of Thermionic Frequency *before* Detector and two stages of Audio Frequency, all under a single master control calibrated in wavelengths—*there's* something to talk about! The turn of one knob and the station comes in at the setting listed in the radio program. Power! Tremendous range in selectivity! Six tubes that bring in distant stations with loud speaker volume! And so easy to operate that "kid sister" in the third grade can tune in six to ten stations per minute!

Four refiners, independent of the master control, stabilize variations in broadcasting and regulate volume. Powerful local stations can be cut out and distant stations brought in and held without interference. No fishing or straining or howling or distortion. If it's in the air Thermiodyne brings it in clearly and always at the same setting.

And remember this—any accessories may be used with Thermiodyne; our guarantee is unconditional

If you've never listened in with a Thermiodyne you've never really heard radio! Let your dealer give you a demonstration today—write *us* for free booklet.

Price $140
Without Accessories

THERMIODYNE RADIO CORPORATION
PLATTSBURGH, N. Y.

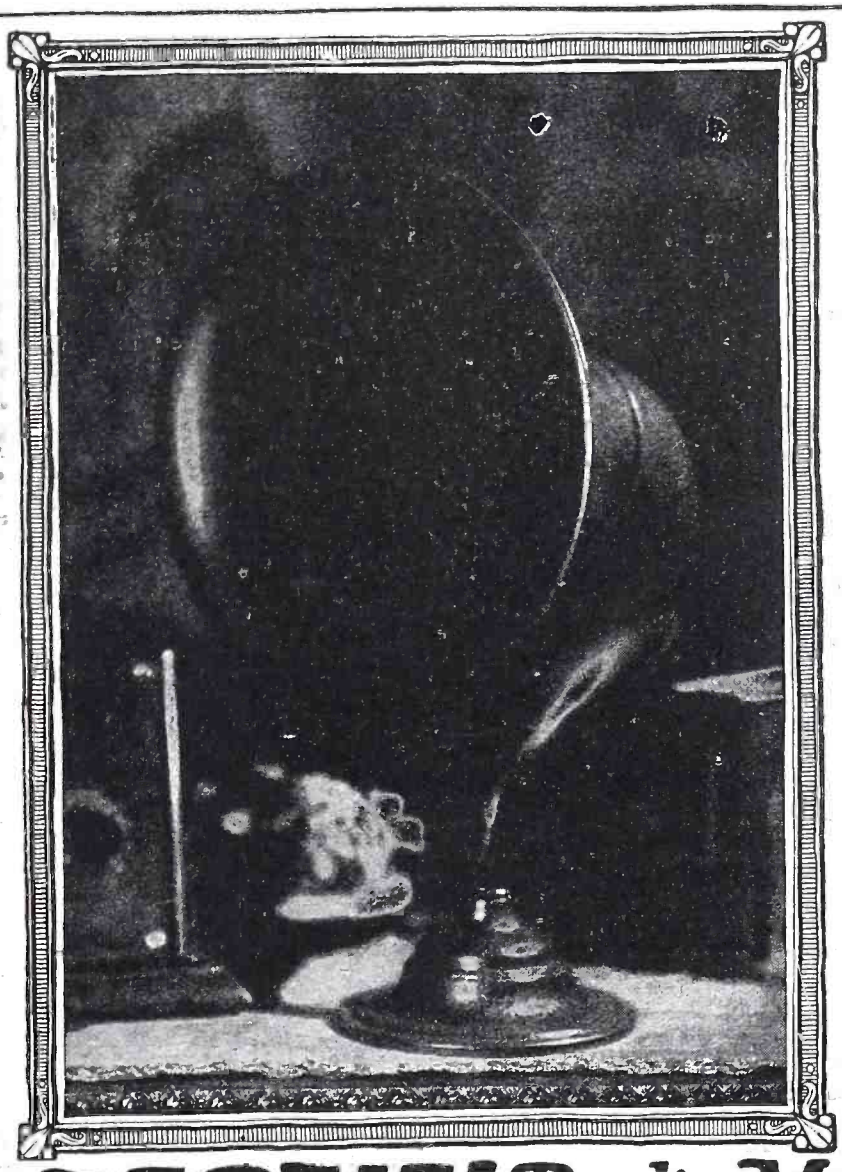
Thermiodyne TF6

Reg. U. S. Pat. Off. [Ther-my-odyne]

Dealers and Jobbers

Write for full particulars regarding franchise for selling the most remarkable receiving set on the market. A few territories are still available, but act quickly.

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



The UTAH
Trade Mark Registered
Made In Salt Lake City
$25.00
Phono-Speaker $10.00

GUARANTEE

Buy a UTAH and use it for two weeks. Compare its tone with the best others are able to produce. If the UTAH does not give at least 50% better reception, return it to your dealer and he will cheerfully refund your money.

NOW! Radio Music as You Never Heard it Before

YOU never heard such tone! You cannot guess the wonderful musical possibilities of radio reception until you hear UTAH reproduction.

Rich, mellow, natural tones of instrumental music—the delicate shadings of the human voice—satisfactory volume from a weak and distant station—or big volume from a strong station, without the rasping and blasting that big volume has always caused—That's UTAH reproduction!

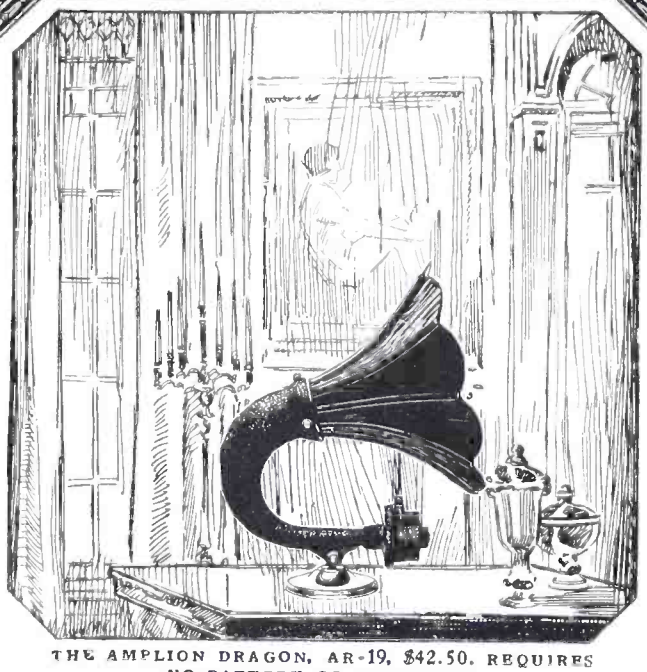
The new UTAH Speaker is the latest triumph of acoustical and electrical engineering—the result of two years work by the leading experts in sound reproduction.

Hear It!

Go at once to your dealer's store and ask for a demonstration. Or better yet, take a UTAH home with you and enjoy it for two weeks under our unprecedented guarantee.

UTAH Radio Products Co., 1427 Michigan Ave., Chicago

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



THE AMPLION DRAGON, AR-19, $42.50. REQUIRES NO BATTERY OR AMPLIFIER

*Alfred Graham & Co., London, England, are the patentees. They have licensed the Amplion Corporation of America to market and manufacture Amplions in this country.

Only

The Amplion has the "Floating Diaphragm" and the non-resonating rubber insulated, acoustically correct "Dragon-shaped" tone conduit. Amplion literature explains.

30 *years* have perfected and made it the finest loud speaker

MASTERPIECE of the world's oldest makers of loud speakers.* Favorite of music lovers in all quarters of the globe. The largest selling loud speaker. That is the Amplion.

You have yet to hear radio supremely reproduced if you have yet to hear the Amplion. For sensitivity, clarity, natural tone and undistorted volume, it is not approached. And why should it be? Is it not the creation of those who *originated* loud speakers, and who have been steadily improving them for over thirty years! At first for use on ocean vessels; since 1920 for radio.

Hear the Amplion—in comparison. Your ears will convince you as no words can. There should be a dealer near you. Write for literature and his name.

***The* AMPLION CORPORATION *of* AMERICA**

Executive Offices: Suite X, 280 Madison Avenue, New York

Canadian Distributors, Burndept of Canada, Ltd., 172 King St. W., Toronto

The Amplion Junior DeLuxe, AR-114, $27.50

Amplion Phonograph Units $19 and $25

Slightly higher in far west

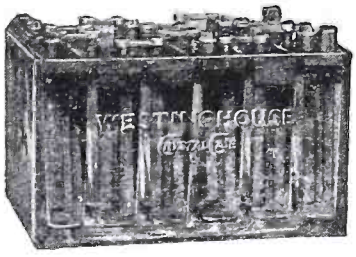
The Amplion Junior, Model AR-111, $24.00

Amplion Dragonfly, Model AR-102, $13.50

Slightly higher in far west

AMPLION

The World's Standard Loud Speaker



Type 24-RG2
$7\frac{5}{16}$" x $5\frac{7}{16}$" x $4\frac{3}{4}$"
3500 Milliampere hours

A Super B Battery

Packed with power to give you volume and distance. Storage battery steadiness that makes for clarity and quiet operation. Rechargeable, which makes it economical and always ready. Recharge over night and start off like new in the morning. Long lasting. Built-in quality and thick radio plates insure long life.

Every necessary feature to make for convenience of operation and reliability in service has been foreseen and provided for. It is the best B Battery we have ever made; the best we know how to make.

THE WESTINGHOUSE UNION BATTERY CO.
SWISSVALE, PENNA.

Distributor for Canada:
THE CANADIAN WESTINGHOUSE CO., LTD.
Offices in all principal Canadian Cities

Distributor for South America, Mexico and Cuba:
THE WESTINGHOUSE ELECTRIC INTERNATIONAL CO.
Mexico City, Buenos Aires and Havana

WESTINGHOUSE
RADIO
"A," "B" and "C"
BATTERIES

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

FREED-EISEMANN

RADIO RECEIVERS

Here are questions asked you every day:

Is the Neutrodyne the best receiver? —is the FREED-EISEMANN the best neutrodyne?—are dry cell tubes as good as storage battery tubes?—is the loop as efficient as the regulation aerial?

Most times—to most questioners—you shrug your shoulders and say it's a matter of individual preference.

But it isn't. It's a matter of *knowledge.* Each of these questions and many more are answered in our booklet "*Buying a Radio*" written for the layman, with a personal word for the expert. Your copy comes free for the asking. Write us.

Four-tube and five-tube models. Prices $100 up.. slightly higher in Canada and west of the Rockies.

Freed-Eisemann Radio Corporation
Manhattan Bridge Plaza, Brooklyn, N. Y.

NEUTRODYNE

The Latest Achievement of the

GENERAL RADIO LABORATORY

The NEW Type 285 Audio Transformer

THE current radio season has seen the advent of many new audio transformers—some of them worthy contributions to better amplification.

Now comes the announcement of the new General Radio transformer which sets an even higher standard of amplification. One stage of amplification using a type 285 transformer operates a loudspeaker with good volume and a quality of tone that is unequalled.

It amplifies high and low notes evenly over the whole audio range so that instrumental or vocal tones are reproduced individually or in combination with a naturalness which delights the most critical radio listener.

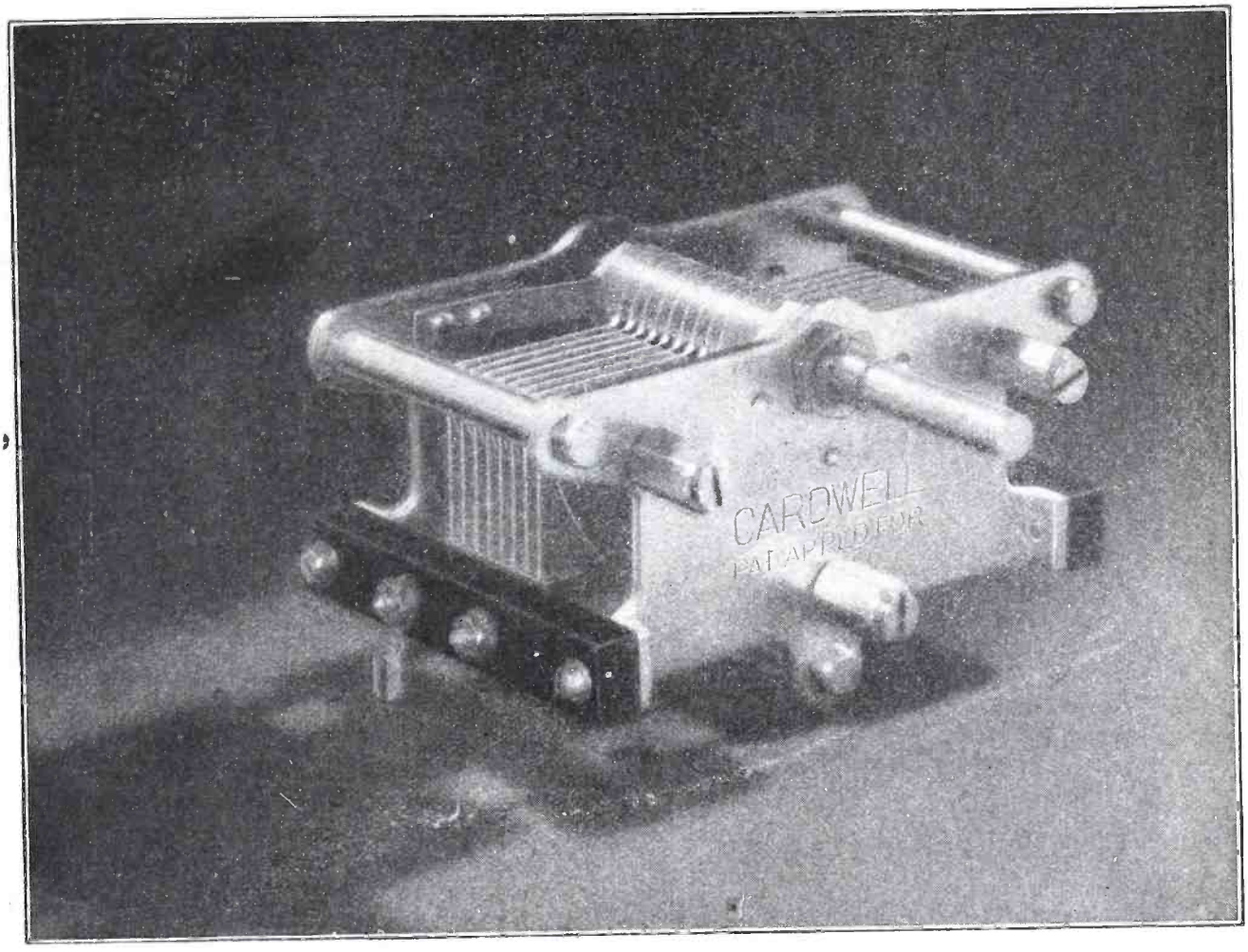
If you want the best there is in transformer design, the type 285 should be your choice.

Price $7.00

See one at your Dealer's or write for Descriptive Bulletin 920U.

GENERAL RADIO Co
Cambridge, Mass.

GENERAL RADIO Co
GR
Cambridge, Mass.
U.S.A.



Insist on CARDWELLS

The *first* "low-loss" condensers

CARDWELL invented the original *low-loss* condenser, using metal end plates and a grounded rotor. The phrase "low-loss" was in fact first applied to Cardwell Condensers by engineers to distinguish these highly efficient condensers from the ordinary varieties.

Cardwell Condensers have been universally adopted by radio editors, experts, and professionals. Cardwells have become the standard of comparison.

Performance is the only real test of a condenser. And Cardwell Condensers have proved their superiority because of their scientifically correct design—small area of contact between insulation and stator supports, rigid three-point frame, permanent alignment, accurate adjustment, etc.

Such details permit exceptional distance records, smooth tuning free from noise, and prevent changes in capacity at given settings.

Use Cardwell Condensers in all receivers. There's a Cardwell Condenser for every requirement—seventy-six different types. A postcard brings you an education on condensers.

TRADE MARK
Registry Applied For

Allen D. Cardwell
Manufacturing Corporation
81 Prospect St., Brooklyn, N. Y.

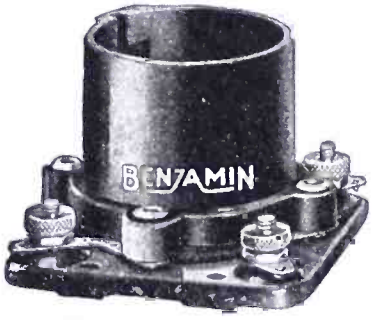
It's a Beauty!

In addition to getting the better tone which comes from using Benjamin shock-absorbing Cle-Ra-Tone Sockets, there isn't anything sounds sweeter to the set builder than to have his friends all say "It's a beauty." You're assured of that if you make Benjamin Radio Products the basis of your set construction.

BENJAMIN CLE-RA-TONE SOCKET

CLEARER RADIO TONE

Shock Absorbing — Spring Suspended



Gives your set a chance to bring through everything that's in it. Tube holding element "floats" on perfectly balanced springs. Keeps out mechanical shock and does away with so-called "tube noises." Spring supports are not affected by stiff bus wiring. Molded parts of genuine Bakelite. A very handsome socket.

8645	For Standard Base VT. . .	$1
8646	For UV-199, etc., Tubes . .	1

Radio Battery Switch

Lightest and neatest switch made. Mounts in single ¼ inch panel hole. No spacer washers required. Push-pull single contact features give positive contact. When it's in it's off, avoiding accidental cutting in of battery.

No. 8640, $0.30

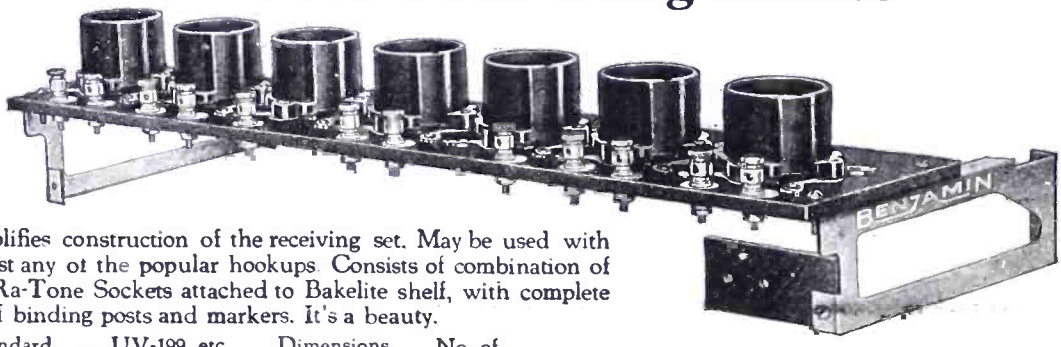
Radio Bracket

Gets the wiring out of sight. Adaptable for standard cabinet mounting. See illustration below. No. 8629, per pair, $0.70.

Grid Leak Panel

With the bracket, provides a safe, secure mounting for this important element. No. 8632, each, $0.15.

Cle-Ra-Tone Gang Socket



Simplifies construction of the receiving set. May be used with almost any of the popular hookups. Consists of combination of Cle-Ra-Tone Sockets attached to Bakelite shelf, with complete set of binding posts and markers. It's a beauty.

Standard VT Sockets	or UV-199, etc. Sockets	Dimensions of Shelf	No. of Sockets	
8613	8603	7⅞″ x 4⅛″ x ¼″	3	$5.50
8615	8605	17¼″ x 4⅛″ x ¼″	5	10.50
8626	8606	17¼″ x 4⅛″ x ¼″	6	11.25
8627	8607	17¼″ x 4⅛″ x ¼″	7	12.00

Brackets and Grid Leak Panel, extra, as shown above

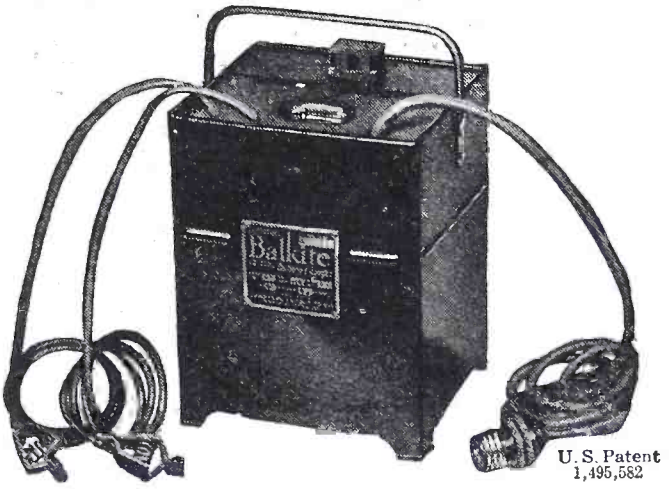
Ask for Benjamin Radio Products at your dealer's or write us and we will send you name of nearby suppliers

Benjamin Electric Mfg. Co.

120-128 S. Sangamon St., Chicago

247 West 17th Street, New York **448 Bryant Street, San Francisco**

TESTED AND LISTED AS STANDARD BY UNDERWRITERS' LABORATORIES



U. S. Patent
1,495,582

Balkite—the noiseless battery charger

can be used while the set is in operation

The Balkite Battery Charger is entirely noiseless. It can be used while the radio set is in use. It does not create disturbances in either your set or your neighbor's. It has no moving parts, vibrators or bulbs, and has nothing to break, adjust or get out of order. It is simple and unfailing in operation. Besides charging "A" batteries it will also charge "B" batteries of the lead type in multiples of 6 cells. *Sold by leading radio dealers everywhere.*

FANSTEEL

Balkite *Battery Charger*

Price $19.50

West of the Rockies $20 · In Canada $27.50

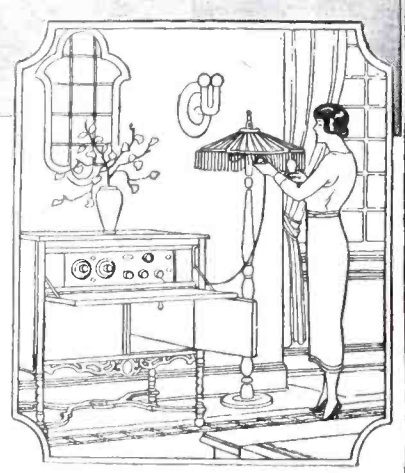
Manufactured by FANSTEEL PRODUCTS CO., *Inc.*, North Chicago, Ill.

The Modern "Arabian Nights Entertainment"

Connect the Mu-Rad MA-20 *to Any Electric Light Socket and be Entertained without Further Effort* ~ ~ ~ ~

"'This rug, my master,' said the merchant to the prince, 'will carry you where you will. Simply express the wish and you are instantly transported.'"

—Arabian Nights Entertainment.



The New

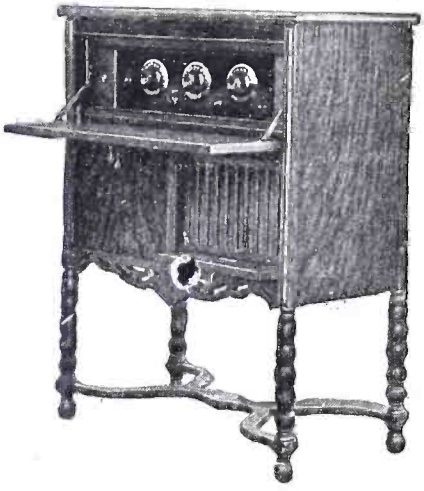
MU-RAD RECEIVER

MA-20

The Last Word in Radio

THE "magic carpet" expressed the medieval idea of the ultimate in swift transportation. TODAY, the radio scientists' conception of the ultimate in radio reception is the MU-RAD RECEIVER MA-20. The entertainment from the great cities of a continent at your command with even less effort than playing a phonograph. Select the stations you want simply by turning the dials to certain numbers—always the same. No batteries to wear out or recharge.

NO Antenna or Loop
"A" or "B" Batteries
Battery Charger



CABINET MODEL MA-20

The MA-20 can also be purchased in a handsome Adam Brown hand-rubbed finished mahogany cabinet with engraved Formica panel.

Write for Literature and the Name of the Nearest Store Where You Can See the MU-RAD MA-20.

MU-RAD LABORATORIES, INC.
809 FIFTH AVE ASBURY PARK, NEW JERSEY

Dear Jim:

So you've been bothered with battery noises.

When a battery leaks electricity between plates or across cell-tops it sure kicks up a row.

This unbalances the current in the set and you get the same spitting and cracking noises as with partly run down batteries.

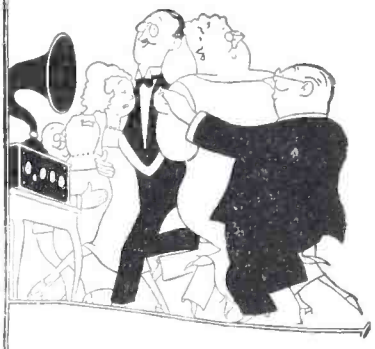
Willard Radio Batteries enable me to cut out these noises, and I can work on a full charge all the time, for Willards are *rechargeable*.

Their Threaded Rubber Insulation guards against leakage inside the battery, and their widely-spaced cells of glass with hard rubber tops say, "Halt," to current that tries to stray outside.

Willards are the only radio batteries insulated with Threaded Rubber. You'll find that *they* will make a tremendous difference in your set.

Your radio friend,

Sam.



WILLARD RADIO BATTERIES

Every radio fan should have WTAM's booklet, "Better Results from Radio." This booklet tells how to get better results from your set, how to clear up battery noises, and gives many other interesting facts that you should know. Not a technical book. Written so everyone can understand.

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.

Mail me to WTAM. I'll bring you "Better Results."

..... Name

..... City and State

..... Street Address

P. R. 6

Model S
Audiophone
$25.00
Rubber horn 14½" in diameter. Cast metal throat. Velvet mat finish of mottled bronze and gold

Each Instrument in PERFECT TUNE

WHEN you tune in a large orchestra, do you hear a great wave of pure harmony? Or do the upper tones of the violins, flutes, oboes, and clarinets come in a trifle "flat".

Because it is itself a true musical instrument, the Bristol Audiophone brings in each instrument and each vocal note in perfect tune. This—not mere noise—is what you should demand in a loud speaker; for it makes all the difference in the world in the performance of your set.

The Bristol line includes five Audiophones, priced from $12.50 to $30.00. If not at your dealer's, write for Bulletins No. 3020, 3021 and 3022-L.

The Bristol Company, Waterbury, Conn.

Cabinet Model
$30.00
Beautifully finished mahogany. Full floating wooden horn and cast metal throat. Musically a companion to the finest set ever built Size 17 x 10 x 10¼"

BRISTOL AUDIOPHONE Loud Speaker

Controlled Volume

With a Radio set of only moderate ability, Superspeaker reproduction of nearby stations might often be stronger than you could possibly need.

But there is always the Superspeaker Volume Control. With it you can modify the heaviest message almost to a whisper. Yet it also puts at your command the greater power you need behind your set, as you reach out and sweep the ether for messages from far away.

This same Volume Control makes you independent of varying battery strength, and enables you to balance delicately every change in temperature or humidity.

Just hear The Superspeaker! Compare it, before you buy, with any other reproducing device, and learn the difference for yourself!

A high quality musical instrument handsomely finished in ebony gloss, standing 26 inches high and weighing more than five pounds. No extra batteries or coils. Nothing to wear out. Built complete by a manufacturer whose reputation, resources and ability are common knowledge throughout the industry.

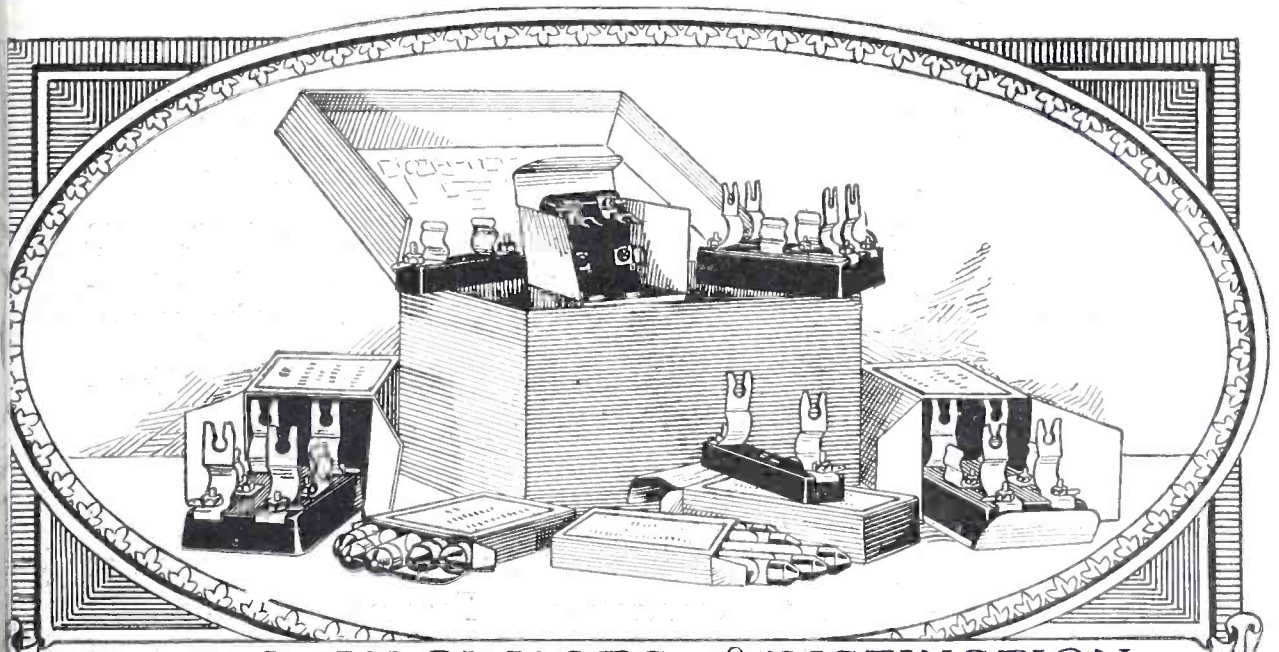
JEWETT RADIO & PHONOGRAPH CO.
5668 Twelfth Street , , Detroit, Michigan

"THERE IS NO SUBSTITUTE FOR THE BEST"

The Superspeaker

Trademark Registered

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



RADIO PRODUCTS of DISTINCTION

The DAVEN Resistance Coupled Amplifier Kits

THE DAVEN SUPER-AMPLIFIER UNIT

For those who prefer to buy a complete Resistance Coupled Amplifier Unit rather than build. This unit comes ready to install—it is the neatest and most compact amplifier now offered to the public.

It is laboratory tested and represents the ultimate in amplifier design. The base is of molded Bakelite and is small enough to fit within any cabinet. All connections are hidden beneath the base.

Sold everywhere.

Ask your Dealer for a copy of our 25c handbook—"RESISTOR MANUAL"—telling about the many possibilities of Resistance Coupled Amplification and how to use it with any of the standard forms of receivers.

These highly perfected Resistance Coupled Amplifiers have convinced the most skeptical that Resistance Coupling is matchless. Add the **Daven Resistance Coupled** Amplifier to your favorite tuner and you will have a worthy combination hard to beat and amplification that is perfect.

The assembly is very simple, while the satisfaction of having built such a perfect device yourself is beyond mere words to describe. Its volume is adequate for all purposes—its perfect tone quality and absolute lack of distortion place it beyond comparison.

These Kits can be purchased at all good Radio Stores—they come with complete instructions for assembly so that the novice will have the same success as would be expected of Radio Engineers. Sockets and mica fixed condensers are not included, but instructions are furnished giving complete information and diagrams. Supplied for either three or four stages.

TRADE MARK

DAVEN RADIO CORPORATION

"The Sine of Merit"

Resistor Specialists

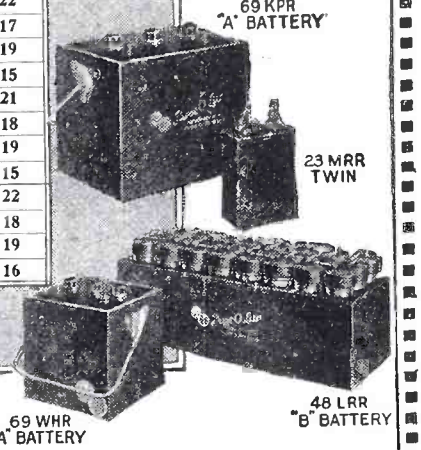
Newark New Jersey

"The Aristocrat of Amplifiers"

Prest-O-Lite

RADIO CHART

Voltage of Tubes	No. of Tubes	Type of Tubes	Total Rated Ampere Drain	Recommended Prest-O-Lite "A" Batteries: Order by following Types	Recommended Prest-O-Lite "A" Batteries: Days between Chargings
5-Volt Tubes	1	UV-200	1	69 WHR OR 67 WHR	22 / 16
C-300 and UV-200 are interchangeable. C-301A, DV-2 and UV-201A are interchangeable	2	UV-201A	½	67 WHR	33
	2	1 UV-200 1 UV-201A	1¼	611 WHR OR 69 WHR	22 / 17
	3	UV-201A	¾	69 WHR OR 67 WHR	29 / 22
	3	1 UV-200 2 UV-201A	1½	611 RHR OR 611 WHR	21 / 18
	4	UV-201A	1	69 WHR OR 67 WHR	22 / 16
	4	1 UV-200 3 UV-201A	1¾	613 RHR OR 611 RHR	22 / 18
	5	UV-201A	1¼	611 WHR OR 69 WHR	22 / 17
	5	1 UV-200 4 UV-201A	2	613 RHR OR 611 RHR	19 / 15
	6	UV-201A	1½	611 RHR OR 611 WHR	21 / 18
	8	UV-201A	2	613 RHR OR 611 RHR	19 / 15
	For sets using current at a rate higher than 2 amperes.		2¼	69 KRL OR 69 KPR	22 / 18
			2½	69 KRL OR 69 KPR	19 / 16



What size batteries will work best in your set?

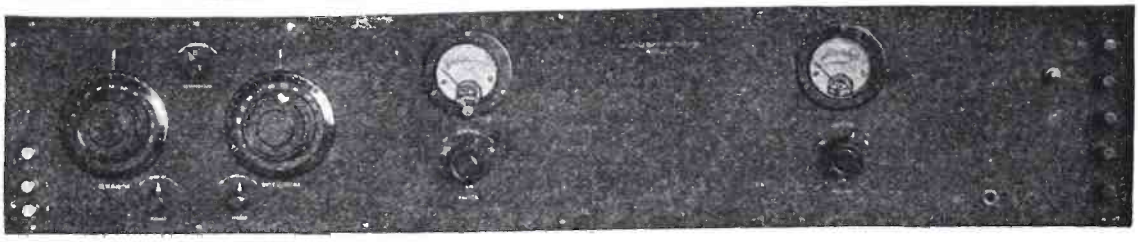
THE Prest-O-Lite Radio Chart makes it easy for you to select the right storage battery for best reception. Also arranges the time between chargings to suit your convenience. Illustrated above is a section of the master chart showing Prest-O-Lite "A" Batteries for 5-volt tube sets. If your set has these tubes, you will find, in this chart, the Prest-O-Lite "A" Battery that fits it exactly. Use either of the two sizes recommended, depending on the number of days' service you want between chargings (based on an average use of your set of three hours a day).

Thousands of radio dealers have the complete chart, showing you also how to select "B" Batteries, as well as "A" Batteries for peanut tube sets. You'll prefer Prest-O-Lite Batteries because of their special features designed for better radio reception. Improved separators and plates insure steady, unvarying current and years of life. The novel solid-seal top prevents current leakage and possible short circuits. They're easy to recharge and priced remarkably low—from $4.50 to $38.25.

See the Prest-O-Lite Chart at your dealer's—or write for booklet, "How to fit a storage battery to your set—and how to charge it."

THE PREST-O-LITE CO., INC., INDIANAPOLIS, IND.

New York Office: 30 East 42nd St. *Pacific Coast Factory:* 599 Eighth St., San Francisco.
Canadian Factory: Prest-O-Lite Company of Canada, Ltd., Toronto, Ont.



For any Circuit

Prompt shipment can be made on tested, standard apparatus of the following manufacture:

E. I. S., Inc.
General Radio
Ultradyne *Willard*
Sangamo Electric
Benjamin Electric
Allen Cardwell
Dubilier *Formica*
Weston *Magnavox*
Jewell *AmerTram*
Western Electric
Radio Corporation
Music Master *Acme*
CutlerHammer *Frost*
Federal *Kellogg*

Pressley Circuit as described in Poplar Radio. We furnish parts as specified.

Super-Heterodyne C-7

Model C-7 the Long Distance Concert Receiver that Excelled in the recent Trans-Atlantic Tests

None of the so-called new "circuits" or modifications of standards approach the C-7 in efficiency—for long range, for high audibility, for selectivity, ***seven tubes give the result of ten*** because this model allows signals to be regenerated and heterodyned through radio frequency amplifier.

E. I. S. Model--All material we furnish is endorsed and recommended by the designers.

Using the finest apparatus and building to Naval standards, model C-7 has a telephone range of 3000 miles.

Norden-Hauck Price List Saves You Money

Free Information—Write for descriptive matter and price list. Our service is as near as your mail box. Special engraving to order.

Full Stock on Hand—We carry complete stocks of laboratory tested apparatus for immediate shipment.

Norden, Hauck & Co. Engineers • Office and Laboratories 1617 Chestnut St., Philadelphia

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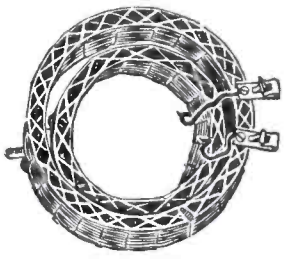
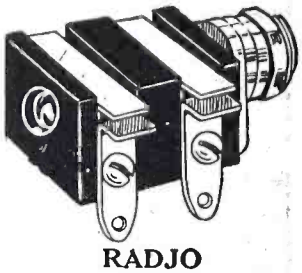


RADJO
Low Loss Tuner

Install a Radjo Low Loss Tuner in your old tube set and increase its EFFICIENCY and SELECTIVITY. Wound by the Lorenz type of winding. Single, Double or Three Circuit Tuner.

PRICE EACH
$5.50

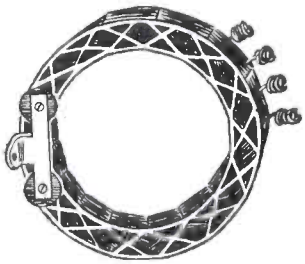
RADJO LOW LOSS PRODUCTS



RADJO
Anti-Capacity Jacks and Switches

Minimum of electrical capacity, wiping contact rugged and compact. The Radjo is one-third the size of other jacks and fits any standard plug. It assures minimum resistance.

PRICES
70c. to $1.00



Radjo Low Loss Radio Frequency Transformer

No dielectric absorption losses. Minimum distributed capacity gives increased clarity, volume and selectivity. For use in Tuned Radio Frequency Neutrodyne and Reflex circuits.

Easy to Mount
Increases Distance Range
PRICE $2.00

FREE! *You owe it to yourself and your set to learn about Radjo Low Loss Products. Send today for interesting Literature. It's free.*

Dealers and Distributors Wanted—Write for Proposition.

Licensed Mfrs.—Sharp Spark Plug Mfg. Co., Cleveland, O.

ELECTRIC CITY NOVELTY & MFG. COMPANY
SCHENECTADY, N. Y.

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

Salisbury Radio Table

$13.50

Direct to you

OUR Radio Table No. 82 combines exceptional strength, durability and handsome appearance. The low price is possible only because of economical manufacturing, which enables us to sell direct to you at a substantial saving. The top measures 30 x 20 inches. There is one roomy drawer, and a strong shelf for batteries. May be had in solid oak, birch mahogany or birch walnut.

Don't send a single cent

CHECK the finish you desire in the coupon below. Do not send any money. Just pay the expressman $13.50, plus the small express charge, on delivery. We stand behind this table with an absolute guarantee. Send in your order today. Salisbury Bros. Furniture Co., Randolph, Vt.

SALISBURY BROS. FURNITURE CO.,
Dept. A-1, Randolph, Vt.

Mail coupon and we'll do the rest.

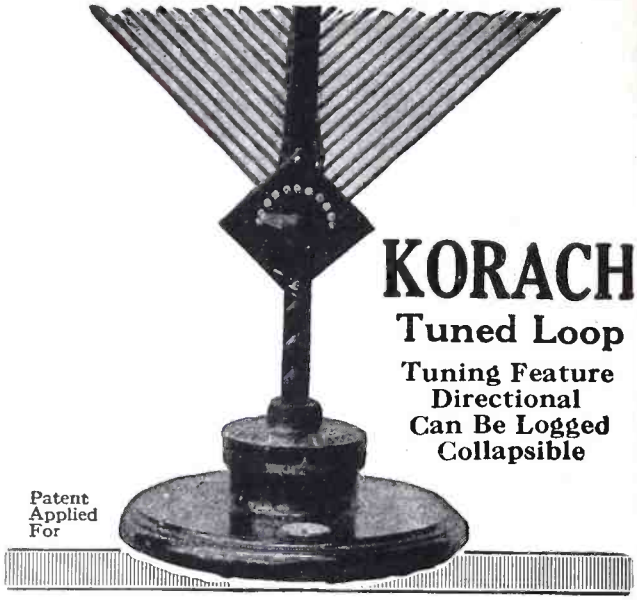
SALISBURY BROS. FURNITURE CO.,
Dept. A-1, Randolph, Vermont.

Send the Salisbury Radio Table, No. 82, finished in (check) ..... Solid Oak, (check) ..... Mahogany, (check) ..... Walnut. I will pay the expressman $13.50 and expressage on delivery.

Name .....

Address .....

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



Patent Applied For

KORACH

Tuned Loop

Tuning Feature
Directional
Can Be Logged
Collapsible

APPROVED!

Recommended and used on the famous COCKADAY 8-Tube SUPERHETERODYNE REFLEX

For perfect results, combined with new, amazing features use the KORACH TUNED LOOP. Laurence M. Cockaday, in the January issue of POPULAR RADIO, recommends the famous KORACH TUNED LOOP on his "Cockaday 8-Tube Superheterodyne Reflex". Mr. Cockaday and his associates are loud in their praises of this marvelous instrument. You too, will find it far superior to anything yet offered. Operates successfully on all sets designed for loop reception Gives remarkable results.

By All Means, Use This Loop

if you are building Cockaday's new Superheterodyne Set Positively the last word in loop construction. Exclusive features give you selectivity and distance unheard of before with loop aerials. If your dealer cannot supply you, order direct from us. Price $16.50. Send $2.00 as good faith deposit with your order, balance C.O.D. Parcel Post. Satisfaction guaranteed.

HERMANSON-KORACH MFG. CO.
309 So. LaSalle St. Dept. 9 Chicago, Ill.

Full Particulars on Request

Dealers and *Jobbers*: Write at once for attractive discounts

"Night Hawk's Friend"

BIG PYRAMID

Crystals

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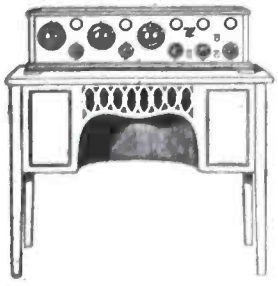
You can't get more rectification out of a crystal than *mother nature* put in the mineral.

"Night Hawk's Friend" is made from the *finest mineral* procurable. Highly sensitive, with plenty of surface for contact, DX is sure to be the result. Dealer or direct, postpaid.

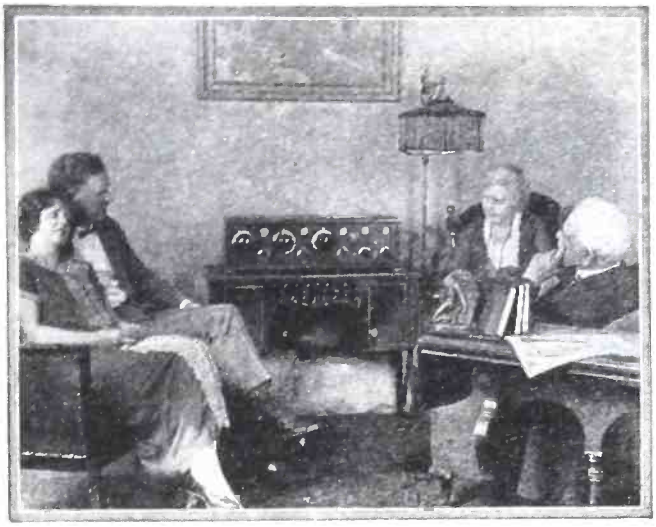
PYRAMID PRODUCTS CO.
117 N. Dearborn St. Chicago, Ill.

Radio Without the Horn!



Goodbye to the Old-Fashioned Horn Speaker!

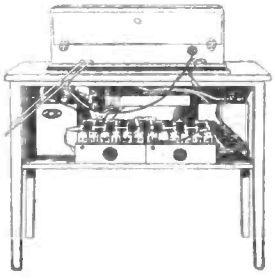
A Vastly Better Reproduction With this New Radio Console!



"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 unsightly apparatus that plays havoc in the decorative scheme of your living room! The horn speaker is out of date and out of place in radio for the home. This console, with its in-built loudspeaker, is scientific and sightly.

A Truly Wonderful Tone

It does a good job of reproducing, for it has a good unit and its sound-box is of resonant wood instead of metal, fibre, or composition.

The appearance of a Windsor loudspeaker console is a delight. Its convenience is a joy. A piece of real living room furniture of pleasing lines 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 console and receiving set. Everything else goes inside—from behind—in spaces cleverly designed to hold the largest batteries and outfit for home use—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 back. These spaces are ample for the largest A battery, and the largest wet B batteries and the largest charging outfit for home use. It is 38 in. long, 18 in. deep, and 29 in. high. Notice the artistic grill that conceals sound-box, and the provision for "knee room" beneath. Made in mahogany or walnut finish, *and the price is only $40!* (West of the 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 reproducing unit and sound-box, but an altogether new beauty and utility in the provision for your entire radio outfit. Mail coupon or postal.

If you wish to use your own favorite unit, a deduction will be made for omission of unit.

WINDSOR FURNITURE COMPANY (11)
1422 Carroll Ave., Chicago

Please furnish pictures and full details, also name of nearest dealer who has the new Windsor loudspeaker console.

Name .....

Address .....

For Circuit Supremacy— CIR-KIT and Supereflex

Erla Supereflex—new epoch in circuits. Not just a "wave" of popularity, but the permanence of *basically* superior principles, just as advanced today as when Erla introduced the circuits still rated more powerful, tube for tube.

Expressing the best of Erla science, Supereflex circuits also are so easy to own! Not only because of extreme economy in first cost and operation, but also because Erla *CIR-KIT* enables any experimenter to produce these greater circuits flawlessly. *CIR-KIT* provides every needed item of Erla Precision Radio Apparatus—exclusively responsible for matchless Erla range, volume, clarity, sensitiveness and remarkable ease of control.

CIR-KIT also provides full-size blueprints; stenciled baseboard; and drilled, lettered panel, so that every step must be correct. Assuring lasting supremacy in circuits; the pride of a truly professional hook-up; and incomparable entertainment, *CIR-KIT* is outstanding in radio today.

Electrical Research Laboratories

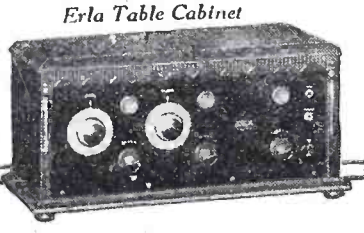
Dept. R, 2500 Cottage Grove Ave., CHICAGO

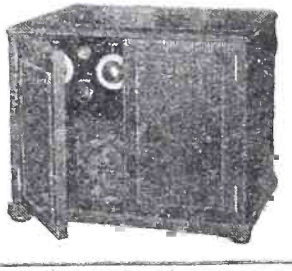
ERLA

Erla complete radio instruments lift radio to the realm of art, with the same superiorities CIR-KIT brings.

Erla Floor Console

Erla Table Cabinet





Erla Table Console

Radio Panels In Individual Envelopes

Manufacturers

Spaulding - Bakelite panels are available in Black, Mohogany, and Walnut finishes. Prompt shipments assured from Spaulding warehouses conveniently located on the Atlantic and Pacific Coasts and Mid-Continent. Each branch is newly equipped with the machinery for producing Bakelite panels, coils, and specialties to manufacturer's order. Our nearest office employs skilled Bakelite Engineers to serve you.

Your Assurance of Manufacture Under the Special Spaulding Process

Just the size panel you need—protected against marring and guaranteed by this envelope container to be Spaulding-Bakelite. You can safely *put your faith* in panels sold in these envelope containers. They are processed expressly for radio, with the same unlimited facilities which produces all Spaulding fibre products, famous the world over.

A laminated phenolic condensation product that possess high dielectric properties and great strength; drills, saws, engraves without chipping; retains a beautiful, everlasting lustre.

Write nearest office for descriptive circular

Spaulding
-BAKELITE

SPAULDING FIBRE COMPANY, Inc.

FACTORY—TONAWANDA, NEW YORK

BRANCH OFFICES—WAREHOUSES

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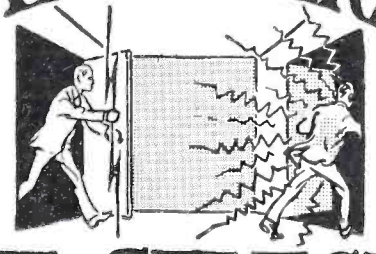
EXIT INTERFERENCE



WELCOME SELECTIVITY

LITERALLY thousands of people have come to know the joys of perfect radio reception through the Ferbend Wave Trap. Testimonials from all parts of the world continue to pour in, unsolicited, from those who have equipped their set with this marvelous instrument.

You, too, will find it the shortest, easiest, and—best of all—the least expensive route to clear, undistorted reception—*without interference.* Never reduces, but nearly always increases volume. You can make your set selective to the point of perfection by simply adding a Ferbend Wave Trap. *It will absolutely cut out any interfering station, no matter how loud, how close by or how troublesome.* So why pay $50.00 to $200.00 extra for increased selectivity when you can buy it for $8.50?

Guaranteed to tune out any interfering station. The Ferbend Wave Trap is designed and manufactured complete by us after years of careful experimenting. It is not to be confused with imitations, hastily assembled from ordinary parts. The price is $8 50. Shipment is made Parcel Post C. O. D., plus a few cents postage. If you prefer, you can send cash in full with order, and we will ship postage prepaid. Clip and mail the COUPON today!

FERBEND ELECTRIC CO.

21 E. South Water Street **CHICAGO, ILL.**

FERBEND Wave Trap REG US PAT OFF

Always look for this Trade Mark. It is your protection against misleading imitations and those who infringe on the registered name "Wave Trap" and its reputation. "If it isn't a FERBEND, it isn't a WAVE TRAP."

Read the evidence

Dunbar, West Va.
Ferbend Electric Co.

Gentlemen: I bought your Wave Trap to see if I could not cut out the awful noise of telegraph stations which ruined most of our programs. Since we installed it in our five-tube Fada Neutrodyne set we have not heard any more telegraphers—*we let 'em in sometimes to show our friends how easy it is to kick 'em out with the Wave Trap.* I would not have a set without a Ferbend Wave Trap.

(*Signed*) H. E Atherton.

Farragut, Iowa.
Ferbend Electric Co.

Dear Sirs: I set my radio where Havana, Cuba, should come in but received only a jumble of K. F. N. F., W.O.R. and W.L.A.G. I then tuned in with the Trap and had Havana for two hours. I have several times taken a jumble like this and separated five and six stations. I find it a great help in cleaning up stations that can not be brought in distinct. I am using a Crosley X.J.

(*Signed*) W. T. Cox.

Towson, Md.
Ferbend Electric Co.

Gentlemen: Well to say I am pleased with the Trap is putting it mildly. It is simply a wonderful instrument. I have have had more or less trouble in getting K.D.K.A., W.B.Z., W.D.R. and W.L.W. with my Freed-Eisemann Set as they are only a few degrees apart on my dials. Your Trap lets me through with the clearest possible reception. In my candid opinion there is no Radio Receiving Set complete without the addition of the Ferbend Wave Trap.

(*Signed*) E. W. Stevenson.

FERBEND ELECTRIC CO.
21 E. South Water St., Chicago, Ill.

Gentlemen: Please send me:

☐ WAVE TRAP. Send postpaid. I am enclosing (check, M. O., etc.) for $8.50.

☐ WAVE TRAP. Send C. O. D. I will pay Postman $8.50, plus few cents postage, when it arrives.

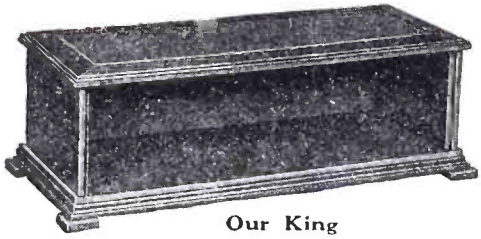
☐ FREE BOOKLET on Interference.

Name.....

Address.....

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

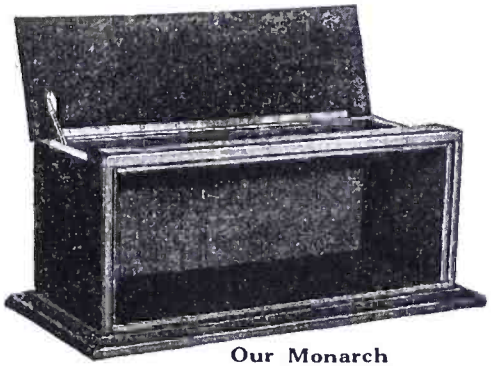
All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



Our King

Utility cabinets are all made of carefully selected lumber. They are beautifully finished and hand rubbed. The workmanship is of as high grade as in the best furniture.

By ordering direct from us you obtain factory to consumer prices and save jobber and dealer profits. If not entirely satisfied with the cabinets received, money will be refunded without question.



Our Monarch

DOES YOUR SET LOOK AS WELL AS IT WORKS?

Your set performs well but does it look well in your home? You owe it to your home and to your set to use a good looking cabinet. Utility cabinets will look well in the best surroundings, and are worthy of the highest grade sets.

Our King type of black walnut (illustrated above) is the best we make and as good a cabinet as is made. Our King is also made in birch.

Our Monarch (illustrated below) is made of walnut also. It differs from Our King chiefly in that it has a split top—a type preferred by some.

Our DeLuxe is of the same general type as our Monarch, but is built of thinner lumber and consequently is cheaper.

For Panel	Deep	Birch No Base	DeLuxe Black Walnut	Monarch Black Walnut	King Black Walnut	King Birch
6 x 7	7"	$1.75	$3.75	$4.40	....	....
6 x 10½	7"	2.25	4.65	5.35	$5.35	$3.35
6 x 14	7"	2.75	5.45	6.20	6.20	3.85
6 x 21	7"	3.25	5.90	6.80	6.80	4.60
7 x 12	7"	2.80	5.50	6.50	6.50	4.00
7 x 14	7"	3.00	5.80	6.70	6.70	4.20
7 x 18	7"	3.25	6.00	6.80	6.80	4.35
7 x 21	7"	3.60	6.50	7.40	7.40	4.90
7 x 24	7"	4.10	7.25	8.00	8.00	5.35
7 x 26	7"	4.75	7.80	8.50	8.50	5.80
7 x 27	7"	5.00	8.50	9.00	9.00	6.20
7 x 28	7"	5.25	9.50	10.00	10.00	6.60
7 x 30	7"	6.00	10.00	11.00	11.00	7.00
7 x 24	10"	5.60	9.25	10.00	10.00	6.70
7 x 26	10"	6.25	9.80	10.50	10.50	7.25
7 x 27	10"	6.50	10.75	11.50	11.50	7.70
7 x 28	10"	6.75	11.50	12.00	12.00	8.00
7 x 30	10"	7.00	12.00	12.50	12.50	8.20
8 x 36	8"	....	....	....	12.00	8.75
8 x 40	8"	6.00	11.50	12.50	12.50	9.25
9 x 14	10"	3.95	6.40	7.00	7.00	5.25
9 x 21	10"	5.00	7.70	9.25	9.25	7.50
9 x 24	10"	6.00	9.50	10.50	10.50	8.50
12 x 14	10"	4.25	7.00	8.00	8.00	5.50
12 x 21	10"	4.75	9.50	10.50	10.50	7.25

Order Direct From

UTILITY CABINET COMPANY

439-443 27th Street, MILWAUKEE, WIS.

WHERE RADIO FANS BUY PARTS OF RECOGNIZED MERIT

Cockaday's 8 Tube Superheterodyne Reflex Receiver

1	General Instrument Low-Loss Condenser (isolantite insulation) .005 mfd.		$5.50
1	General Instrument Low-Loss Condenser (isolantite insulation) .001 mfd.		6.00
1	Haynes-Griffin Input Transformer (new type)		4.50
3	Haynes-Griffin Intermediate-Frequency Transformers (new type)	ea. $4.60	13.50
	(Set of transformers carefully matched, $20)		
1	Precision Autodyne Coupler		3.50
1	Karas-Harmonic Audio-Frequency transformer		7.00
1	Amplex Grid-denser .0005 mfd.		1.25
1	Benjamin Cle-ra-tone Socket		1.00
7	Federal Sockets No. 16	ea. $1.20	8.40
1	Pacent Double Circuit Jack		.60
1	Pacent Single Circuit Jack		.50
2	Na-ald 4 inch Dials No. 3043	ea. .75	1.50
1	Amsco 2 ohm Rheostat		1.35
1	Amsco Potentiometer 400 ohms		1.50
2	Daven Resisto coupler mountings	ea. 1.25	2.50
1	Daven Grid-leak Mounting		.35
2	Daven Resistor .5 Megohms	ea. 50	1.00
1	Daven Resistor 5 Megohms		.50
1	Daven Resistor .005 Megohm		1.00
2	Daven Resistor .25 Megohm	ea. 50	1.00
1	Radion Panel 7x24 ins.		3.00
2	.0001 N. Y. Coil Mica Condensers	ea. 35	.70
4	.006 N. Y. Coil Mica Condensers	ea. 75	3.00
1	.00025 N.Y. Coil Mica Condenser with grid-leak Mounting		.45
1	Duratran Radio-Frequency Transformer		4.00
1	Walbert A Battery Switch		.50
1	Baseboard 9 3-8 x 22 3-4 x 1-2 ins.		.75
1	Connection Block 1 x 9 x 3-16 ins.		.40
7	Eby Binding Posts	ea. .20	1.40
	Material for making brackets		.25
1	Koruch Tuned Loop		16.50
			$93.40
1	Mahogany Cabinet		12.50

Cabinet sent free with complete order.

Parts in stock for Cockaday Four Circuit Tuner with resistance coupled amplifier and Pressley Superheterodyne.

Try us on any radio parts you have been unable to secure.

MORISON
Electrical Supply Co. Inc

Wholesale *Retail*

C.O.D. Mail orders will be shipped promptly

15 EAST 40th STREET NEW YORK CITY

The "Works" of the DeJur one hole RHEOSTAT

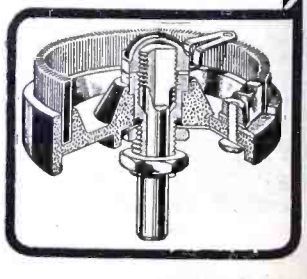
Genuine Bakelite Throughout

Note below how the contact slider and shaft are made in one piece. Permanently set at the factory, this insures perfect contact throughout the entire resistance range. The one hole makes DeJur the easiest rheostat to mount and when mounted it sets fixed and rigid. No screws to get loose and no back panel fussing. Compare the DeJur. You will readily recognize its difference and superiority.

At dealers everywhere

Jobbers—Write for discounts

DE JUR PRODUCTS CO.,
Lafayette & Broome Sts. New York



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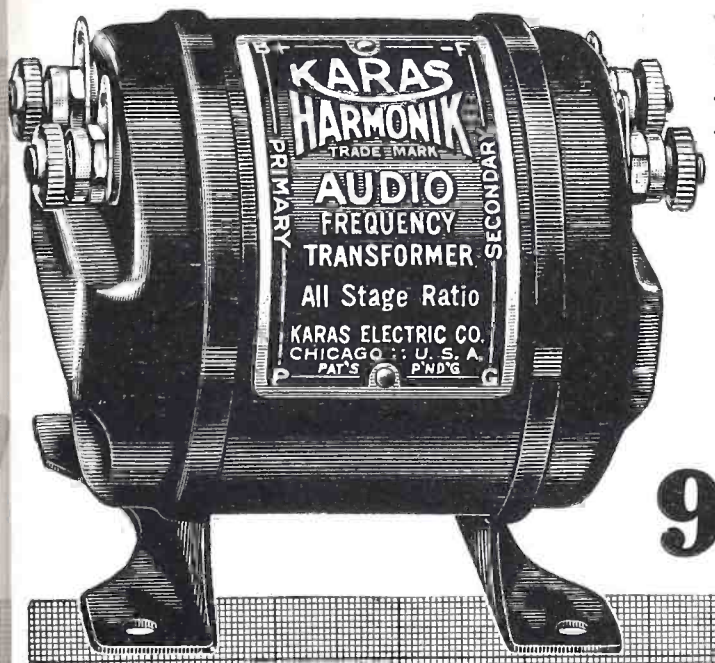
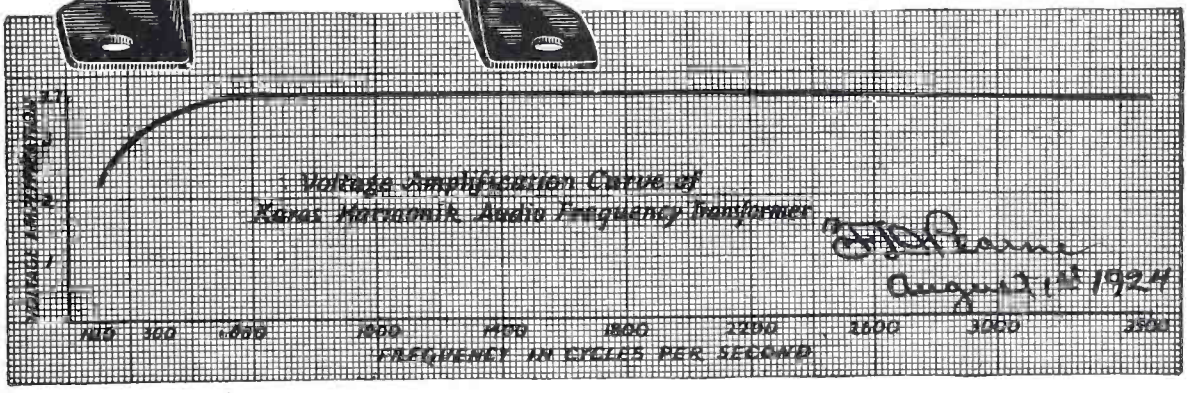


How Size and Weight plus Scientific Design made the

KARAS HARMONIK TRADE MARK Audio Frequency Transformer

98.1% Perfect

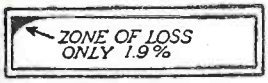


The curve of the Karas Harmonik, attested by Frank D. Pearne and verified by Popular Radio Laboratory and numerous other testing laboratories and bureaus

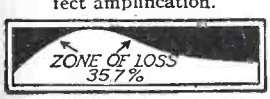
The only "eye evidence" of quality in an audio transformer is the laboratory curve showing the amplification factor at each audio frequency within the audible range. This curve of the Karas Harmonik proves 98.1% perfect performance—a vast improvement over the best that was known before the Karas Harmonik was developed Here is the explanation of the pure, natural musical tones which the Karas Harmonik delivers in such surprising volume—a quality of reception far in advance of anything radio has ever known before.

Typical Transformer Curves Compared with the Curve of the Karas Harmonik and showing the "Zone of Loss" by comparison with the ideal straight line curve that would mean 100% perfection.

Black areas indicate zones of loss—no amplification.



The curve of the Karas Harmonik proving 98.1% perfect amplification.



The curve of the average $5 transformer, 64.3% perfect.

The curve of the typical high ratio transformer, showing the tremendous loss at low and high frequencies which results in only 39.3% complete amplification. This curve is also typical of most low priced transformers.

If a transformer is to deliver natural, undistorted music, it must amplify equally at all audio frequencies Most transformers have a common fault—a resonance peak at about 1,000 frequency, and only partial amplification above and below that point. To attain high amplification at low frequencies a high impedance in the primary circuit is essential. This means more turns of the primary winding—with the consequent increase in the turns of the secondary. But the normal result of a large number of turns on the secondary winding is to create a high distributed capacity. This has the effect of a shunt across the primary, which by-passes high audio frequencies and results in two forms of distortion. First: a serious loss in volume of high tones. Second: the failure to amplify the harmonics of middle tones whose fundamental frequencies match the resonance peak of the transformer. Thus the fundamentals of such tones are amplified out of all proportion to their harmonics and the identifying characteristics of the voice or instrument are lost. Thus it is plain that the conditions favorable to the proper amplification of low frequencies are in direct conflict with the conditions favorable to the amplification of high frequencies. That was the problem faced and conquered for the first time by Karas Engineers. It takes lots of iron and lots of wire to overcome these faults. The 100% transformer would have to be as large as some radio sets—and the cost would be prohibitive. To bring this ideal transformer within practical size and price limits—that was the KARAS achievement! And their final design was 98.1% *perfect.*

This was not accomplished in a day or a week It took over a year—and cost thousands of dollars. Over 40 different designs of coil, core and air gap were tried. The market was scoured for a formula of iron that would give the core greater conductivity. Only by using a core of new design with large cross section and made of special formula iron were we able to combine high primary impedance with low distributed capacity and thus get uniform amplification—98.1% perfect. This meant a larger and heavier transformer—but it was made so compact that it will fit in any set. And the price was brought down to only $7.00—no more than the price of others which were considered best before the Karas Harmonik came onto the market.

The superiority of the music delivered by the Karas Harmonik will arouse instant enthusiasm in every one who hears it. Knowing that, we back our product with an unusual guarantee. Put a pair in your new set, or substitute them for the old transformers in your present set. Use them for 30 days. If you are not delighted with the results, return the transformers and your money will be cheerfully refunded.

Ask your dealer today for a pair of Karas Harmoniks. If he has not yet been able to obtain a stock of them, send direct to us, enclosing the price of $7.00 each. We will mail promptly, postage prepaid.

NOTE: For a more complete explanation of the principles of proper transformer design we refer the interested reader to an article by Jesse Marsten, "How to Select Your Audio Frequency Transformer", in the December issue of Popular Radio.

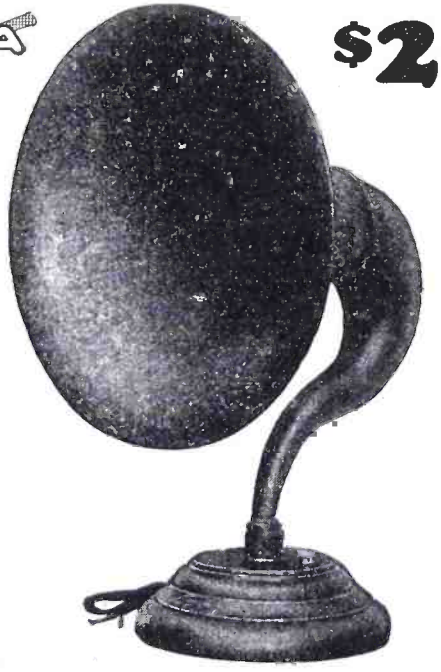
KARAS ELECTRIC CO. Dept. 58-32, 4040 N. Rockwell St. CHICAGO

TRIMM "Concert"

Model No. 80

MEMBER R·M·A

$25



THE SPEAKER that successfully carries the volume of high-powered, multi-stage amplifiers. Extra large diaphragm brings in the low pitched tones of organ and cello so often lost in radio reception.

TRIMM

Superior Reproducers

Headsets

Professional - - **$7.50**
Dependable - - **$5.00**

Speakers

Concert Model - **$25.00**
Home Speaker - **$10.00**

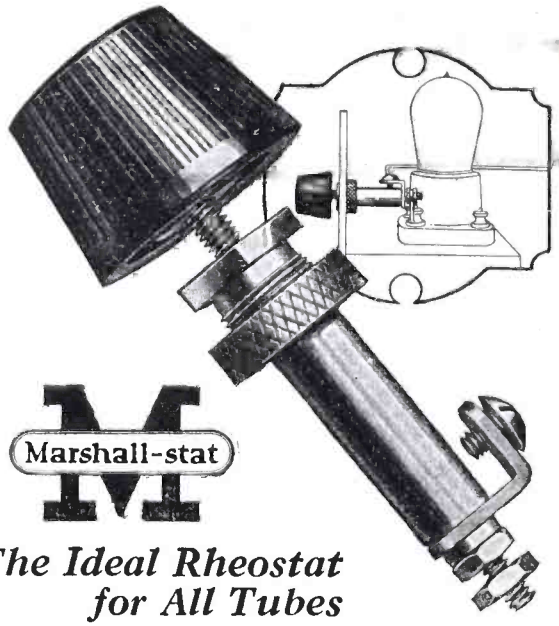
Phonodapter

GIANT Unit - **$10.00**
Little Wonder - - **$4.50**

TRIMM

RADIO MANUFACTURING COMPANY

24 So. Clinton St.
CHICAGO
U.S.A.



Marshall-stat

The Ideal Rheostat for All Tubes

The Marshall-stat provides a means of obtaining any desired tube 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 double adjustment to make.

Besides its precision and ease of operation, the Marshall-stat requires only one hole in the panel, has only two terminals, can be used with any tube or combination of tubes, and is so scientifically constructed that breakage of the specially-treated Marshall discs is impossible. Compact—**note full-size cut above.** Can be fitted anywhere. Price $1.75.

MARSHALL ELECTRIC COMPANY
3237 Locust Blvd., St. Louis, Mo.

Send for Old Man Ohm's descriptive folder on the Marshall-stat.

40c

each in any value from ¼ to 10

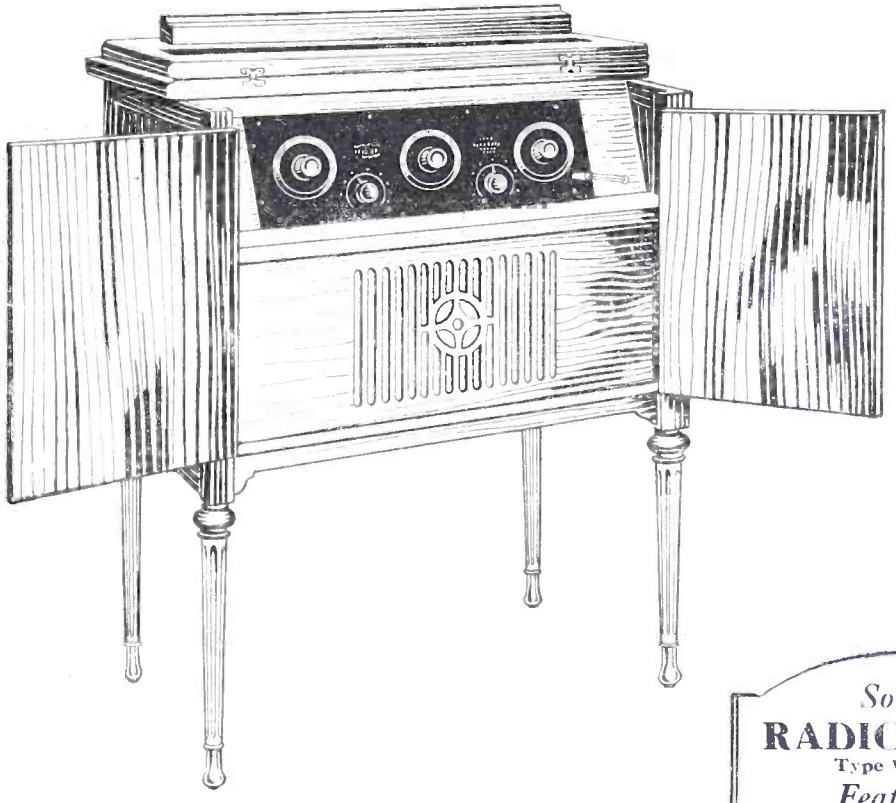
FRESHMAN SUPERIOR

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., 240-248 W. 40 St., N. Y.



The man who said, "A prophet (or product) is not without honor save in his own country," did not know about the Radiodyne.

We quote from a letter sent out by Julius Andrae & Sons Co., Wisconsin's leading radio jobber, "There were more Radiodynes sold in this state last year than of any other model."

A product that is the leader in it's own town or country is a good product, indeed.

The Radiodyne is popular because it will bring in the program you select clear and distinct no matter where radiocast or where you live.

If you can get it with any set
you can get it better with the

Some
RADIODYNE
Type WC-12
Features

Has an Amazing Degree of Selectivity
Uses 6 Dry Cell Tubes
Receives from Great Distances
Has Wonderful Volume
Exceptional Clarity
Self Enclosed in Beautiful Two-Tone Mahogany Cabinet
Models Range in Price from $65.00 to $250.

Write for Our Free Booklet

WESTERN COIL & ELECTRICAL CO.
308 Fifth Street
Racine, Wisconsin

WC Radiodyne

The Voice of the Nation

A new RHEOSTAT

with immovable coils

The coils of the new Centralab Rheostat are made of bright, non-corroding wire, and are firmly clamped between and imbedded in insulating discs so they cannot move. This eliminates the noise in the set caused by lateral movement of coils away from and towards each other as the contact arm passes over them. It also maintains a uniform spacing between windings, giving smooth, even regulation and eliminating dead spots.

The contact arm is made of sturdy, spring tempered phosphor bronze, and is positively locked to the shaft. The contact shoe slides over the resistor at a tangent and cannot catch. The rheostat is attractive in appearance and substantial in construction. All metal parts except wires are of brass, heavily nickel plated. The knob may be adjusted flush with the panel or replaced by any standard dial. Single hole mounting. Firm, positive contacts.

No. 206—6 ohms resistance **$1.25**
No. 230—30 ohms resistance **1.25**

Centralab
Adjustable
Grid Leak

No. 106—(*without condenser*) . . . **$1.25**
No. 107—(*with .00025 condenser* **$1.60**

Centralab
Non-Inductive
Potentiometer

No. 110—
400 *ohms* **$1.50**
No. 111—
2000 *ohms* . . . **$1.75**

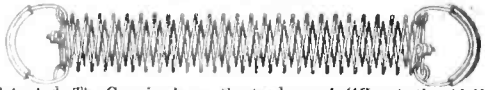
Centralab Battery Switch
No. 300 . . . . . **50c**

Centralab
CENTRAL RADIO LABORATORIES
305 Sixteenth Street MILWAUKEE, WIS.

KEY TO THE AIR

Permanent Cartridge Detector
Guaranteed for reflex and all R. F. circuits.
PRICE $1.00
Price in Canada $1.25

INDOOR CAGE ANTENNA
A highly efficient Antenna System sold on a guarantee of *Reliable Reception.*



Patented. The Genuine bears the trade mark "Key to the Air".
$2 At your dealers—or direct by mail on receipt of price.
Price in Canada $2.50

STAFFORD RADIO CO.
Medford Hillside - - Massachusetts
Send for circuit diagrams of Single Tube Receiver

5 TUBE RADIO SET $38.50 COMPLETELY ASSEMBLED

10 DAYS FREE TRIAL

Coast to Coast

Direct from factory to you at less than Dealer's Cost. Marvelous 5 tube radio set. Latest and most efficient TUNED RADIO FREQUENCY circuit. Approved by America's Leading Radio Engineers. Easy to operate. Dials can be logged. Tune in your favorite stations instantly, on the same dial numbers every time. No guessing. Mr. Howard of Chicago said, "While 5 Chicago Broadcasting Stations were on the air, I tuned in **17 out-of-town stations** from 40 to 1,000 miles away, on my loud speaker, very loud and clear as though they were all in Chicago."

Description: **5 tube set. Comes complety assembled in beautiful mahogany cabinet, size 25 x 7½ x 7½. Has 2 stages Tuned Radio Frequency, Detector and 2 stages Audio Frequency. Equipped with the highest quality, approved *standard low-loss parts.* Genuine Bakelite Panel, Bakelite dials. Use any standard tubes and batteries.**

10 DAYS' FREE TRIAL

Don't miss this chance to buy this high grade 5 tube set direct from factory. Regular value $100.00. Our factory price only $38.50. Send no money. Sign and mail coupon. Pay only $38.50 when delivered (plus small transportation charges). Try it 10 days. If you are not delighted with results—if you do not consider it equal or better than any $100.00 set, send it back and we will cheerfully refund your money.

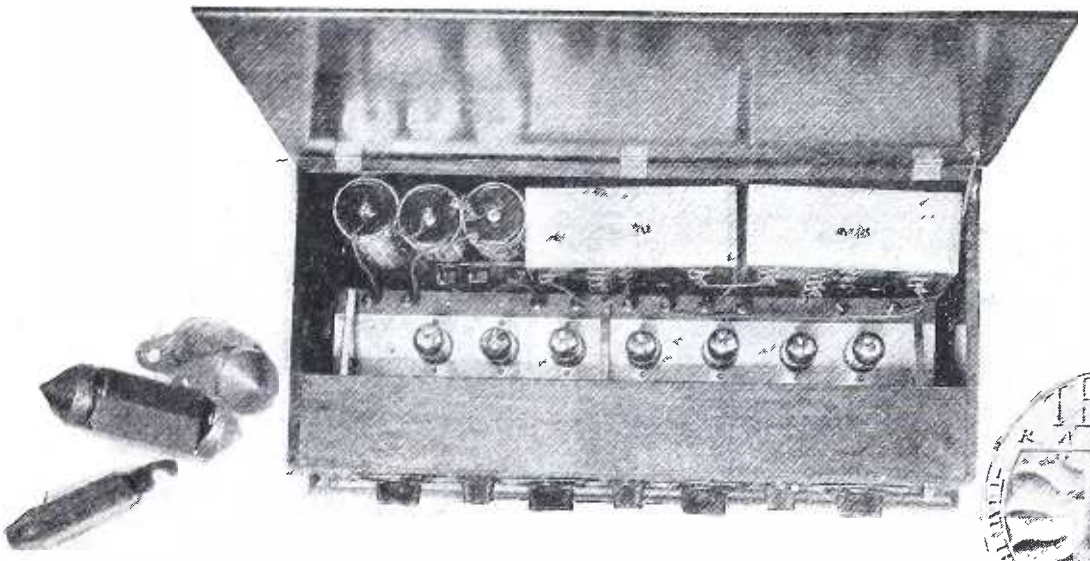
COUPON

Metro Electric Co.
400 N. Michigan Ave., Dept. 17, Chicago, Ill.

Gentlemen: Ship me on approval your 5 tube long distance radio set. I will pay $38.50 on arrival (plus transportation charges) with the understanding that if I am not fully satisfied after ten days' free trial, I may return it and you will refund my money.

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

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



Interior view of a typical set you can build with the new Telos KIT.

With all its amazing power and range—this set costs less to operate than most sets of half its size!

IT need not cost you a fortune to construct and own a set that out-performs any factory-made receiver on the market.

For the 5, 6 and 7 tube sets you can easily build with the new Telos Kit are designed for *dry cell* use. By super-imposing (reflexing) the A. F. on the three stages of Telos tuned R. F., far less equipment is needed—and you save money there. In the set pictured above, full efficiency is secured, with one-half the plate current of any other of its size! Tubes and batteries last twice as long!

If you have hesitated to build the set you dream about, then this Telos economy is something you should investigate. Use the coupon below for your copy of "The KIT of a Thousand Possibilities". It's free, but the edition is limited to sincere seekers for better *radio!*

Telos Radio

Danziger-Jones, Inc.,
Dept. A, 25 Waverly Place,
New York, N. Y.

Send me at once your booklet "The KIT of a Thousand Possibilities".

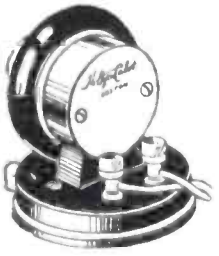
Name .....

Address .....

.....

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

A Wonderful Loudspeaker for $12.00



PHONOGRAPH ATTACHMENT $10.00

Ask any dealer to let you listen to this new Holtzer-Cabot instrument, and you will be convinced of its exceptional volume and remarkable quality of tone.

This Loudspeaker has the four factors that are necessary for entirely satisfactory reception.

Volume without distortion.

Sensitivity.

Pure Quality of Tone and

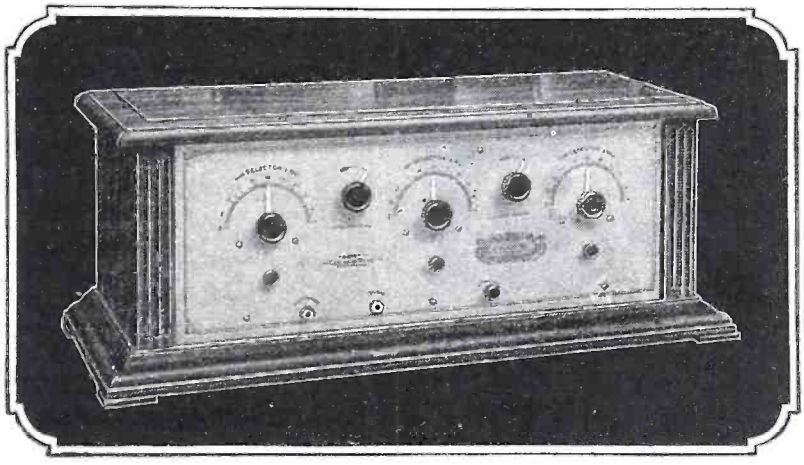
Adjustment for different strength signals.

The Holtzer-Cabot Loudspeaker, Phonograph Attachment and Headsets are the results of 35 years of painstaking manufacture.

Send for Booklet Dept. P. R.

No. 2 Universal Headset $9.50

No. 4 National Headset $6.00



It Equals Any Set!

SUPER

CLEAR-O-DYNE

Five Tubes—$120.00

THE fast growing popularity of Super Clear-O-Dyne is due to a widespread recognition of the fact that it offers the utmost in radio performance, in beauty, in genuine workmanship and quality—yet the price is much lower than such sets usually bring.

It tunes through local and separates distant stations that are only five meters apart; loud speaker volume over great distances; a clear mellow tone. The solid mahogany cabinet and gold finished front panel give it great dignity and beauty. The materials and workmanship are the very finest.

This remarkable value is due only to the fact that all the parts are made complete in the Cleartone factories.

Big production enables us to serve a few more jobbers and dealers. Quick delivery. Write or wire now.

The Super Clear-O-Dyne in a console cabinet, $190.00

Clear-O-Dyne Model 70..$75.00	Clear-O-Dyne Model 80..$120.00
Clear-O-Dyne Model 71.. 90.00	Clear-O-Dyne Model 82 Console..... 190.00
Clear-O-Dyne Model 72 Console.....135.00	Other Sets from $60.00 up.

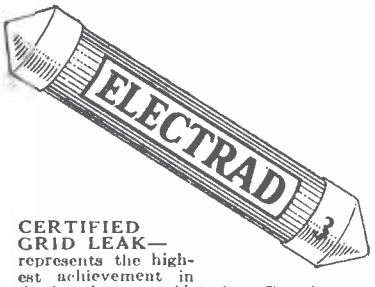
A Few Owners Who Have Heard Europe

Carrol Smart, Wilmington, Ohio
J. W. Weeks, Tillsonburg, Ont., Can.
Alfred Herschede, Cincinnati, Ohio
A. Broerman, Cincinnati, Ohio
Carl Ulrich, Cincinnati, Ohio

"Cleartone"
THE CLEARTONE RADIO CO.
CINCINNATI, O. U. S. A.

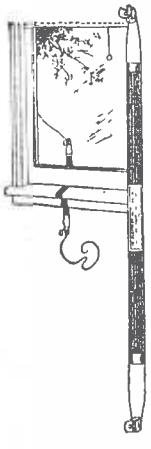
THE CLEARTONE RADIO COMPANY 462 McMILLAN STREET, CINCINNATI, OHIO

THE VARIOHM will clear up those far distant stations that you hear only indistinctly—and bring them in like locals. Gives that last hair's-breadth tuning which transforms a radio set into a perfect musical instrument. Controls tube volume accurately. Eliminates tube noises. Allows infinitely fine variations of adjustment from ¼ to 30 megohms. Price unmounted $1.25. Mounted $1.50.



CERTIFIED GRID LEAK—represents the highest achievement in fixed resistance grid leaks. Permits the electricity to flow from the grid of your tube silently, smoothly and continuously—at all times. Accurately calibrated—fixed and permanent resistance. Sizes ½ to 6 megohms, 50c.

INDOOR LIGHTNING ARRESTER—is as neat as it is safe. Air gap between two copper conductors is hermetically sealed in a shell of moulded glazed porcelain, with highly ornamental finish. Complies with National Board of Underwriters' Regulations. Install one—and avoid regrets later.



LEAD-IN—Solves all lead-in problems. No boring of holes in your window. No disfiguring porcelain tubes protruding into the room. Absolutely safe and unobtrusive. Fits under the window, can be bent to any shape. The most efficient lead - in made. Avoid inferior imitations—look for Electrad label. Price 40c.

Electrad Certified Radio Parts

Built with Precision— Guaranteed for Results

YOU can't woo the capricious air waves to your receiver with inferior parts. Electrad Certified Radio Parts are made by specialists of long experience—and represent the highest engineering standard. Built with the utmost precision—they perform with precision. Certified means guaranteed for workmanship and performance.

Other Electrad Certified Parts

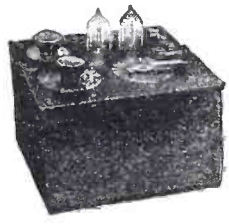
Audiohms, Outdoor Lightning Arresters, Lamp Socket Antennas, Glass Grid Leaks, Variable Grid Leaks and Condenser combined, Grid Leak Mountings, Hydrogrounds, Aerial Outfits, Fixed Resistance Units, Indorarial, Resistance Coupled Amplifier Kits, Verni Tuners.

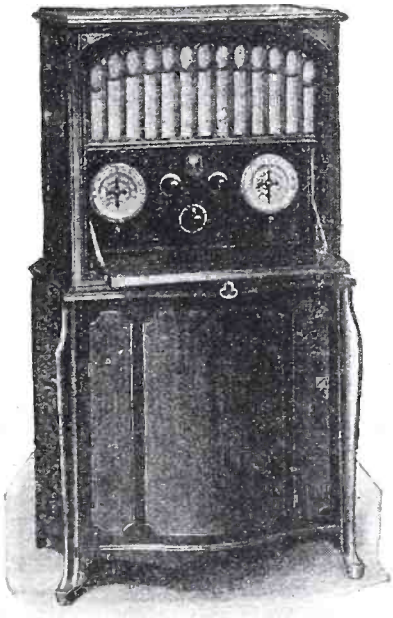
Electrad Radio Parts are on sale at most good radio stores. If your dealer can't supply you order direct—and give his name.

ELECTRAD Inc.

428 Broadway, New York City

IN STOCK





Ready for Immediate Delivery—

Complete Line of Radiolas

Radiola III	$35.00
Radiola Balanced Amplifier	30.00
Radiola III A	90.00
Radiola Regenoflex . . .	191.00
Radiola X	245.00
Radiola Super Heterodyne	269.00
Radiola Super VIII . . .	425.00
Radiola Loud Speaker UZ 1325	25.00

We can promise stock shipment because we are one of the largest RCA distributors and placed ample orders with the Radio Corporation of America to take care of our dealers.

Wire in your order now—we'll ship immediately.

WHOLESALE EXCLUSIVELY

LUDWIG HOMMEL & CO

929 PENN AVENUE — PITTSBURGH, PA.

They say~

(Continued from last month)

5 THEY SAY OF THE ULTRADYNE L-2:

"Selectivity is so high and amplification so strong that distant stations can be tuned in through local stations and put on the loud speaker."

Ultradyne amplifies with Thordarsons!

6 THEY SAY OF THE PFANSTIEHL MODEL 7:

"People *now* want trouble-proof service and purity of tone. The new Pfanstiehl . . . gives a clear, natural tone at any distance. . . . There is no distortion, however great the amplification. . . . It comes in like velvet. . . . Two stages of audio amplification—low ratio, of course, to give perfect quality, with all the volume desired."

Pfanstiehl amplifies with Thordarsons!

7 THEY SAY OF THE HOWARD NEUTRODYNE:

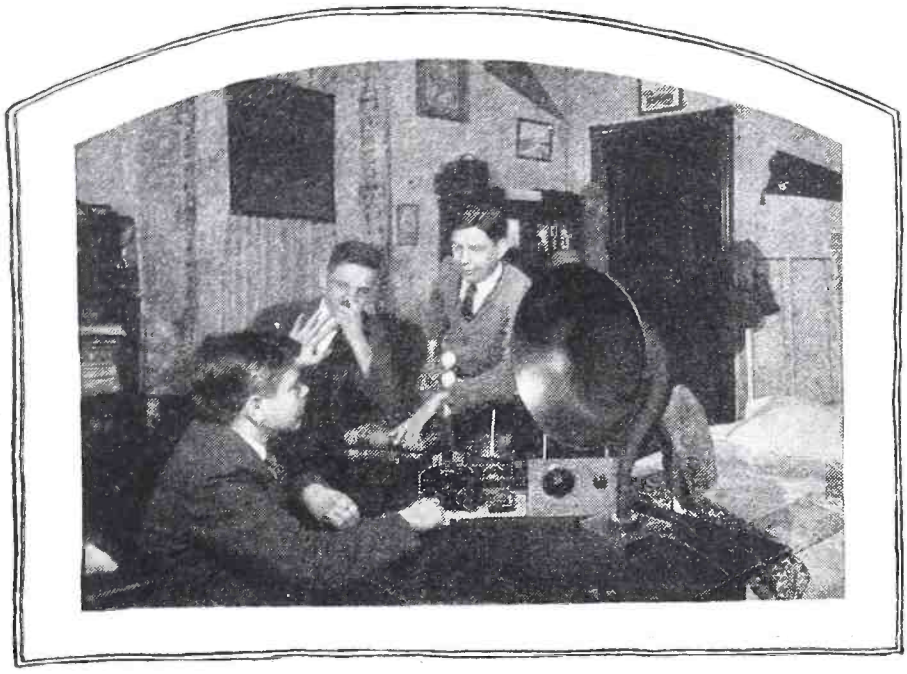
"It bring in distant stations distinctly. It has natural tone qualities. It has remarkable volume."

Howard amplifies with Thordarsons!

8 THEY SAY OF THE RADIODYNE:

"When you own a Radiodyne you can hear singers' voices and orchestral harmonics faithfully reproduced through the loud speaker . . . so clear and distinct that you lose nothing."

Radiodyne amplifies with Thordarsons!



"And the little red squirrel said . . ."

"Cheese it, sailor! We're out of the bed-time story class. Tune in on Calcutta."

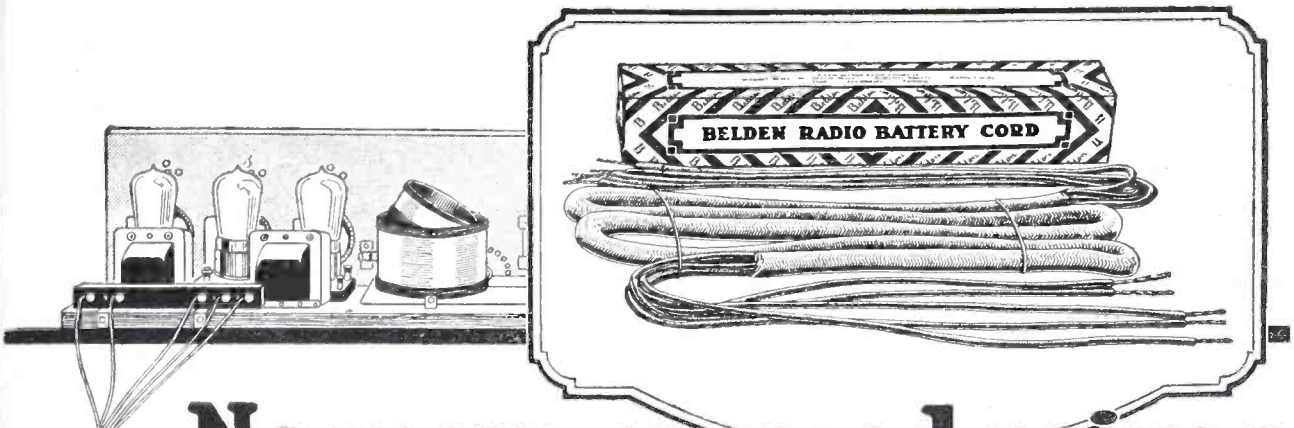
* * *

Boys' interest in radio is highly selective. They know what they want. Then, they get it. The boy-market is the best radio market in the world. One boy is sold on a certain brand of radio supplies, and after that you cannot budge him. He will buy *that* tube or *that* condenser or *that* coupler, and no other. He will scour his town until he finds it. Then he sells his pet to his friends. His friends sell their friends.

Put the gang-spirit, the "have-what-the-other-fellow's-got" impulse to work for your radio supplies. A gang of 500,000 youngsters read THE AMERICAN BOY. They average from 15½ to 16 years of age. They are just the age when the radio virus works best. Stories and articles in THE AMERICAN BOY deal with the fascinating subject of radio in all its various aspects in an accurate and authoritative manner. The editorial policy stimulates the inquiring, inquisitive spirit. In short, the magazine holds the boy-mind and the boy-confidence.

He swears by THE AMERICAN BOY. Win him, win his enthusiasm and his support—and you have made a big dent in the buying habits of his family. Put these 500,000 alert salesmen to work selling your radio supplies. Make them swear by your advertising.

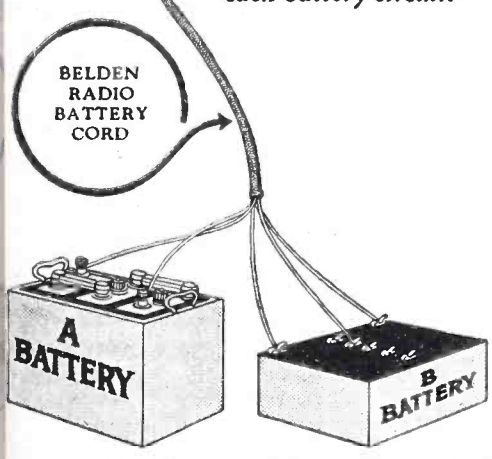
The American Boy
"The Biggest, Brightest, Best Magazine for Boys in All the World"
Detroit Michigan



No more crossed wires to burn out your tubes

Color Code

Every conductor is marked distinctly in color to identify each battery circuit.



ONE accidental short-circuit between your A-battery and B-battery wires may burn out every tube in your set. It is folly to spend hours making carefully-soldered connections within the set, and then do a hasty, makeshift job of wiring from the set to the batteries.

The Belden Radio Battery Cord eliminates the danger of short-circuits between wires and insures a neat, compact job of battery wiring that improves the appearance of every set. The five flexible conductors (equivalent to two No. 16 and three No. 18 wires) are rubber-covered and then individually protected with a glazed braid. The five conductors are then enclosed in a glazed brown braid that resists wear and protects the conductors.

Try one of these six-foot Belden radio battery cords, before you burn out any tubes. It is inexpensive insurance against trouble, and you will have a better-looking set.

Other Belden Radio Products

Our instructive booklet, "Helpful Hints for Radio Fans," describes many other Belden Radio Products, such as Enameled Aerial Wire, Loop and Litz Wires, New Terminals, Magnet Wire on Small Spools, and many other items. Send for the booklet, right now!

Send for this Free Booklet!

Belden Manufacturing Company
2316 South Western Ave., Chicago, Ill.

Please send me your booklet—Helpful Hints for Radio Fans.

Name _____

Address _____

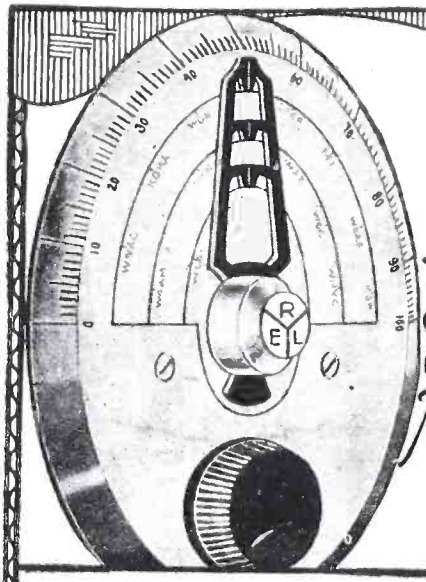
_____

Radio Dealers

Belden Radio Battery Cords are demanded by all careful set-builders. Send for complete dealer bulletin, by writing us on your business letterhead. Write, today!

Belden
Manufacturing Company
2316 South Western Avenue
CHICAGO, ILLINOIS

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



The Station You Want is Marked on the Dial

Direct Tuning

Designed by R. E. Lacault, E. E., A.M.I.R.E., inventor of the famous Ultradyne circuit. This monogram seal (R. E. L.) is your assurance of Lacault design.

Stop fishing for your favorite station. *Select* the program you want—get it lightning-quick. Replace your old dials with ULTRA-VERNIER Tuning Controls. Then, when you have tuned in a delightful station, pencil-record it on the dial. Never again need you guess or fumble for that station, or bother with wavelengths. Simply turn the finder to your pencilmark, and you hear it!

$2.50

At your dealer's

Made by the Hammarlund Mfg. Co., your assurance of quality and dependability — produced solely for the Phenix Radio Corporation.

Should you move—or a station discontinue or wavelengths change—erase the marks, leaving the dial beautifully clean and new. Thus, you may *now* have all the joy of radio, with none of the discouragements. Moreover, the ULTRA-VERNIER is a single vernier tuning control.

At your dealer; otherwise send purchase price and you will be supplied postpaid.

ULTRA-VERNIER
TUNING CONTROL

PHENIX RADIO CORPORATION
7-9 BEEKMAN STREET
NEW YORK CITY

for Dealers 96 Pages

Describing and Pricing the Best Lines in RADIO

This catalog puts the dealer in touch with one convenient source of supply from which 25 leading lines of radio equipment may be had.

These lines were selected by radio experts; are sold by radio experts, and are backed by the guarantee of men who know the radio business thoroughly.

If you now handle radio, or are planning to put it in, you should have this catalog. It lists your every need, and supplementing it is the practical service of our expert radio men. Our central location and large radio assortments enable us to make prompt delivery of any order to any location. Let Sutcliffe service help you build your radio business bigger. Send for this catalog to-day. Dept. A.

The Sutcliffe Company,
Incorporated
Louisville, Ky.

DX "mushy"?

FREE

BOOKLET

On "Tube Control" tells how to bring in distant stations clear and loud. Just drop a post card to

UNITY MFG. CO.
226 North Halsted Street
CHICAGO, U. S. A.

EBY

BINDING POSTS

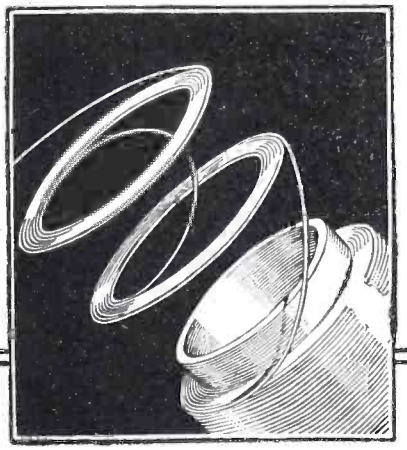
Twenty-five Different Engraved Tops

They Don't Lose Their Heads

SPEAKER — PHONE

H. H. EBY MFG. CO.
Philadelphia

This WINDING minimizes distortion



It is patented and known nationally as the famous

HELICAL WINDING

which is different from any other winding used in Transformer construction. This Helical Winding is the reason why

Samson Helical Wound Transformers

on recent trans-Atlantic tests gave conclusive proof of Samson Helical Wound Transformer efficiency by bringing in English stations on loud speaker with only one stage of audio.

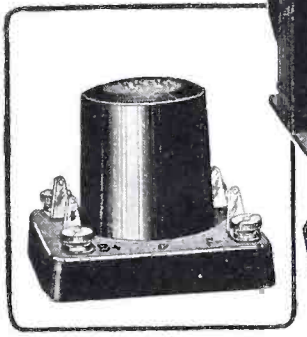
Get distance; get volume; get quality of tone; tune out your strongest local station and tune in for any point with a "Super" built with Samson Transformers.

Send for information on our new Super-Kit. If your Dealer can't supply write to:—

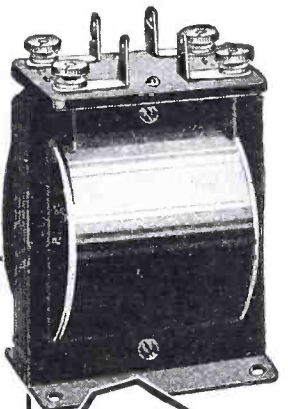
Samson Electric Company

Mfrs. for over 40 years

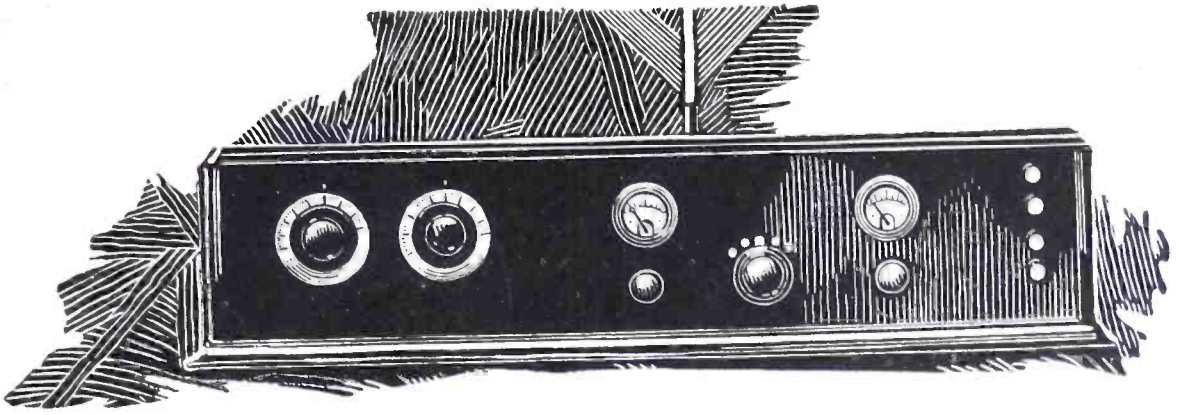
Canton, Mass.



AT RIGHT: Two types of Samson Transformers



H·W· stands for HELICAL WINDING



The *Most Lasting* Front for a Radio Set!

FORMICA is the most widely accepted material for radio panels, because it is the best and most uniformly efficient insulator; because it is by far the best looking material; because it is mechanically strong and because all of its qualities of appearance, strength and insulating ability are as nearly *permanent* as anything made by man can be.

The materials of which Formica is made are chemically inert—they are not in any way affected by weather or time. They will never craze or crack as the best varnish or lacquer ultimately will do. They never deteriorate.

With few exceptions all the leading set makers use Formica because they know it is permanently satisfactory.

Write for booklet, "What Formica Is."

THE FORMICA INSULATION COMPANY

4641 Spring Grove Avenue, Cincinnati, Ohio

SALES OFFICES

50 Church Street.....New York, N. Y.
9 South Clinton St.....Chicago, Ill.
516 Caxton Bldg.....Cleveland, Ohio
1142 Granite Bldg.....Rochester, N. Y.
422 First Avenue.....Pittsburg, Pa.
6 Beacon Street.....Boston, Mass.
55 Calle Obispo.....Habana, Cuba
289 Victoria St..Toronto, Ontario, Canada
1026 Second Avenue...Minneapolis, Minn.
1210 Arch Street.....Philadelphia, Pa.
708 Title Building.....Baltimore, Md.
585 Mission Street.....San Francisco, Cal.
419 Ohio Building.....Toledo, Ohio
309 Plymouth Bldg.....New Haven, Conn.
Whitney Central Bldg...New Orleans, La.

1 Formica is used by 125 leading set makers. Ninety per cent. of the sets in the shows this year had Formica parts.

2 Formica will last forever.

3 Formica in appearance is the finest of all panel materials and always remains so.

4 Formica's electrical qualities of every kind far exceed any possible requirement.

5 Formica has high mechanical strength and will not break in use

6 Formica will not sag from heat or cold flow under pressure. It retains its dimensions. Everything you fasten to it stays tight and precisely where you put it.

7 Formica panels are sold in neat craft paper envelopes that assure you that you are getting the genuine.

8 Formica is one of the most widely used and most generally approved materials in radio.

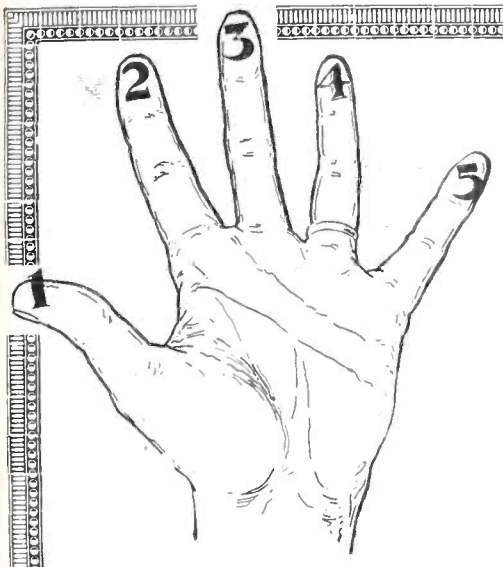
FORMICA

Made from Anhydrous Bakelite Resins

SHEETS TUBES RODS

Hear the Formica band every Wednesday evening from 9 to 10 Central Standard Time over WLW.

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



FIVE POINTS OF RADIO QUALITY

All Developed to the Utmost Degree

in Air-Way

Receiving Sets

TONE, SELECTIVITY, DISTANCE, VOLUME and APPEARANCE

are the five fundamental requirements of radio receiving sets to meet the demands of the buying public, and render satisfactory profits to the dealer.

AIR-WAY receiving sets are designed to and do meet these requirements to the satisfaction of the most discriminating buyer.

Their appearance attracts the buyer's attention and their performance meets his approval. Consequently they are satisfactory and profitable to the dealer, because they sell easily and stay sold, without the necessity of continuous service to keep them in satisfactory operation.

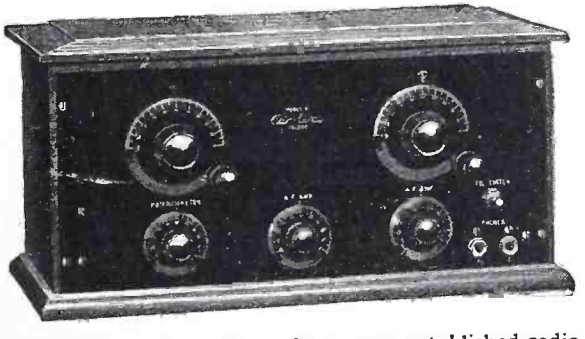
Model 51

PRICE $125.00

Model 51 is a five-tube tuned radio frequency set embodying the latest developments in this type of receiver, and includes such strictly up-to-date elements as Spider-web coils, Low-loss condensers, etc.

It is the ideal set for the D-X fan who wants to pick up stations all over North America, but still demands reception with pleasant audibility and clarity of tone.

Mounted in a five-ply walnut cabinet of attractive design and handsome finish. **PRICE, $125.00.**



AIR-WAY Model 41

A four-tube set with one stage of tuned radio frequency, detector and two stages of audio frequency amplification that meets all the requirements of the buyer of modest means.

We offer this set for the consideration of the dealer and buyer as absolutely the best radio value now on the market; in which is combined coast-to-coast reception, perfect tone qualities, and the utmost simplicity of tuning in connection with the required degree of selectivity.

Price $65.00

We invite correspondence from every established radio dealer, regardless of the lines he may now be handling, and have a most attractive proposition to offer. Write for it today.

AIR-WAY ELECTRIC APPLIANCE CORPORATION

TOLEDO **OHIO**

"With the Tongues of Men"

HUMAN voices pulsating with life, vibrant with emotion, speak from Music Master rich and clear, as in the church, miles or hundreds of miles away.

In the comfort of your own home—near or far—you hear the sermon, the organ, the singing, the entire church service, as though you were seated among the congregation.

The reproducing element of Music Master responds to the faintest radio impulses; the heavy cast aluminum tone chamber eliminates blast and distortion; the amplifying bell of natural wood—like the violin and the cello—reproduces in tones that are full, resonant and life-like.

Your dealer will be glad to send Music Master to your home to be tried and proved with your own set.

Dealers Everywhere

Connect Music Master in place of headphones.
No batteries required.
No adjustments.

Model VI 14-inch..$30
Model VII 21-inch..$35
Model VIII Cabinet Type with "Full-Floating" Wood Horn.....$35

Music Master Corporation

Makers and Distributors of High-Grade Radio Apparatus

Tenth and Cherry Streets

Chicago **PHILADELPHIA** *Pittsburgh*

Music Master

RADIO REPRODUCER

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

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

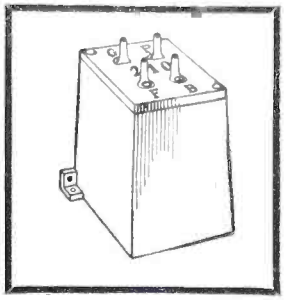
Silver-Marshall, inc.

RADIO

MATCHED — TESTED — CHARTED

. . . with . . .

Laboratory Proof



The TWO-TEN—iron-core intermediate transformer, passes an 11 kilocycle band without distortion. Peaked at 5,000 meters. Provides 1½ to 3½ times the amplification obtainable with any other transformer.

The TWO-ELEVEN—a sharply tuned input or output transformer. Peaked at 5,000 meters.

Both types in individual aluminum cases. Suitable for use with any tubes in from one to four stages.

These transformers are supplied in sets of two or three TWO-TENS and one TWO-ELEVEN, with identical peaks and separate curves for each.
Price, each.....$8.00

Two-Ten and Two-Eleven Long Wave Transformers

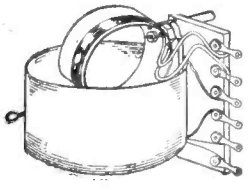
Never before has it been possible for you to secure long wave transformers for your receiver with advance certainty that they would function properly. Never before have the words "matched" and "tested" had any genuine significance. No longer need you experiment with transformers of unknown characteristics.

You can have the same long wave transformers that have made the *SILVER-MARSHALL* 401 Unit the choice of engineers—each instrument supplied with its individual curve. All guesswork is removed. The success of your intermediate amplifier becomes an assured fact. The individual curves of the TWO-TEN and TWO-ELEVEN transformers show exactly where each instrument peaks, the side-bands it will pass, and the exact amplification to be expected in any circuit.

All curves are charted under the supervision of McMurdo Silver, Asso. I.R.E., and each transformer must measure up to a predetermined standard before receiving the famous S-M O-K. Think what this means—you are now able to have the full benefit of measurements heretofore available only in the fully equipped laboratory.

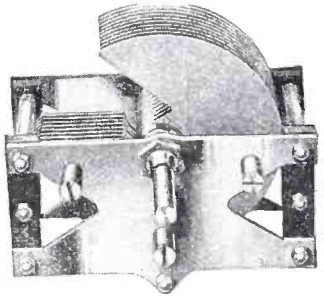
For Those Who Build the Best

Low-loss parts designed by Mr. Silver to give maximum efficiency. They are used by him in his famous FOUR-TUBE KNOCKOUT SET—the set that will do on a seventy foot antenna all a super will do on a loop. Circulars on these parts and the FOUR-TUBE KNOCKOUT will be sent upon request.



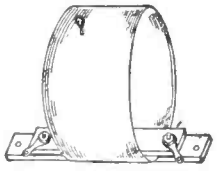
Type 105 Low-loss Coupler

Type 105 Low-loss Coupler. For three-circuit, tuned R.F., or other circuits. Self-supporting coils, with a minimum of dielectric material in their fields. Wave-length range, 200 to 550 meters with .0005 condenser.
Price.....$5.00



Silver Low-loss Condenser

Type 301 Straight-line, low-loss, grounded rotor condenser. Supplied only in .0005 Mfd. capacity.
Price.....$4.50



Type 205 Antenna Coil

Type 205 Low-loss Antenna Coil. For tuned R.F. or other circuits. The windings are self-supporting, giving an air dielectric for minimum losses. Wave-length range, 200 to 550 meters with .0005 condenser.
Price.....$2.50

The Portable Super-heterodyne

Every Fan who means to build a Super should send for McMurdo Silver's book, "The Portable Super-heterodyne".
Price.....50c

The Four Tube Knockout

For the man who wants a receiver that is less complicated than the Super. Send for Mr. Silver's new book on this Four-tube Wonder.
Price.....25c

Silver-Marshall, inc.
110 So. Wabash Ave., Dept. A
Chicago, Ills.

Eastern Distributor
TWENTIETH CENTURY RADIO CORP.
102 Flatbush Ave.
Brooklyn **New York**

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

KING QUALITY BUFFALO

KING-HINNERS RADIO COMPANY
Licensed by
Independent Radio Manufacturers Inc.
NEUTRODYNE
Other Patents Pending

Build Your Own Neutrodyne Receiver With This Kit

CONTENTS OF KIT

- One antenna coil.
- Two primary and secondary coils.
- Three 15-plate low loss condensers.
- Two neutralizing condensers.
- One fibre screwdriver.
- Templates.

WITH this King Quality Kit and a few hours interesting work you can build your own neutrodyne receiver. It will give you all the advantages of neutrodyne reception — no more "fishing" for stations, no more "squeals," "howls" or other distortions. Just turn the dial to proper place, and in comes the station you seek every time, full, clear, distinct.

The King Quality Kit is easily assembled. It contains the vitals of neutrodyne. The templates included with kit give complete instructions.

Write for Catalog

KING QUALITY PRODUCTS, Inc.
BUFFALO, N. Y.

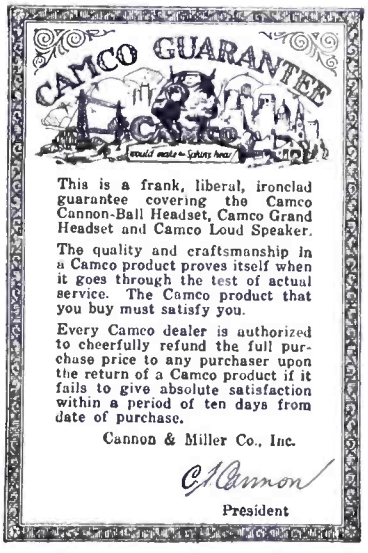
KING QUALITY RADIO

Cannon-Ball Headset
$3.50

Your Radio Ears deserve comfort and a reproduction of the radio program with a clearness and richness of tone that will please them. Users of Camco Cannon-Ball Headsets have every reason to consider them the best buy they ever made for $3.50. Ask any user, your dealer or write for folder.

"Radio as you like it"

Camco Cannon-Ball Headset, $3.50; Camco Grand Headset, $4.75; Camco Loud Speaker, complete with permanent adjustment Loud Speaker unit, $9.50. West of Rockies, $10.50.



This is a frank, liberal, ironclad guarantee covering the Camco Cannon-Ball Headset, Camco Grand Headset and Camco Loud Speaker.

The quality and craftsmanship in a Camco product proves itself when it goes through the test of actual service. The Camco product that you buy must satisfy you.

Every Camco dealer is authorized to cheerfully refund the full purchase price to any purchaser upon the return of a Camco product if it fails to give absolute satisfaction within a period of ten days from date of purchase.

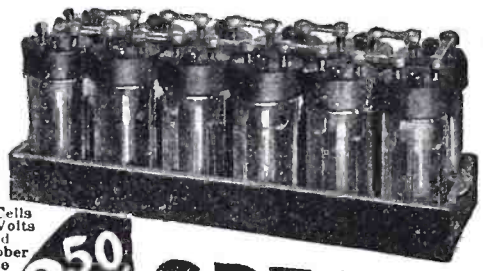
Cannon & Miller Co., Inc.

C. J. Cannon

President

Dealers: **Ask your jobber about Camco products or write for complete details.**

CANNON & MILLER CO., Inc.
SPRINGWATER, N. Y.



12 Cells 24 Volts Solid Rubber Case

$3.50 C.O.D. SPECIAL
INTRODUCTORY PRICE

For a limited time *only*, and to introduce this new and superior Storage "B" Radio Battery to the Public, we are selling it for $3.50. Regular Retail Price is $5.50. You save $2.00 by ordering NOW. A finer battery cannot be built than the

World Storage "B" Battery
(12 CELLS—24 VOLTS)

To ten million homes with Radio Sets—and to countless millions of prospective buyers—this WORLD Storage "B" Battery brings a new conception of battery economy and performance. Here is a battery that pays for itself in a few weeks—will last for years and can be recharged at a negligible cost. *And you save $2.00 by ordering now.*

A *Superior* Battery Equipped With Solid Rubber Case

Has heavy duty 2 1-8 in. x 1 in. x 1-4 in. plates and plenty of acid circulation. Extra heavy glass jars allow ready observation of charge and prevent leakage and seepage of current. It holds its charge, while idle, at constant voltage. You will find this battery a boon to long distance reception. It does away with a great many noises so often blamed on "static." Mail your order today.

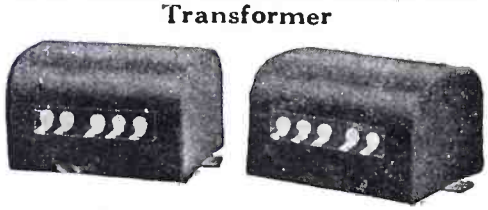
SEND NO MONEY

Just state number of batteries wanted and we will ship day order is received. EXTRA OFFER: 4 batteries in series (96 volts), $13.00. Pay Expressman after examining batteries. 5 per cent discount for cash in full with order. Send your order NOW and save $2.00.

WORLD BATTERY COMPANY
Makers of the famous World Radio "A" Storage Battery
1219 S. Wabash Ave., Dept. 77, Chicago, Ill.

SAVE $2.00 BY ORDERING NOW!

"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."

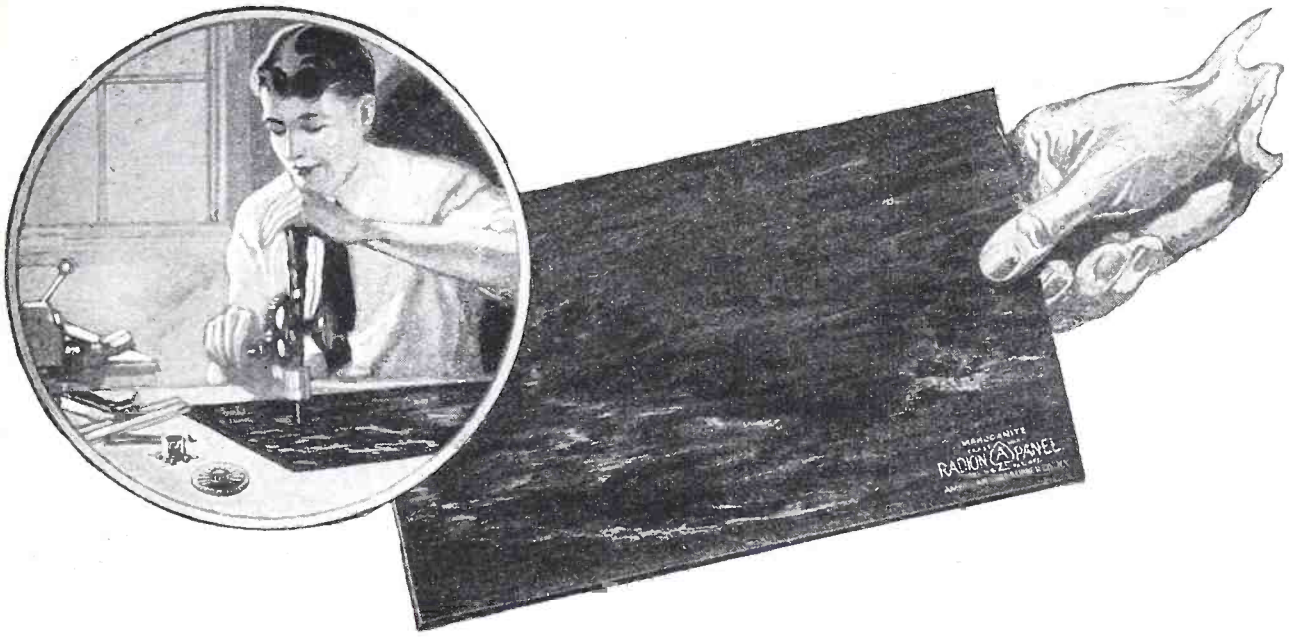
E. P. Gordon, *Open Road:* "A system of audio-amplification which is becoming increasingly popular. Its use . . . . will give surprising results in both quality and volume, and is thoroughly recommended by this department."

NEED WE SAY MORE?

COMO APPARATUS COMPANY
446 Tremont St. Boston, Mass.

For Sale at Leading Dealers

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



Just use ordinary tools on this panel—*built to order for radio*

YOU don't need special tools to do a good job on a Radion Panel. Just the usual tools found around any house will give you clean-cut, workmanlike results. You need have not the slightest fear of chipping.

Radion is the easiest of all to cut, drill, and saw. It was developed *to order* by our engineers to meet the demands of radio set builders. There is nothing quite like it for real results.

Highest rating as radio-frequency insulation

AUTHORITATIVE laboratory tests give Radion the highest rating as radio-frequency insulation. That means that losses from surface leakage and dielectric absorption are exceptionally low. And low losses mean clearer reception, more volume and more distance.

You can see that Radion is different by looking at the finish. But that high-polished, satin-like surface is not for beauty alone. It's useful, too. Moisture and dirt cannot gather to cause leakage and leakage noises.

Radion resists warping. It's strong It's moisture proof. It comes in eighteen stock sizes and two kinds, Black and Mahoganite.

Better performance will make it worth your while to ask for Radion by name, and to look for the name on the envelope and the stamp on the panel. Radio dealers have the exact size you want for your set.

Other Radion Products

The same qualities of low-loss insulation and attractive appearance characterize Radion dials (to match panel) binding post panels, insulators, knobs, etc.—also the new Radion built-in horn.

Send for booklet "Building Your Own Set"

OUR new booklet, "Building Your Own Set," giving wiring diagrams, front and rear views, showing a new set with slanting panel, sets with the new Radion built-in horn, lists of parts and directions for building the most popular circuits—mailed for ten cents. Mail coupon today.

AMERICAN HARD RUBBER COMPANY
Dept. B2, 11 Mercer Street, New York City
Chicago Office: **Conway Building**
Pacific Coast Agent: **Goodyear Rubber Co., San Francisco—Portland**

RADION

The Supreme Insulation

PANELS

Dials, Sockets, Binding Post Panels, etc.

AMERICAN HARD RUBBER COMPANY
Dept. B2, 11 Mercer St., NEW YORK CITY

Please send me your new booklet, "Building Your Own Set," for which I enclose 10 cents (stamps or coin).

Name .....

Address .....

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

Federal Factory Facts

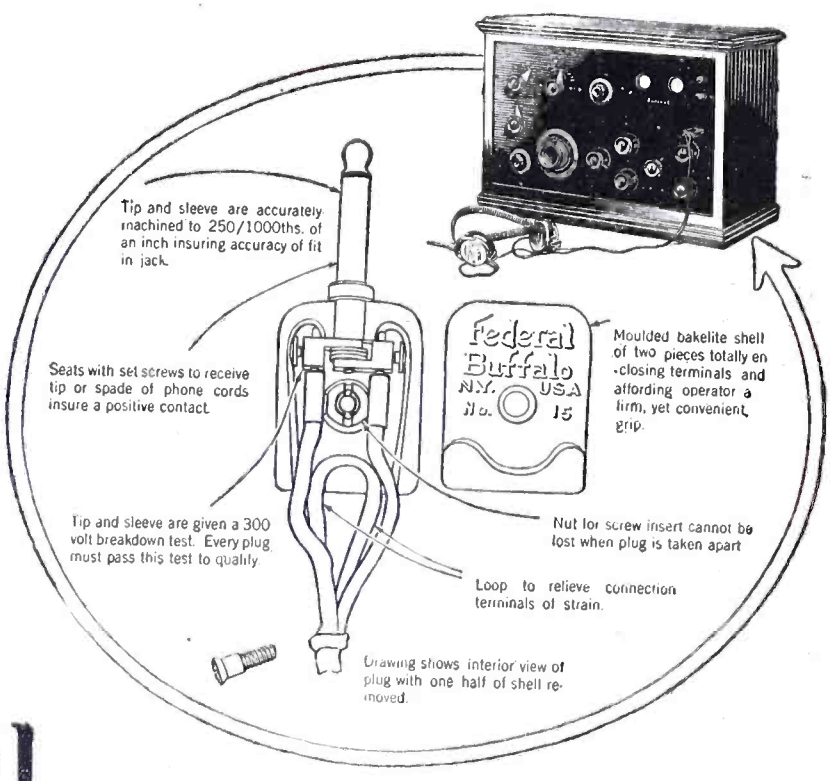
THE plug is the *key* that unlocks the full possibilities of your receiver. No matter what you are getting off the air, you *hear* only what the plug lets through.

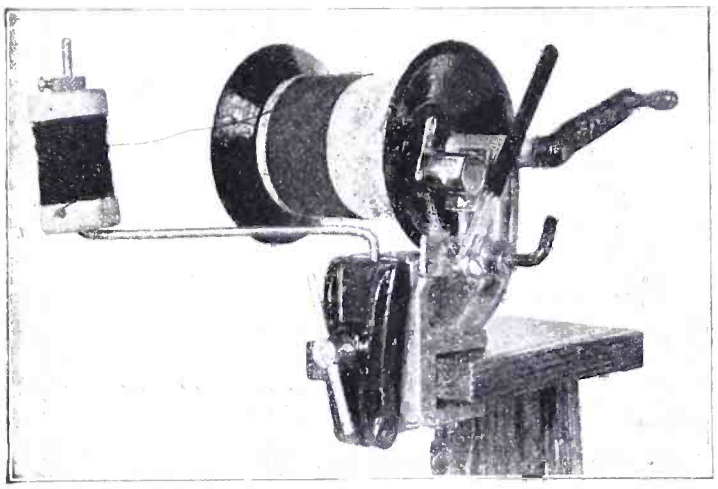
Buy a No. 15 Federal Plug for your radio phones or loud speaker if you want to know what your radio set can give you.

Buy a Federal Plug today—also take advantage of the other 130 standard radio parts sold under the same Federal iron-clad performance guarantee.

FEDERAL TELEPHONE MANUFACTURING CORP.
Buffalo, N. Y.
Boston New York Philadelphia
Pittsburgh Chicago
San Francisco Bridgeburg, Can.

Federal
Standard RADIO Products





Universal Radio Tool

Clamps on Edge of Bench or Table

USED FOR:

Winding { Plain Tube Coils. Spiderwebs (on forms). Rotors, etc.

Cutting wire.
Looping or bending bus wire.
Has vise, handy for many uses.
Can be supplied with counter to register number of turns wound if desired.

Price $6.00 each, Counter $2.25 extra

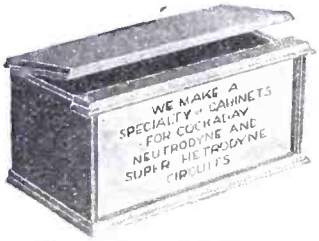
Dealers: Write for our proposition.

Specialty Automatic Machine Co.
Chelsea, Mass.

Campbell RADIO CABINETS

"From the Lumber to You"

Special Sizes to Order



Mounting Boards 50c each

WILL NOT WARP OR CRACK

Made of No. 1 wood finished in either Mahogany or Walnut, bright or rubbed finish to match the finest of furniture.

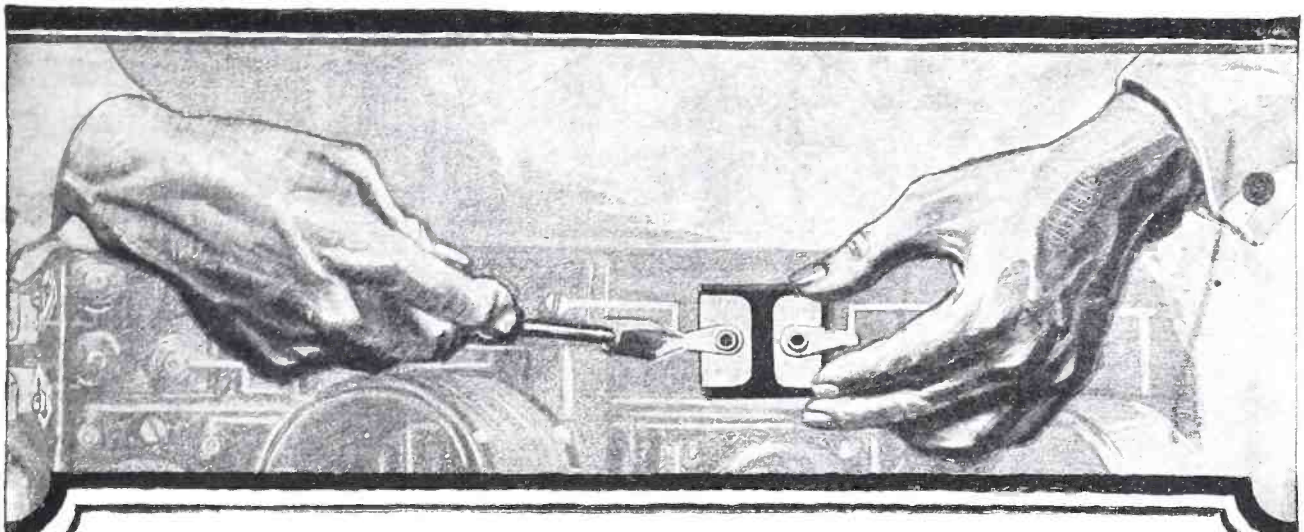
PRICES

Cash with order, prepaid east of Missouri River; west, add 15 cents to quoted price. Send Post Office or Express Money Order.

Panel Sizes	Imitation Walnut or Mahogany	Genuine Walnut or Mahogany
7 x 10 x 7	$3.00	$4.75
7 x 14 x 7	3.30	5.50
7 x 18 x 7	3.82	6.75
7 x 24 x 7	5.25	9.00
7 x 26 x 7	6.05	10.00
7 x 28 x 8	7.25	11.50
7 x 27 x 9	7.25	12.50
7 x 40 x 10	11.25	18.00

Manufacturers' and Dealers' Liberal Discounts Sent Upon Request

THE PERKINS-CAMPBELL CO. ***(Established 1879)***
410-440 New St., Cincinnati, O. **(References: Dun or Bradstreet's)**



Nine out of ten sets use MICADONS

Nine out of every ten sets made use Micadons—the standard fixed radio condenser. Set builders choose them for many reasons.

They know that the Micadon is a Dubilier product: hence supreme in quality and efficiency.

They know that Micadons can be obtained in accurately matched capacities and the capacity is permanent.

They know that Micadons are easily installed, equipped as they are with extension tabs for soldering and eyelets for set screw assembly.

They know that Micadons are made with type variations to meet every possible requirement.

For best results use Micadons

Dubilier

CONDENSER AND RADIO CORPORATION

PRICES

PZ indicates panel type with switches.
CZ is plain type without switches.

Voltage	M.A.H.	Type PZ	Type CZ
130	2500	$36.00	$33.00
100	2500	27.50	24.50
70	2500	21.50	18.50
45	2500	16.00	14.50
22½	2500	.....	7.50

KIC-O CHARGERS

Type K-1 Single unmounted.....$1.50
Type K-2 Single mounted.....3.50
Type K-3 Multi-Polar mounted..5.00
KIC-O Special Charger Chemicals (one cell).....50

"This KIC-O equipment has been approved by the Popular Radio Laboratory"

You take no chances with KIC-O Batteries

This storage battery supreme is now serving radio fans all over the country. It is giving clearer reception, and avoiding the annoying difficulties so often met with in the use of inferior batteries. KIC-O "B" Storage Batteries give an even, dependable discharge over long periods of service. They are not harmed by standing idle or by overcharging. Nickel-zinc elements, including in their composition liberal proportions of iron and nickel preserved by a special alkaline solution, give KIC-O "B" Batteries practically unlimited life.

With KIC-O Double and Single cell Chargers you recharge your "B" Batteries at a small cost from any regular 110 volt A.C. lighting line.

Let KIC-O Equipment end your radio "B" battery troubles—NOW.

See your dealer or send the coupon to

KIMLEY ELECTRIC COMPANY, INC.
2667 Main St. **Buffalo, N. Y.**

Kimley Electric Co., Inc.,
2667 Main St., Buffalo, N. Y.
Gentlemen: Please send items checked below to undersigned address:
KIC-O "B" Battery type .....
Voltage ..... Price .....
KIC-O Charger (specify which).....
.....
Full information regarding KIC-O equipment.
Send C.O.D. subject to guarantee of satisfaction or money back to
.....
.....
.....

HIGH QUALITY — LOW PRICE

The CLARITRON TUBE $2.30 BY MAIL

OUR TYPE 499
Detector and Amplifier

YOU OWE IT TO YOURSELF TO USE CLARITRON TUBES

You cannot get a better tube at any price—and why pay more? Our Price is low because we sell direct and are content with a fair profit.

We guarantee that CLARITRON TUBES measure up to the highest standards. The well known New York Testing Laboratories declared CLARITRON to be better than standard tubes selling for $4.00.

We make all kinds of tubes including:
Our No. 501A—for same use as 201A
Our No. 112—for same use as WD12
Our No. 499—for same use as 199
$2.30 for any type

We ship all orders as soon as received. Shipments made by Parcel Post, C. O. D., or Prepaid on Receipt of Express or Postal Money Order.

SUPERIOR RADIO COMPANY, Dept. 201
176 Shephard Ave. **Newark, N. J.**

OUR TYPE 501A
Detector and Amplifier

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

KESTER Radio SOLDER
(Rosin-Core)
If your dealer cannot supply you send us 25c in postage
CHICAGO SOLDER COMPANY
CHICAGO, U. S. A.

KESTER Radio SOLDER
(Rosin-Core)
If your dealer cannot supply you send us 25c in postage
CHICAGO SOLDER COMPANY
CHICAGO, U. S. A.

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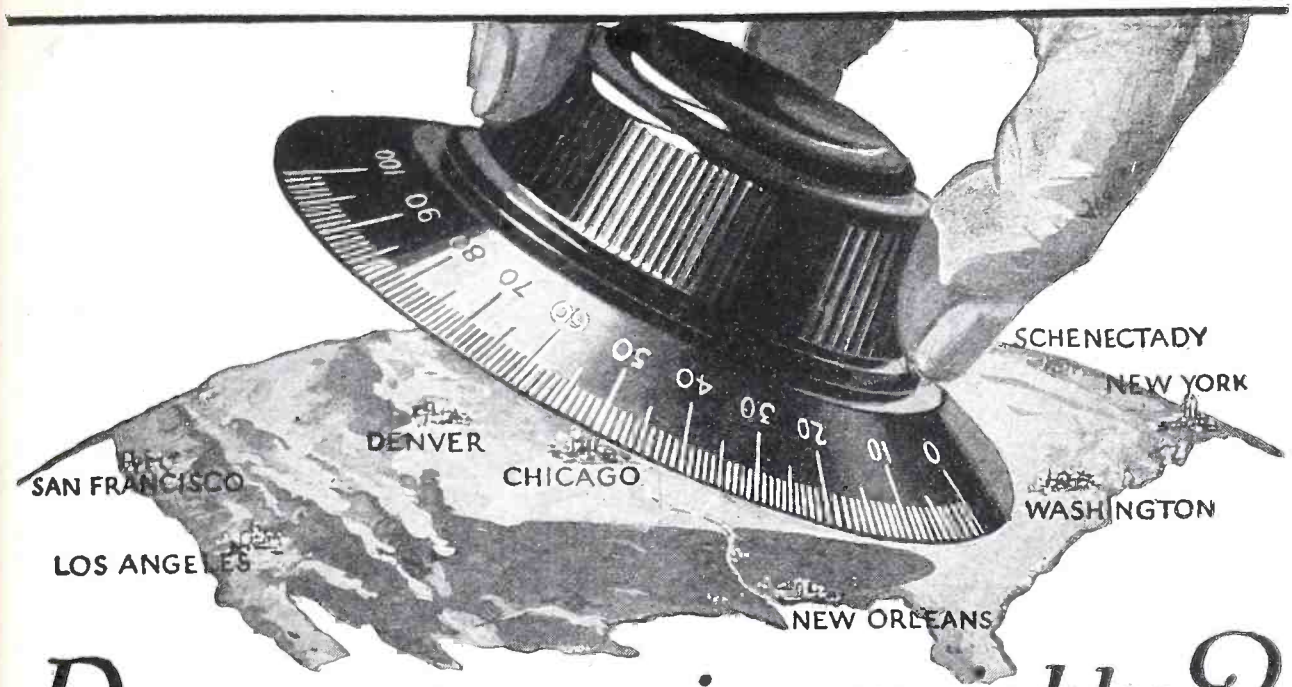


Do you tune-in quickly?

What a difference a good dial makes

ENJOY the pleasure and comfort of tuning in with greater ease and speed than ever before. Use Na-Ald Super De Luxe Dials and experience real dial satisfaction.

Station after station can be tuned in quickly and comfortably. Even if you tune in over and over again, searching for distant stations until late into the evening, you will experience no eyestrain nor finger-cramps when you turn the big generous-sized knob. It fits your fingers naturally.

It took engineers and optical experts months of careful study to perfect the scientific design of Na-Ald Dials. Stop Watch tests developed the best possible position of numbers, and lengths, spacing and width of lines.

You can obtain Na-Ald Dials at radio, electrical and hardware stores. Use them not only in the set you build but also install them in the set you buy, if not already adopted by the manufacturer. Super-De Luxe 75c; other sizes 35c, and 50c.

Send for free copy of radio booklet—"What to Build", showing a number of the best tested and selected circuits.

Na-Ald also manufactures a complete line of Bakelite Sockets for all tubes. De Luxe with special clean-easy feature, 75c; others 35c, 50c, 75c.

ALDEN MANUFACTURING COMPANY
Also Makers of the famous Na-ald Sockets
Dept.C-3, Springfield, Mass.

Alden Processed
NA-ALD
Sockets and Dials

Alden Manufacturing Company,
Dept. C-3, Willow Street,
Springfield, Mass.

Please send free copy of booklet "What to Build", showing tested and selected circuits.

Name .....

Address .....

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

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

The Big Clear Voice of Radio

NOW

$12

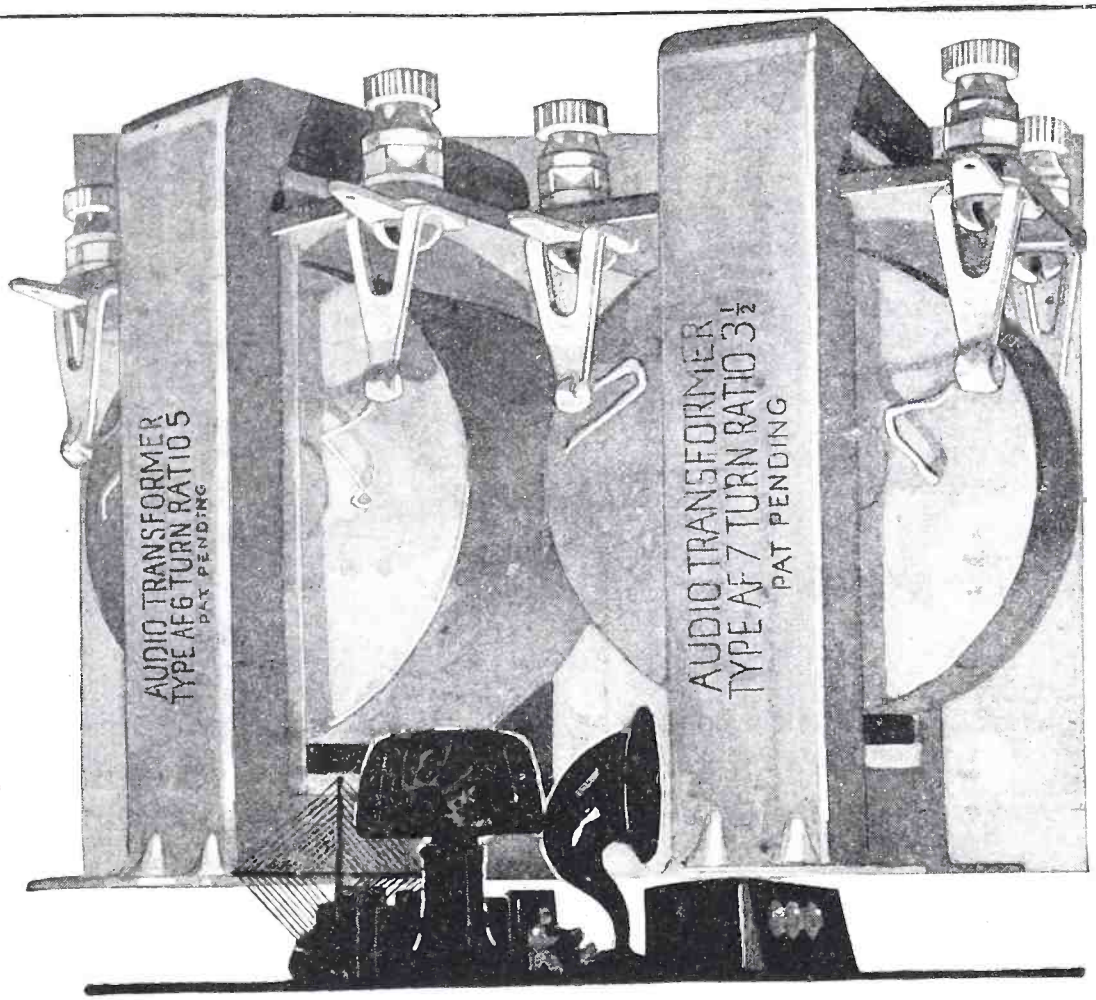
Herald MODEL *B*

THE same speaker that won nation-wide popularity at $18, in competition with the most expensive speakers built, is now priced $12. At this new low price, Herald-B is the greatest value ever offered in radio.

The only speaker in its class with full-sized goose-neck, fibre horn. Height over all, 25 inches. 12-inch bell.

No need to pay $25 and more for a real "he" loud speaker. Hear the $12 Herald at your dealer's.

HERALD ELECTRIC CO., Inc., 113 Fourth Avenue, New York



TWIN GIANTS

IT requires *good* audio transformers to take the output of the detector tube and add nothing but volume. And AmerTrans are real giants when harnessed to the task of transforming weak signals into clean-cut, enjoyable, loudspeaker entertainment.

Give the audio side of your set the consideration it deserves and use a pair of AmerTrans.

AmerTran is made in two types, one quality—
A F 6 — ratio 5: 1 and A F 7 — ratio 3½: 1.
Buy them by the pair!

AMERICAN TRANSFORMER COMPANY

175 EMMET STREET, NEWARK, N. J.

"Transformer builders for over twenty-three years"

Price either model $7.00
At your dealers.

AMERTRAN
TRADE MARK REG. U.S. PAT. OFF.

Send for leaflet giving useful amplifier information.

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

Ordinary house lighting current (110 volt, 60 cycle alternating) transformed into the same sort of current as was formerly obtained from "B" batteries. Takes up little more room than one 45 volt "B" battery. Entirely contained in a neat metal box—6" wide by 4½" deep by 10" long. Uses one or two UV-201-A or C-301-A vacuum tubes.

Never Failing "B" Current from Any Electric Light Socket

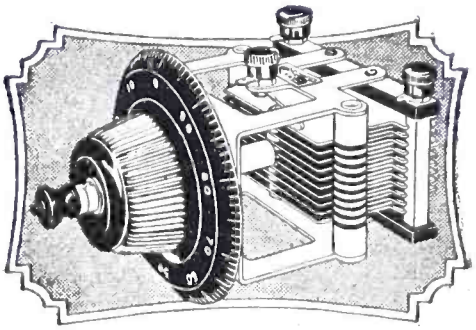
The MU-RAD B-Radicator

UNIFORM "B" power night after night—without renewing batteries—direct from the nearest electric light socket. No more diminishing current, no "B" battery noises, no loose connections and costly, bothersome replacement. Requires no more attention than simply screwing the plug into the electric light socket. Supplies current for any set up to 8 tubes at a cost less than that of burning one 10 watt lamp. No adjustments, nothing to wear out.

Write for Literature

MU-RAD LABORATORIES, INC. 809 FIFTH AVE., ASBURY PARK, NEW JERSEY

The Only True Micrometer Type
VARIABLE CONDENSER



There is no condenser made, nor is there any vernier attachment, knob, dial or other contrivance for a variable condenser which gives one-twentieth the adjustment possible with the BARRETT & PADEN Micrometer Condenser.

Stations which are jammed so close to each other on the dial of the usual condenser that it is impossible to separate them, are pulled apart twenty times the distance on your dial when you use a BARRETT & PADEN Micrometer Condenser. Use them. You'll see the difference!

Max.	*Min.*	
.0005	.000008	$6.00
.00035	.0000078	
.00025	.000007	

If your dealer cannot supply you, order direct.

BARRETT & PADEN
1314 SEDGWICK ST. CHICAGO, ILL.

Dealers! Write for our proposition.

Astonishing Loop Results
On Super-Het Circuits

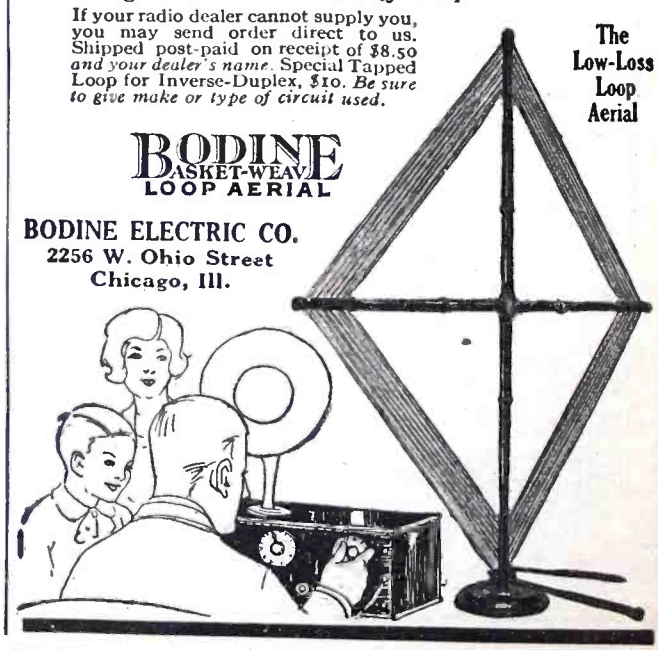
The many advantages of loop reception have now been increased by the remarkable new Bodine Low-Loss Folding Loop. The stranded wire used is bank-wound on the basket-weave principle. With circuits sufficiently sensitive for loop operation, especially the Super-Heterodyne, the Bodine makes the set more selective, increases DX range, cuts down static and interference, and through lowered resistance and distributed capacity materially increases volume and clarity. You must SEE the Bodine to fully realize its big advance over the old-style loop.

If your radio dealer cannot supply you, you may send order direct to us. Shipped post-paid on receipt of $8.50 *and your dealer's name.* Special Tapped Loop for Inverse-Duplex, $10. *Be sure to give make or type of circuit used.*

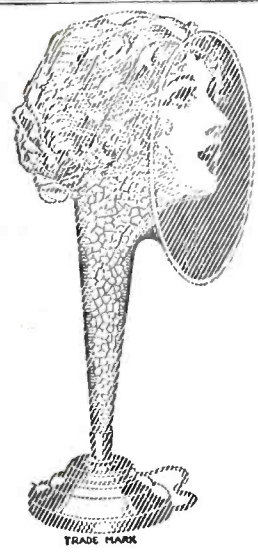
BODINE BASKET-WEAV LOOP AERIAL

BODINE ELECTRIC CO.
2256 W. Ohio Street
Chicago, Ill.

The Low-Loss Loop Aerial



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



Atlas

TRADE MARK

RADIO REPRODUCTION *speaker*

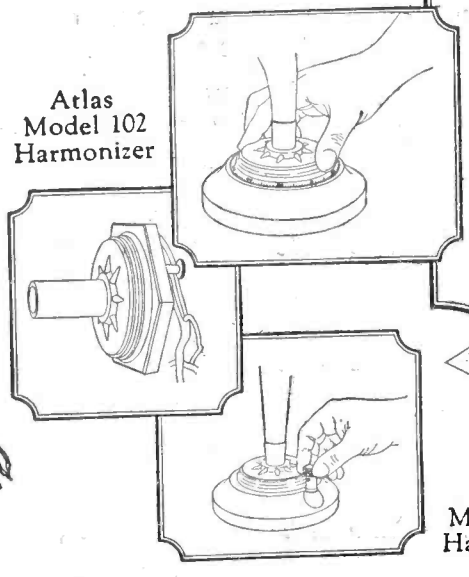
YOU DO NOT *want* just noise from your radio set.

Tone-range, quality, clarity, volume; each, alone, just noise. But their balanced combination as from *Atlas* Speakers "gives the best that's in your set". This is balanced Atlas Radio Reproduction.

MULTIPLE ELECTRIC PRODUCTS CO., Inc.
365 Odgen Street, Newark, N. J.
(Dept. W.)
New York, Boston, Philadelphia, Baltimore, Pittsburgh, Detroit, Chicago, St. Louis, San Francisco.
Marconi Wireless Telegraph Co. of Canada, Ltd.
Sole Canadian Distributors

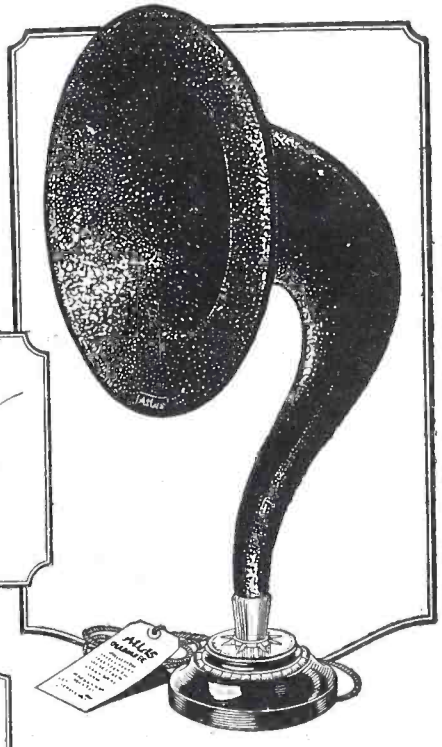
Atlas Type B Unit—the heart of the Atlas Speaker

Atlas Model 101 Speaker



Atlas Model 102 Harmonizer

Atlas Model 101 Harmonizer



Atlas Model 102 Speaker

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

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

First in the Field — Specializing in Cockaday Kits !

WE SELL GENUINE PARTS ONLY

As authorized and specified by Mr. Laurence M. Cockaday. The parts listed in these kits are complete in every detail. Nothing else to buy to assemble. COMPARE OUR OFFER!

5 TUBE NEW COCKADAY 4 CIRCUIT TUNER WITH RESISTANCE COUPLED AMPLIFIER KIT

1	"Precision" Cockaday Coil Set	$5.50	
1	"Cardwell" Vari. Cond. .0005	5.00	
1	"Cardwell" Vari. Cond. .00035	4.75	
2	"Accuratune" Dials	7.00	
1	"Amplex" GRID-DENSER	1.25	
1	"N.Y." Fixed Cond. .00025	.35	
9	"N.Y." Fixed Cond. .005	5.40	
5	"Benjamin Cle-ra-tone" Sockets	5.00	
1	"Bradleyleak"	1.85	
3	"Bradleyohms" No. 25	6.00	
1	"Amsco Dubl-Wundr"	2.00	
4	"Amperites" No. 1-A with mountings	4.40	
1	Switch Lever	$ .30	
3	"Improved" DC Jacks	3.00	
1	"Improved" SC Jack	.70	
1	"Improved" Battery Switch	1.00	
1	"Precise" Transformer	5.00	
3	"Electrad" ½ meg. Leaks	1.50	
3	"Electrad" Mountings	1.05	
8	Rajah Binding Posts	1.60	
7	Switch Points—2 stops	.15	
1	Baseboard	.75	
3	Sub-Panels (Genuine Bakelite)	.60	
1	Set Blueprints	1.10	
	Bus Bar, Brackets, Screws	2.25	
	Total Price	$67.50	

FREE 5 GENUINE R. C. A. OR CUNNINGHAM TUBES

1 U. V. 200, 4 U. V. 201A *Plus* a Genuine Bakelite Panel drilled and engraved.

WIRED COMPLETE In Genuine Mahogany Cabinet. $85.00

8 TUBE NEW COCKADAY SUPERHETERODYNE REFLEX RECEIVER KIT

1	General Instrument .0005 Condenser (Isolantite Insulation)	$5.50	
1	General Instrument .001 Condenser (Isolantite Insulation)	6.00	
1	Haynes Griffin imput transformer (new type)	5.00	
3	Haynes Griffin intermediate transformers (new type)	15.00	
1	Precision Autodyne Coupler	3.50	
1	Karas Harmonik Audio Frequency Transformer	7.00	
1	Amplex Grid Denser .0005	1.25	
1	Benjamin Cle-ra-tone Socket	1.00	
7	Federal Sockets No. 16	8.40	
1	Pacent Double Jack	.60	
1	Pacent Single Jack	.50	
2	Na-Ald 4 inch Dials	1.50	
1	Amsco Rheostat 2 Ohms	1.35	
1	Amsco Potentiometer 400 Ohms	1.50	
1	Daven Grid Leak Mounting	.40	
2	Daven Resisto - Coupler Mountings	$2.50	
2	Daven Resistors .5 Megohms	1.00	
1	Daven Resistor .5 Megohms	.50	
1	Daven Resistor .005 Megohms	.50	
2	Daven Resistors .25 Megohms	1.00	
2	New York Mica Condensers .0001 Mfd.	.70	
4	New York Mica Condensers .006 Mfd.	3.00	
1	New York Mica Condenser .00025 with clips	.45	
1	Duratran Radio Frequency Transformer	4.00	
1	Walbert "A" Battery Switch	.50	
7	Eby Binding Posts	1.40	
1	Sub-Panel 1 x 9 Genuine Bakelite	.25	
1	Baseboard (Hardwood)	.75	
	Bus Bar, Brackets, Screws, Blueprints	.95	
	Total Price	$76.00	

FREE 5 GENUINE R. C. A. OR CUNNINGHAM TUBES

U. V. 201A or C. 301A *Plus* a Genuine Bakelite Panel Drilled and Engraved.

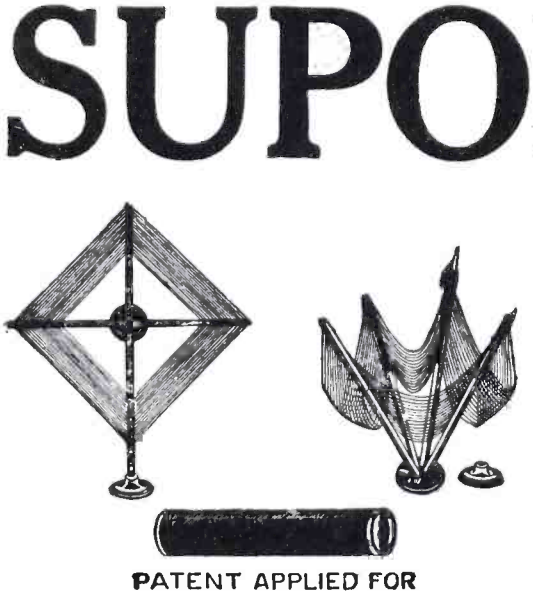
***OR*—1 Korach Tuned Loop Plus a Genuine Bakelite Panel Drilled and Engraved**

WIRED COMPLETE IN GENUINE MAHOGANY CABINET $110.00

Write for Special circular about these Kits also for our Radio Catalog sent free.

Orders over $5.00 Shipped Prepaid, Money Orders or C. O. D. One-third must accompany all C. O. D. orders. Not insured unless insurance charges included.

SUPORTENA



PATENT APPLIED FOR

The ultimate in Folding Loop Development Inductance can now be varied at will, to suit the receiver.

An ingenious Slider on Upright Support equivalent to 16 different Taps!!

A Development especially adapted to Superheterodyne receivers.

Tunes below 100 and over 600 meters!!

Increases the efficiency of any loop set.

$9.00 Construction Similar to the Popular PORTENA Loop, with Addition of The Slider Improvement.

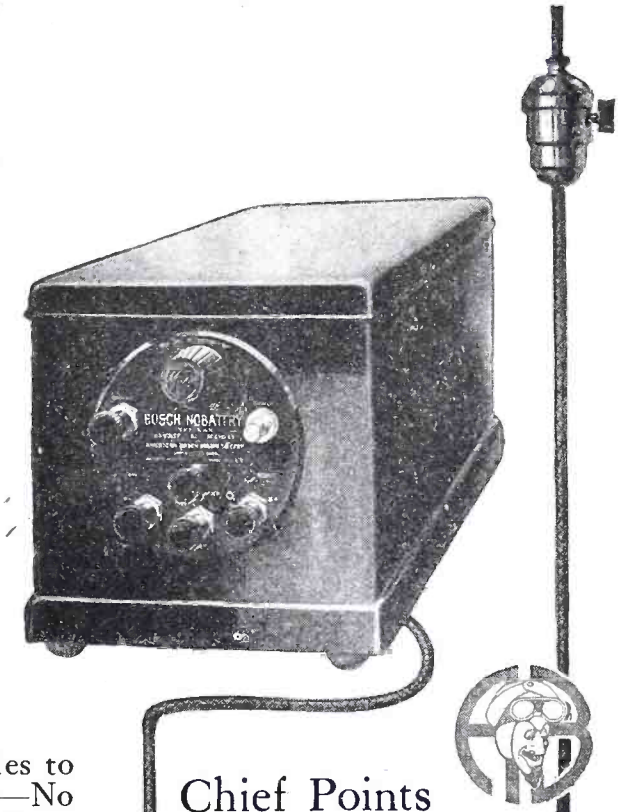
Manufactured by Radio's Master Loop Craftsmen.

J. NAZELEY CO.

571 HUDSON ST. NEW YORK

NEW!

"B" CURRENT FROM THE ELECTRIC LIGHT SOCKET



Switch it on! Switch it off!

That's all you have to do. No "B" batteries to charge or replace—No bother or nuisance—No trouble or disappointments—No guess work about your plate voltage.

Here's a magic box that takes your ordinary AC house current and converts it into direct current of the proper voltage to operate your radio set at maximum efficiency—today or a year from now.

It doesn't run down or get weak—doesn't need attention or new parts. It's as easy to operate as an electric iron, and should last just as long.

It is absolutely dependable, too! The fact that it is built and guaranteed by the makers of the world famous Bosch Magneto should establish complete confidence in its efficiency and reliability.

Do not confuse the Bosch Nobattry with other "B" battery eliminators. It uses no tubes, and is radically different in design and construction. It is the perfect "eliminator" which conservative radio users and dealers have been waiting for.

Learn more about it. Write today for illustrated folder, giving the name and address of your radio dealer.

Type BAN For alternating current.....$49.50
Type BDN For direct current.....$30.00

DEALERS—Don't delay—the demand is sure to be enormous. Wire today for sales proposition and discounts. State whether you are a dealer or jobber, and give references to aid us in quick allocation of territories.

AMERICAN BOSCH MAGNETO CORP.
Main Office and Works: Springfield, Mass.

Chief Points of Superiority

1. Suitable for any receiving set, using 1 to 14 tubes—will also take care of power amplifier.
2. Unlimited current supply.
3. Requires no attention—does not run down or wear out.
4. Cannot burn out radio tubes even if wrongly connected.
5. Uses no tubes—there's nothing to repair or replace.
6. Costs only a fraction of a cent to operate.
7. Detector voltage adjustable—from 15 to 50 volts.
8. Amplifier voltage adjustable, too—from 90 to 150 volts.
9. Constant voltage—plenty of pep.
10. Gives clear tone, greater volume, and more distance.
11. It is NOISELESS—there's absolutely no hum or distortion.
12. Will operate low power transmitting sets.

BOSCH NOBATTRY

J. L. McLaughlin at work in the Precise Laboratory

One reason for
PRECISE superiority

J. L. McLaughlin— our Research Engineer

THOUSANDS of radio fans each week are learning of the marvellous efficiency of PRECISE instruments. Every one of these instruments is built in accordance with Mr. McLaughlin's specifications, combining perfection of design with the best of materials and workmanship.

Precise Instruments

SUPER-MULTIFORMER No. 1700—for Superheterodyne Circuits.
POWER AMPLIFYING TRANSFORMERS No. 800-801—for Push-Pull Circuits.
AUDIO TRANSFORMER No. 285—the "Ultimate in Transformers."
FILTOFORMER No. 1900—radio frequency choke and by-pass condenser.

Send today for New Booklet

by Mr. McLaughlin giving complete constructional data for building his new 23-inch, 7-tube, One-Control Superheterodyne. Price in U.S.A., $1.00.

Sold by the better dealers

Precise Manufacturing Corporation, Rochester, New York

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53 W. Jackson Blvd., Chicago 821 Market St., San Francisco

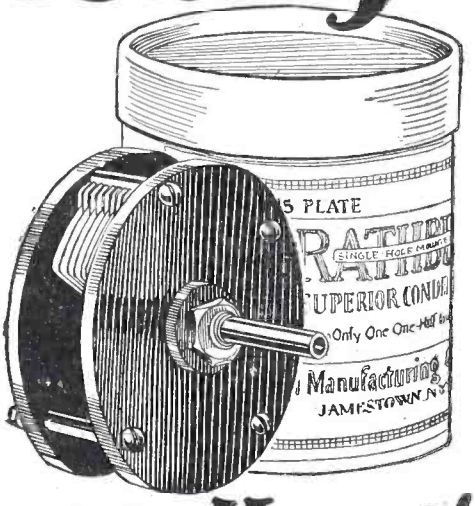
Eastern Sales Office—Niagara Sales Corp., 3-5 Waverly Place, New York City

Southern Representatives—Saal Products Sales, Inc., 35 Warren Street, New York City

CANADIAN DISTRIBUTORS

Perkins Electric, Ltd. · Toronto · Montreal · Winnipeg

Are You Fooled by "Low Loss" BUNK!



A RATHBUN Condenser is *Honest!*

Startling Statements that Say:

" Our Condenser has *No-Loss* "
" Our Condenser has *Lowest Loss* "
" Losses *CANNOT BE MEASURED* "

ARE BUNK

Engineers who know will back us up on all statements that we make. Rathbun Superior Condensers are as near perfect as condensers can be made today. They are Low in Loss, highly efficient (See LEFAX report). When folks speak about low-losses in condensers, eddy-currents MUST be taken into consideration. Why? Because eddy-currents are often more serious than dielectric losses at radio frequencies. Eddy-currents do not exist in Bakelite End Plates. So why pay much more for condensers when you can buy Rathbun Superior Condensers that have genuine Bakelite End Plates?

H. F. Harmon, Engineer; formerly of Bureau of Standards, says: "Losses due to eddy-currents in metal end plates of condensers are more serious at radio frequencies than in condensers using a good dielectric material, such as Bakelite."

Sylvan Harris, Engineering Expert, says: "It is a safe bet to say that nearly all measurements which have heretofore been made of the resistance of condensers for radio receiving at radio frequencies have been incorrect since many fallacious assumptions have been made. A new and exact method of making these measurements has recently been developed and a great many condensers have been measured by this method. In these measurements it was proven conclusively that in the average condensers on the market, whether it be the low-loss type or the old style, that the dielectric losses represent on the average 10% or less of the total resistance of the condenser. It is therefore evident that there are other losses in condensers than dielectric losses, the reduction of which may result in considerable more improvement than is effected by merely replacing end plates of insulating material with metal end plates."

NOTE THESE POINTS: LOW PRICES—$1.00 to $4.50, single-hole-mounting, overall plate protection, correct alignment, rigid, simple, light, compact and durable. Nothing to get out of adjustment. Will stand a lifetime of service. Low-loss and high efficiency.

Money Back GUARANTEE: If you can get longer distance, sharper tuning, clearer reception or more volume with any other condenser on the market today, return ours and get your money. The LEFAX report is included in our "CONDENSER GUIDE" which presents many truthful facts that you'll be glad to know to guide you in the purchase of condensers. Write for it.

Rathbun Claravox Superior Radio Reproducer

Have you heard the NEW Rathbun Claravox Superior Radio Reproducer? Not just a "Loud Speaker" but a real Radio Reproducer—a great surprise for your eyes and ears. Write for details.

RATHBUN MANUFACTURING COMPANY, Inc.

Dept. PR. 3, Jamestown, N. Y.

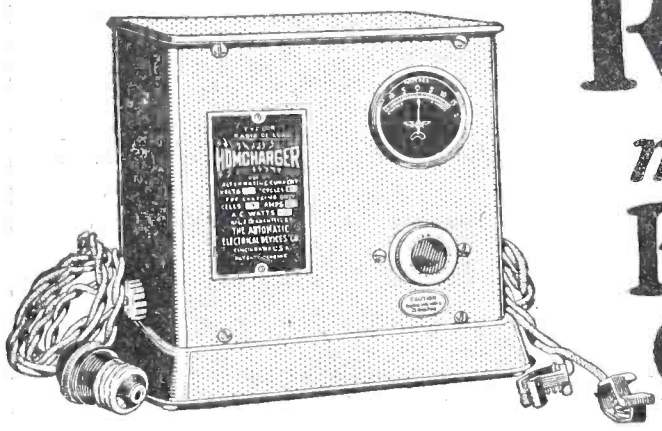
RATHBUN MFG. CO. PAT. PEND. JAMESTOWN, N.Y. U.S.A.

Molded on every original single-hole-mounting low-loss unconditionally guaranteed Condenser.

RATHBUN SINGLE-HOLE MOUNTING
SUPERIOR CONDENSERS

Handsome - Safe - Fast

GOLD SEAL HOMCHARGER



Radio's *most popular* Battery Charger!

OVER 250,000 Radio fans have found the big capacity 5 ampere GOLD SEAL HOMCHARGER ideal for keeping their Radio batteries fully charged and operating at top efficiency. Connects to any lamp socket and charges all Radio "A" and "B" and Auto Storage Batteries over night for a nickel.

Simple, reliable, fool-proof. Can be operated by any one. Contains no bulbs, acids or fast wearing carbon contacts. Only one moving part, replaceable for $1.00 after thousands of hours' use.

Absolutely safe—no danger of shock or fire. Approved by Insurance Underwriters everywhere. Beautifully finished in mahogany and gold. May be used right in the finest living room. Price, $18.50 complete for all currents.

fast!

—charges in one-third the time required by 2 or 3 ampere chargers.

Sold by all good Radio dealers, or shipped charges prepaid upon receipt of purchase price.

THE AUTOMATIC ELECTRICAL DEVICES CO.
132 W. Third St., Cincinnati, Ohio

Free

Largest Manufacturers' vibrating rectifiers in the world

Write for booklet, "The Secret of Distance and Volume in Radio," containing information on this subject and fully describing the GOLD SEAL HOMCHARGER.

Free

I had no idea such a speaker could be built

and after putting it through every test, trying to make it distort and rattle, have given up all hope. Have never heard anything that will compete with Thorola for volume, clearness, and tone quality, and gladly commend this unit to all lovers of radio who desire the best. (Signed) F. P. Wallou, Station WABM

Under the remarkable 10-day Refund Warranty, THOROLA *must* fulfill every claim—*must* improve power, range, TONE QUALITY.

THOROLA 4 . . . . . $25
THOROLA 9 (*Cabinet*) 40
THOROLA 6 (*Phonograph Attachment*) 15
Thorola models require no battery—Simply plug in same as headphones
THOROPHONE (*Power Type Speaker*) $45

Radio directors, great musical artists, acoustic specialists, are unanimous on Thorola. Today, with any radio set, Thorola Loud Speaker signifies that the best possible radio is being heard.

Thorola won the cultured ear to radio with betterments direct from the realm of music. The Thorola Controlled Mica Diaphragm was introduced to record sound impulses by the truest method known. The Thorola Separix for the first time sharply preserved overtones, without which there is no real music or natural speech. The Thorola horn of Thorite compound eliminated uncontrolled natural resonance. The exclusive Thorola Synchronizer balances speaker and circuit, an essential of finest radio.

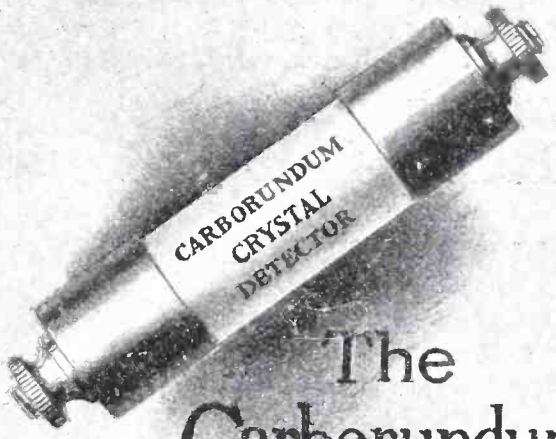
All these inherent superiorities are brought to peak efficiency by the far larger size of the Thorola reproducer, permitting precision construction.

Incomparable in design and construction, Thorola is incomparable in tonal purity and extreme volume. To know the furthest advance in radio entertainment you must hear a Thorola demonstration.

REICHMANN COMPANY, 1725-39 W. 74th St., CHICAGO

Thorola

THE SPEAKING LIKENESS



The Carborundum Crystal Detector

$1.50

From your dealer or post-paid direct

MONTHS of exhaustive research brings this remarkable Carborundum Crystal Detector Unit to the radio world. A specially made, carefully selected Carborundum Crystal, set in a protective cartridge.

Permanently fixed to retain its sensitivity indefinitely—it will not burn out.

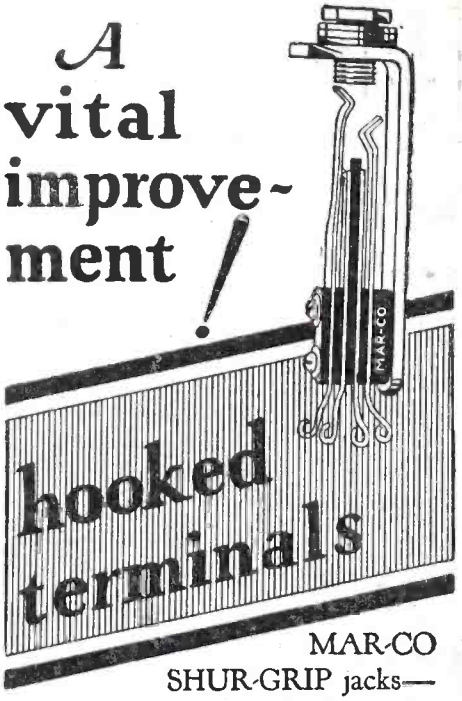
Sharpens the tuning—increases the selectivity of any crystal or reflex set—and no booster battery is needed.

It gives results never before attained by any other crystal detector.

Every Carborundum Crystal Detector Unit is laboratory tested and is guaranteed for any properly designed circuit.

Manufactured only by
THE CARBORUNDUM COMPANY
NIAGARA FALLS, N.Y.

A vital improvement!



MAR-CO SHUR-GRIP jacks—*with hooked terminals*—make set construction easier—short circuits impossible—and leak-proof connections permanent!

Formica insulation thruout—heavily nickeled finish—sterling silver contacts—five types—60 cents to $1.00—and mighty well worth the difference!

MAR-CO
RADIO PRODUCTS
SHUR-GRIP JACKS

Any MAR-CO plug, with a SHUR-GRIP jack, is ample assurance that *all* the energy in your set . . actually gets to your speaker!

—and when you need a variable condenser, get one you *know* will cut down leaks—a MAR-CO! Handsomely finished, individual tension adjustment, a precision instrument throughout!

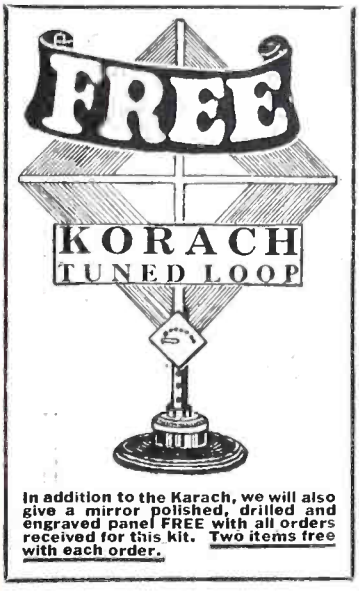
Write for Your FREE copy to-day

Everyone Interested in RADIO Should Write for this FREE Radio Book

Every item advertised on this page—every statement made—everything we do or sell is *absolutely legitimate*. Perfect satisfaction is yours when you buy from Wholesale Radio.

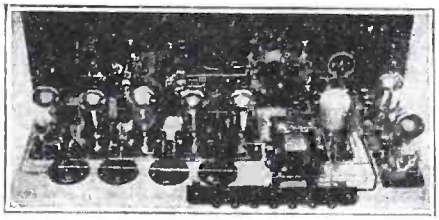
Our WRS Cockaday Kit is a complete kit. Every part is exactly as Mr. Cockaday himself built it. Everything from the authorized condenser right down to the last screw. The construction work on this kit has been carried to the point where all you have to do is fasten the parts in place, cut and fit the wires, solder them in place, and you have a very handsome and reliable long distance receiver.

Our sets and kits approved by POPULAR RADIO LABORATORIES



In addition to the Karach, we will also give a mirror polished, drilled and engraved panel FREE with all orders received for this kit. Two items free with each order.

COCKADAY 8-TUBE SUPERHETERODYNE



PARTS FOR BUILDING THE COCKADAY EIGHT-TUBE SUPERHETERODYNE REFLEX

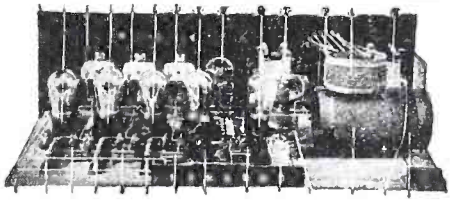
	List Price
1 General Instrument low-loss condenser (Isolantite insulation) .0005 mfd.	$5.50
1 General Instrument low-loss condenser (Isolantite insulation) .001	6.00
1 Haynes Griffin input transformer (new type) } 3 Haynes Griffin intermediate transformers (new type) }	20.00
1 Precision autodyne coupler	3.50
1 Karas Harmonik audio-freq. transformer	7.00
1 Amplex gridenser .0005 mfd.	1.25
1 Benjamin Cle-ra-tone socket	1.00
7 Federal sockets No. 16	8.40
1 Pacent double circuit jack	.60
1 Pacent single circuit jack	.50
2 Na-ald 4 in. dials No. 3043	1.50
1 Amsco Rheostat 2 ohms	1.35
1 Amsco Rheostat 400 ohms	1.50
2 Daven resisto-coupler mountings	2.50
1 Daven grid-leak mounting	.35
2 Daven resistors .5 megohm	1.00
1 Daven resistor .5 megohms	.50
1 Daven resistor .005 megohm	1.00
2 Daven resistors .25 megohm	1.00
2 N. Y. mica fixed condensers .0001 mfd.	.70
4 N. Y. mica fixed condensers .006 mfd	3.00
1 N. Y. mica fixed condenser .00025 mfd. with grid-leak mounting	.45
1 Duratran radio-freq. transformer	4.00
1 Walbert A battery switch	.50
7 Eby marked binding posts	1.40
1 Bakelite xx 7x24 highly polished, drilled and engraved panel Free	
1 Sub-panel size 1 x 9 drilled	.25
1 Set of POPULAR RADIO three full sized blue prints	1.10
1 Box Dixie assorted screws, nuts, wires, etc	.50
40 ft. bus bar wire	.75
1 Baseboard	1.00
2 "4" Brackets	.20
KIT PRICE	$77.95
THIS SET WIRED AND BUILT IN A BEAUTIFUL, GENUINE MAHOGANY CABINET, READY FOR USE	$99.50

NEW COCKADAY FOUR CIRCUIT TUNER

WITH RESISTANCE-COUPLED AMPLIFIER

All Parts Exactly As Specified by Mr. Cockaday

OUR KIT IS ABSOLUTELY COMPLETE TO LAST SCREW



List of Parts:

1 Cockaday Precision coil	$5.50
1 Cardwell 21 pl. .0005 mfd. condenser	6.00
1 Cardwell 17 pl. .00035 mfd. condenser	4.75
2 Accuratune micrometer control dials (new type)	7.00
1 N. Y. mica fixed condenser .00025	.35
1 Amplex Gridenser	1.25
6 Benjamin CLE-RA-TONE sockets	5.00
1 Amsco "DUBLWUNDR" comb. pot-rheo	2.00
4 Amperites No. 1-a	4.40
3 Improved double circuit jacks	3.00
1 Improved single circuit jack	.70
1 Precise audio frequency transformer	5.00
9 N. Y. mica fixed condensers .005	5.40
1 Amsco switch lever	$ .25
9 Switch points and 2 stops	.20
1 Improved filament battery switch	1.00
1 7 x 24 panel, drilled and engraved	3.50
3 Electrad certified grid leaks ½ meg.	1.50
3 Electrad grid leak holders	.75
3 Bradleyohms (new type)	6.00
1 Bradleyleak (new type)	1.85
3 Sub panels	.50
1 Base board	.75
8 Rajah Terminals	1.60
20 ft. bus wire	.20
1 box assorted Dixie screws, nuts, brackets	.50
Total	$67.95

As an appreciation of the tremendous volume of business that our customers have given us during the past year, we offer FREE—FOUR GENUINE UV 201-A RCA TUBES WITH EVERY KIT ORDERED

ON APPROVAL

You can examine at your express office without obligation to accept. If you accept and within a reasonable time you do not get satisfactory results we will take back anything or everything undamaged and willingly refund your money.

QUICK SHIPMENT

Goods subject to examination before acceptance if desired. We pay transportation to any P. O. or Shipping point in U. S. No money in advance unless you prefer to. Letters answered quickly and intelligently. Radio questions answered free.

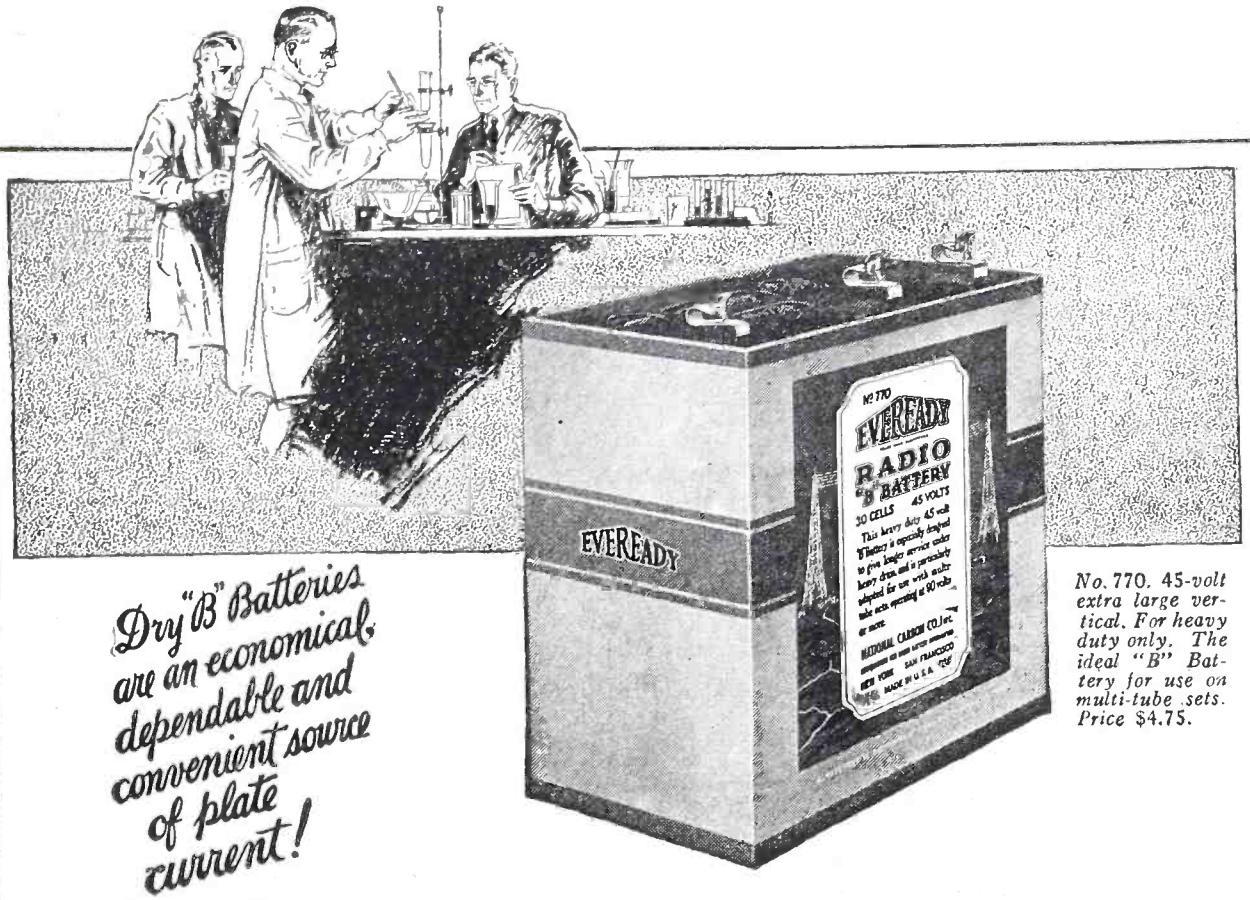
SEND MONEY ORDER OR PAY POSTMAN

WHOLESALE RADIO SERVICE COMPANY

9 Church St. N.Y.C.

DEPT. P

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



Dry "B" Batteries are an economical, dependable and convenient source of plate current!

No. 770. 45-volt extra large vertical. For heavy duty only. The ideal "B" Battery for use on multi-tube sets. Price $4.75.

Scientists constantly improve battery quality

EVEREADY "B" Batteries today contain more electricity, more service, more satisfaction than ever before.

Processes evolved by the scientists of the Union Carbide and Carbon Research Laboratories, Inc., when put in effect in the Eveready factories, are responsible for this great accomplishment.

At the same time the factories have effected a still higher standard of workmanship. A system of inspection that is a marvel of efficiency was inaugurated. The results, gratifying beyond measure, were accomplished with a speed and completeness that have few parallels in industry. The final tests showed more electricity, more battery service, greater Eveready satisfaction without increasing battery sizes *and with a substantial reduction in price.* "B" Battery operating costs, using the new Evereadys, in most cases show a reduction of at least one-half.

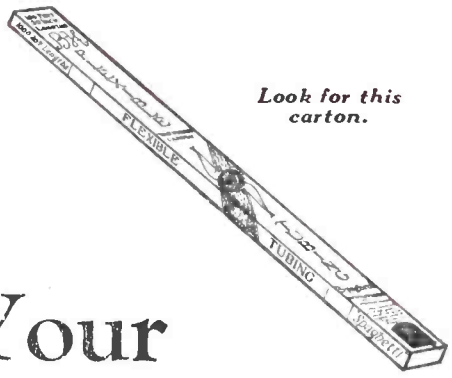
There is an Eveready Radio Battery for every radio use.

Insist on Eveready "B" Batteries.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY HOUR
EVERY TUESDAY at 9 P. M.
(Eastern Standard Time)
For real radio enjoyment, tune in the "Eveready Group." Broadcast through
WEAF New York WJAR Providence
WEEI Boston WFI Phila.
WGR Buffalo WCAE Pittsburgh

EVEREADY
Radio Batteries
—they last longer



Look for this carton.

Your Protection—

For your protection B-H Radio Tubing (Spaghetti) is sold in our cartons and under our trade mark.

You know you are getting the best when you ask for it by name.

Bare wires are good, if you want to take the chance of blowing out all your tubes. Play safe and use—

B-H Brand Radio Tubing

Made of special woven cambric—
Varnished with *six* coats—
Proof against water, oil and acid—
Extremely flexible—
***Guaranteed* not to crack.**

Your satisfaction is our aim—our trade mark is your protection. Ask for it by name.

Look for the red and black trade mark.

If your dealer cannot supply you, order direct from us.

Also Manufacturers of High Grade Optical Tubing and Magneto Tubing of High Dielectric Strength.

Bentley-Harris Mfg. Co.
Elm and Ash Streets
Conshohocken, Pa.

You Will Get

100%

Efficiency

from your set if you keep tabs on your storage batteries with the

Perfection HYDROMETER

The 100% Perfect Instrument

It's in the float. If the name PERFECTION is not on the float it is not a genuine PERFECTION.

Scientifically made for instant, accurate battery testing. Will not leak. The ribbed, acid proof rubber connections prevent rolling and breakage.

$1.00 at all Radio Stores

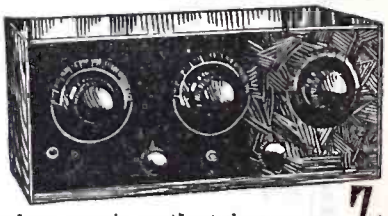
APPROVED POPULAR RADIO LABORATORY

Bemco Manufacturing Company
243 W. 55th St.
N. Y. City

SIMPLEX

RS5

5-Tube Tuned R. F. Set



A NEW Simplex receiver that is a revelation for distance, volume, tone, selectivity. All standard Simplex parts. In genuine mahogany cabinet—without accessories **$57**

Write for information

SIMPLEX RADIO CO., Manufacturers
Philadelphia, Pa.

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

When Winter Winds Blow Cold

FRESHMAN MASTERPIECE

The Greatest Value Ever Offered In A Radio Receiving Set!

A 5-tube Tuned Radio Frequency Set made of the finest low loss materials and in a beautiful genuine solid mahogany cabinet, that is attractive enough for the most pretentious room, and at sixty dollars, economical enough for the most modest.

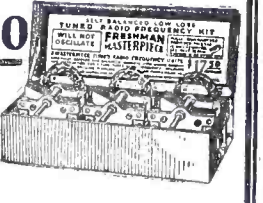
Combines all points essential to the perfect receiver. Real distance reception without that squealing and howling. So selective that once a station is picked up—it can be brought in again at the same points on the dials, whenever you want it. And what's more,

IT IS MIGHTY EASY TO OPERATE

$60

Tuned Radio Frequency Kit

$17.50



It's Easy to Build

a five tube radio frequency receiver when you use the Freshman Masterpiece Kit. The result will be a receiver that will bring in even the most distant stations with the volume and clarity of locals. The equal of any 5 tube set in selectivity, simplicity of operation and all around efficiency.

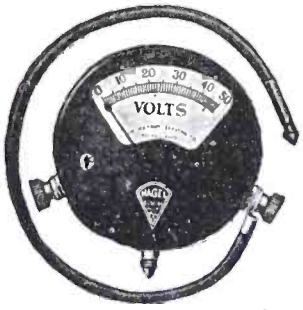
No Neutralizing or Balancing Condensers Required

Have Your Dealer Install One in Your Home!

All genuine Freshman Masterpiece Sets have a serial number and trade-mark riveted on the sub-panel. The Receiver is not guaranteed if number has been removed or tampered with.

Chas. Freshman Co. Inc.
Radio & Condenser Products
Freshman Building, 240-248 W. 40th St., New York

NAGEL ELECTRIC TOLEDO



No. 22—About ⅓ actual size.

NAGEL
high resistance is 60 ohms per volt!

The majority of pocket type voltmeters, hastily constructed for the radio trade, have low resistance windings. This causes serious damage to the batteries through drainage as well as a decided error in readings due to temperature rise of the windings.

Nagel high resistance Voltmeters are built to standard—*60 ohms per volt*—which is 5 to 10 times that of other medium priced instruments. High resistance insures accuracy under constant service.

See your dealer today. If he hasn't Nagel radio battery measuring instruments, have him send your order to

The W. G. Nagel Electric Co.
Hamilton St. Toledo, Ohio

Nagel measuring instruments are giving daily service on over 6,000,000 automobiles

NAGEL

Manufacturers of

DRY CELL TESTERS · AMMETERS
HIGH-RESISTANCE VOLTMETERS
and VOLTAMMETERS · BAKELITE
HOT MOULDED INSULATIONS

FREE

To Each Purchaser of a World Battery

A 24-Volt "B" Storage Battery positively given FREE with each purchase of a WORLD "A" Storage Battery. The WORLD Battery is famous for its guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 60%.

Prices That Save and Satisfy

Auto Batteries		Radio Batteries	
6-Volt, 11 Plate	$12.25		
6-Volt, 13 Plate	14.25	6-Volt, 100 Amps.	12.50
12-Volt, 7 Plate	17.00	6-Volt, 120 Amps.	14.50
		6-Volt, 140 Amps.	16.00

Shipment Express C. O. D. subject to examination. 6 per cent discount for cash in full with order.

2-Yr. Guarantee Bond in Writing With Each World Storage Battery

proves satisfactory World performance. Mail this ad with your name and address—we will ship battery day order is received; and give you your choice of "B" Storage Battery or a handsome nickle finish Auto Spotlite, FREE. Write TODAY.

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 3 CHICAGO, ILL.

This FREE "B" Storage Battery takes the place of dry cell "B" batteries. Can be recharged and will last indefinitely. To be sold retail for $6.00. It is the only battery of its kind equipped with solid rubber case—and insurance against acid and leakage. Take advantage of this remarkable introductory offer NOW. (To those who prefer it, we will send FREE a handsome nickel finish Auto Spotlite, instead of the "B" Battery. Be sure to specify which is wanted.)

GIVEN FREE
To introduce this new and superior World "B" Storage Battery to the Public

Globe
LOW-LOSS TUNERS

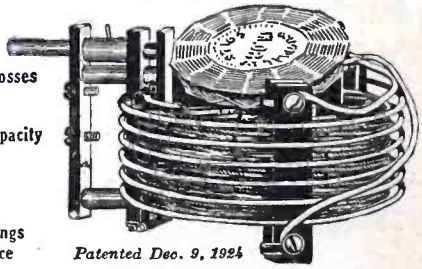
Loses Nothing
Tunes every radio impulse the aerial receives

No Metal
No Eddy Current Losses

Little Insulation
Low Distributed Capacity

Large Wire
Self Supporting

Anti-Capacity Windings
Low R. F. Resistance



Patented Dec. 9, 1924

GET ORIGINAL GLOBE COILS

Standard Tuner (Broadcast Range)	$7.00
Short Wave (35-135 Meters)	$7.00
For Superdyne Circuit	$8.50
R. F. Transformer	$6.00

Circular on Request. Dealers and Jobbers Write.

SEND ORDERS DIRECT TO

Globe Radio Equipment Co.
217 WEST 125th ST., N. Y. C.

** Imitation is Deceit. * Legal Action Pending.*

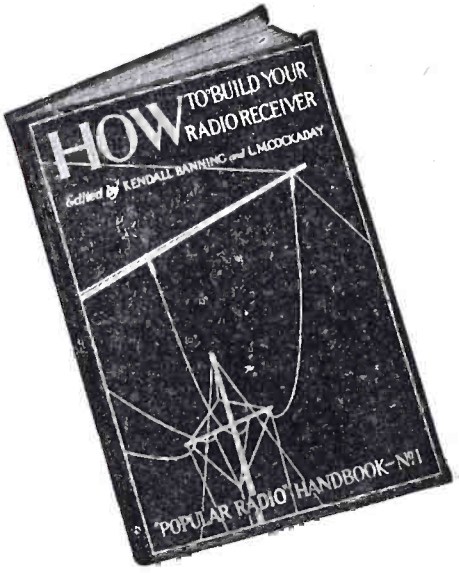
Instruction Book and Radio Manual

FREE

WITH

POPULAR RADIO

FOR NEXT THIRTY DAYS



Build Your Own

Aside from the feature of economy, there is the thrill and satisfaction that comes from building your own receiving set. Instead of being a mere "dial-twister" you will necessarily have a very definite basic knowledge of what radio is all about after constructing a set.

Thousands of sets have never been constructed because of the atmosphere of mystery that has enveloped the whole subject of radio. Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO, through their close contact with the great radio public sensed this and compiled a book that will convince the veriest beginner that technical training is not essential. If you have a little time to devote to a most fascinating pastime, send for a copy of "How to Build Your Radio Receiver" and discover how simple and easy set building really is. This famous book has made it so.

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 $3.00 in payment for a 12 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.

POPULAR RADIO Dept. 25,
627 West 43d Street,
New York City.

Offer expires Feb. 20, 19-5

Enclosed remittance of $3.00 is payment in full for a 12 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."

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 loud-speaker. 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 loud-speaker. Has been called the "Rolls-Royce" of radio receivers.

POPULAR RADIO

627 West 43d Street, New York City

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

Type 6-D Broadcast Receiver

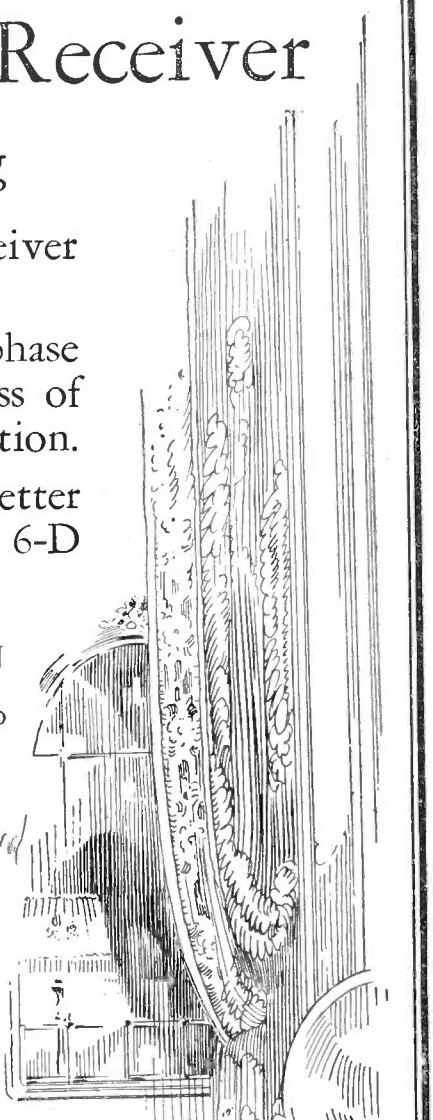
Non-oscillating ~ Non-radiating

IN dollar-for-dollar value, the 6-D Receiver leads the field.

This remarkable Receiver excels in every phase of performance—purity of tone, sharpness of tuning, range, volume and ease of operation.

You can pay more, but you cannot buy better reception. By all means, examine the 6-D before making a final selection.

EISEMANN MAGNETO CORPORATION
165 Broadway, New York
DETROIT SAN FRANCISCO CHICAGO



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.

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.

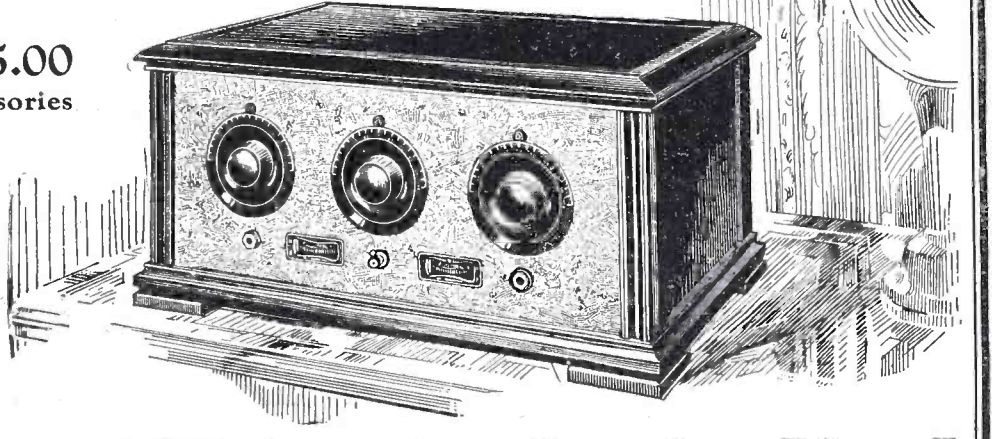
Panel: Aluminum, with attractive crystal black finish. A perfect body capacity shield.

Dials: Sunken design. Shaped to fit the hand and permit a natural position in tuning.

Wave lengths: 200 to 600 meters, with uniform efficiency of reception.

Aerials: 75 to 125 feet single wire.

Price $125.00
without accessories



EISEMANN

EISEMANN

ELECTRICAL EQUIPMENT

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

FREE PARTS!

Introduce POPULAR RADIO to a few of your friends and take your pick of radio parts

HERE is an opportunity for you to secure all or any of the parts needed to build complete three of our most popular receivers—and at no expense. You, surely, are well acquainted with the features of POPULAR RADIO that have given it more subscribers than any other radio publication. Won't it be easy to use your enthusiasm in inducing your friends and their friends to subscribe too?

To make it possible for you to secure an order from everyone we will permit you to make the following offers:

POPULAR RADIO

24 Months	for	$5.00	counts	75	credits
12 "	"	3.00	"	50	"
8 "	"	2.00	"	33	"
6 "	"	1.50	"	25	"
4 "	"	1.00	"	16	"

You remit the full amount collected with names and addresses of subscribers and ask for the parts that your total CREDITS entitle you to; or, if you prefer, let us credit them to you and when you have a substantial total, order the parts you want and we will charge against your CREDIT account.

As a further concession, suppose you have sent us 5 annual subscriptions for POPULAR RADIO, and in addition to a set of Approved Cockaday Coils want a .0005 Amplex Grid-denser. The Coils are 220 CREDITS and the Grid-denser 50 CREDITS. The subscriptions total only 250 CREDITS and you need 20 CREDITS more. We will permit you to buy the additional CREDITS at 3c. apiece—so for 5 annual subscriptions and 60c. in cash we will ship the two parts you want.

NO CREDITS allowed on your own subscription and subscriptions sent us on this offer do not include premiums to the subscriber too, as we want *you* to have the full CREDIT value.

The specifications in all three sets name the parts used in building the original laboratory sets. We know that these parts if used will insure satisfactory results. But it does not prevent you from using other brands which will prove equally satisfactory. In fact, if you prefer some other brand or any parts not listed on this page, tell us what you want and we will tell you the number of credits required. We are prepared to supply any radio material you may require.

We also want to call your attention to the famous POPULAR RADIO Simplified Blueprints described on page 142. Any of these sets will be supplied for only 44 Credits.

Or for 60 Credits you may have a copy of "How to Build Your Radio Receiver" described on page 130.

CREDITS Needed for Parts Required for the Craig 4-tube Reflex Receiver with Sodion Detector

(Described and illustrated in POPULAR RADIO for February, 1925)

Quantity	Item	Credits
2—Sickles Coupler Coils	No. 20	560
2—Sickles r. f. transformer coils		
2—Duplex Series FR, 21-plate variable condensers .000507 mfg. @ 220		440
2—Na-ald 4-in. dials for the above condensers @30		60
4—Na-ald standard sockets, type 400 @30		120
1—Cardwell 7-plate variable condenser .0001 mfd.		160
1—Dubilier mica fixed condensr .00025 mfd. with clips for grid leak		18
1—Dubilier mica fixed condenser .0005 mfd.		14
2—Dubilier mica fixed condenser .006 mfd. @30		60
1—Daven grid leak 5 megohms		20
2—Daven resisto-couplers @50		100
2—Daven resistors .1 megohm @30		60
2—Daven resistors .25 megohm @20		40
1—Cutler-Hammer rheostat 30 ohms		40
1—Cutler-Hammer rheostat 4 ohms		40
1—Carter closed circuit jack, type 102-A		32
1—Carter filament control jack, type 103		36
1—Federal No. 65 audio-frequency transformer		280
1—Bradleyswitch		24
1—Amsco switch lever, with points and stops		19
8—Eby binding posts @8		64
1—Composition panel 7 x 26 inches		130
Total		2,317

CREDITS Needed for Parts Required for the Cockaday 8-Tube Superheterodyne Reflex

(Described and illustrated in POPULAR RADIO for January, 1925)

Quantity	Item	Credits
1—"General Instrument" lowloss condenser (Isolantite insulation .0005 mfd)		220
1—"General Instrument" lowloss condenser (Isolantite insulation .001 mfd.)		240
1—"Haynes-Griffin" input transformer (new type)		
3—"Haynes-Griffin" intermediate transformers (new type)		800
1—"Precision" autodyne coupler		140
1—"Karas Harmonik" audio-frequency transformer		280
1—"Amplex" grid-denser .0005 mfd.		50
1—"Benjamin" Cle-ra-tone socket		40
7—"Federal" sockets No. 16 @ 48		336
1—"Pacent" double-circuit jack		24
1—"Pacent" single-circuit jack		20
2—"Na-ald" 4-inch dials No. 3043 @30		60
1—"Amsco" rheostat, 2 ohms		54
1—"Amsco" rheostat 400 ohms		60
2—"Daven" resisto-coupler mountings @50		100
1—"Daven" grid-leak mounting		14
2—"Daven" resistors .5 megohms @20		40
1—"Daven" resistor .5 megohms		20
1—"Daven" resistor .005 megohms		40
2—"Daven" resistors .25 megohms @20		40
2—"New York" mica fixed condensers .0001 mfd. @14		28
4—"New York" mica fixed condensers .006 mfd. @30		120
1—"New York" mica fixed condenser .00025 mfd., with grid leak mounting		18
1—"Duratran" radio-frequency transformer		160
1—"Walbert" "A" Battery switch		20
7—"Eby" binding posts @8		56
1—Composition panel 7 x 24 ins.		120
1 "Korach" tuned loop		660
Total		3,760

CREDITS Needed for Parts Required for the NEW Cockaday 4-Circuit Tuner with Resistance-Coupled Amplifier

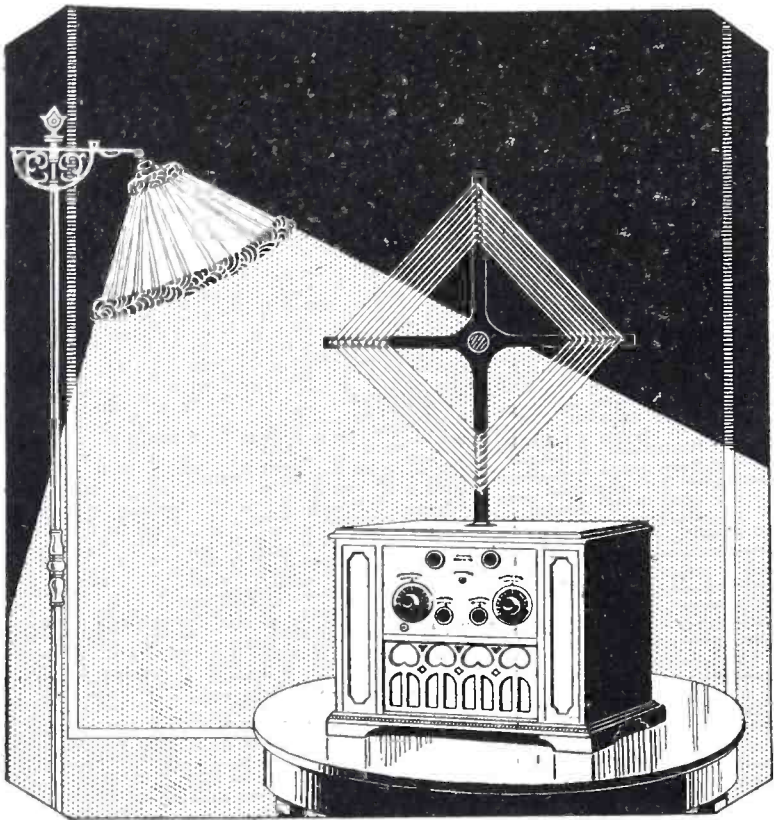
(Described and illustrated in POPULAR RADIO for October, 1924)

Quantity	Item	Credits
1 set	"Precision" Cockaday Coils	220
1—	"Cardwell" variable condenser (.0005 mfd.)	200
1—	"Cardwell" variable condenser (.00035 mfd.)	190
2—	"Accuratune" micrometer control dials @140	280
1—	"New York" mica fixed condenser (.00025 mfd.)	14
9—	"New York" mica fixed condensers (.005 mfd) @24	216
1—	"Amplex" grid-denser	50
1—	"Bradleyleak"	74
3—	"Bradleyohms" No. 25	240
5—	"Benjamin" Cle-ra-tone sockets for UV201a tubes	200
1—	"Amsco Dubl-Wundr" combination potentiometer-rheostat	80
1—	"Amsco" switch lever	12
4—	"Amperites" No. 1-A, with mountings	176
3—	"Improved" double-circuit jacks	120
1—	"Improved" single-circuit jack	28
1—	"Improved" filament battery switch	40
1—	"Precise" audio-frequency transformer No. 285-A	200
3—	"Electrad" Certified grid leaks, ½ megohm @20	60
3—	"Electrad" Certified grid leak mountings @14	42
7—	Switch points @1	6
2—	Stops @1	2
1—	Composition panel 7" x 24" x 3/16"	120
8—	"Radah" snap terminals @8	64
		2634

POPULAR RADIO

Department 21

627 West 43d Street, New York City



De Forest Radiophone

Requires no aerial—no ground wire

Batteries, De Forest Loud Speaker and Tubes complete within cabinet.

Easily movable from room to room, it is ready to operate within five minutes after it is delivered to your home.

You have the radio habit now!

You'd better have a De Forest

WHETHER you have an instrument or not, whether you know it or not, you have the radio habit already. Do you go to the theatre? Do you go to political meetings? Do you read the day's news? Do you seek contact with people who offer either amusement or information? Then you're essentially a radio fan, for radio is giving many of the best of these things in a way in which they cannot be obtained elsewhere.

The De Forest is a complete and self-contained instrument with a loop the size of a picture frame instead of an aerial wire, with batteries and loud speaker self-contained.

It can be easily moved from room to room. It has a remarkable tone quality. It brings out the voice or instrument as sincerely and truthfully as the performer himself does. And it is an immediate result-getter that is simple to operate!

Whatever there is in radio, the De Forest can give it to you. It yields good results from the beginning and gradually increasing results as your skill grows. *There is nothing else like it.*

It will pay you to look up a De Forest Agent

He is willing and equipped to teach you the simple technique of using the De Forest. Let him demonstrate it in your own home.

DE FOREST RADIO COMPANY, Jersey City, N. J.

Also makers of De Forest Tubes—The "Magic Lamp" of Radio

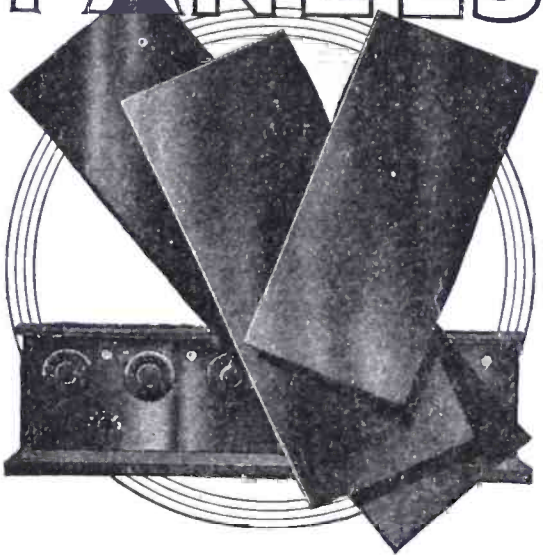
DE FOREST RADIOPHONE

REG. U.S. PAT. OFF. REG. U.S. PAT. OFF.

The Importance of Good Radio Panels

A superior panel will increase the efficiency of your reception through reducing surface leakage. You can be certain of this by building your set with

ELECTRASOTE
TRADE MARK
PANELS



These beautifully finished panels will neither warp nor change color. They are scientifically constructed to reduce surface leakage to a minimum, hence assure increased efficiency of the set.

One of the famous "sote" products introduced by The Pantasote Company, Inc., Electrasote Radio Panels are sold strictly on their merits—yet are

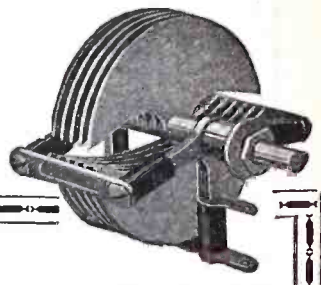
Lower Priced
than other standard panels

Make your Set an "Electrasote Panel Set"—and get results!

On sale at good Radio Dealers

M. M. FLERON & SON, Inc.
Sole Sales Agents
Trenton, New Jersey

FREE Bulletin



"Good Condenser Design"

What makes a good condenser? Send for this free folder and post yourself on today's requirements. This article is full of meat. It makes plain all the electrical as well as the mechanical qualities of a good condenser.

If you are planning to build a receiving set or to bring your present one up to date, go to your dealer and ask to see the new

Premier "CROFOOT" Variable Condenser

"CROFOOT" has all the necessary electrical and mechanical features. It is a real low loss instrument. It has the lowest minimum capacity yet attained—.000005 M. F. and the greatest tuning ratio—1 to 74. Made entirely of brass and hard rubber giving remarkably low skin resistance and low insulation leakage. Semi-straight line plate construction. All plates soldered; a feature identified by the "red stripe." A sturdy, smooth acting, compact and graceful instrument. Mounts with one hole. Ratios 1 to 19, 1 to 42, 1 to 53 and 1 to 74. Price from $2.75 to $3.75. Vernier attachment with dial 75 cents additional.

FREE Hook-Up Diagrams

Ask your dealer for a complete set of Premier diagrams covering all types of hook ups. If he cannot supply them send his name and receive a set with bulletin.

Premier Electric Company
3807 RAVENSWOOD AVE., CHICAGO

PREMIER
Quality Radio Parts

AMBASSADOR
Low Loss Products

Master Tuning Coil
Perfectly Balanced Head Phone
Low Loss Condenser

High grade, standard radio products that will increase the efficiency of any set and add to the satisfaction of the user. Ambassador Low Loss Products have long been the choice of particular fans. See them—compare them, and you will choose them too.

At all good dealers.

Write for FREE diagrams of circuits in which Ambassador Products can be used.

AMBASSADOR SALES COMPANY
108 Greenwich St., New York
326 W. Madison St., Chicago

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Your choice of the best magazines at less than publisher's regular prices

POPULAR RADIO Two annual subscriptions $5.00

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Today's Housewife McCall's Popular Radio $5.00 Reg. For **$4.00**	*American Magazine *Woman's Home Companion Popular Radio $7.00 Reg. For **$5.75**	Success Popular Radio $5.50 Reg. For **$4.25**

* Combinations starred (*) must go to one address.

THIS page represents an opportunity for you to secure your entire season's reading at a substantial cash saving over regular rates. The special combinations above and the representative list at the side should cover all the magazines you are accustomed to read. But if any of your favorites are missing, let us quote prices. You will find our rates as low or lower than you can get anywhere else.

As most of these combinations can be sent to different addresses, you will find that your friends and neighbors will be glad to have you forward their order with your own that they may take advantage of these very low prices.

If your subscriptions for any of these magazines have not yet expired, your present order will be entered as an extension.

So fill out the coupon below and mail it promptly. Magazine prices change so rapidly that these rates cannot be guaranteed for more than thirty days.

POPULAR RADIO

627 West 43rd Street, New York City, N. Y.

Date.....192 .

POPULAR RADIO, Dept. 22,
627 West 43d Street,
New York City, N. Y.

Enclosed remittance of $..... is payment in full for the magazines ordered on the attached list.

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.

MAKE any selection you wish from the following list, to be sent to different addresses if desired. Remit only the amount shown in the right-hand column, *if more than one magazine is ordered.* All quotations cover twelve issues to the year unless otherwise specified.

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Radio Broadcast	4.00	"	"	3.50
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Snappy Stories (24 issues)	4.00	"	"	3.50
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Today's Housewife	1.00	"	"	.75
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Boys' Life	2.00	"	"	1.75
Boys' Magazine	1.00	"	"	.85
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Every Child's Magazine	1.50	"	"	1.25
Every Girl's (10 issues)	1.00	"	"	.95
Everyland (10 issues)	1.50	"	"	1.40
John Martin's Book	4.00	"	"	3.50
Junior Home Magazine	2.50	"	"	2.25
Kindergarten-Primary (5 issues)	.75	"	"	.70
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St. Nicholas	4.00	"	"	3.25
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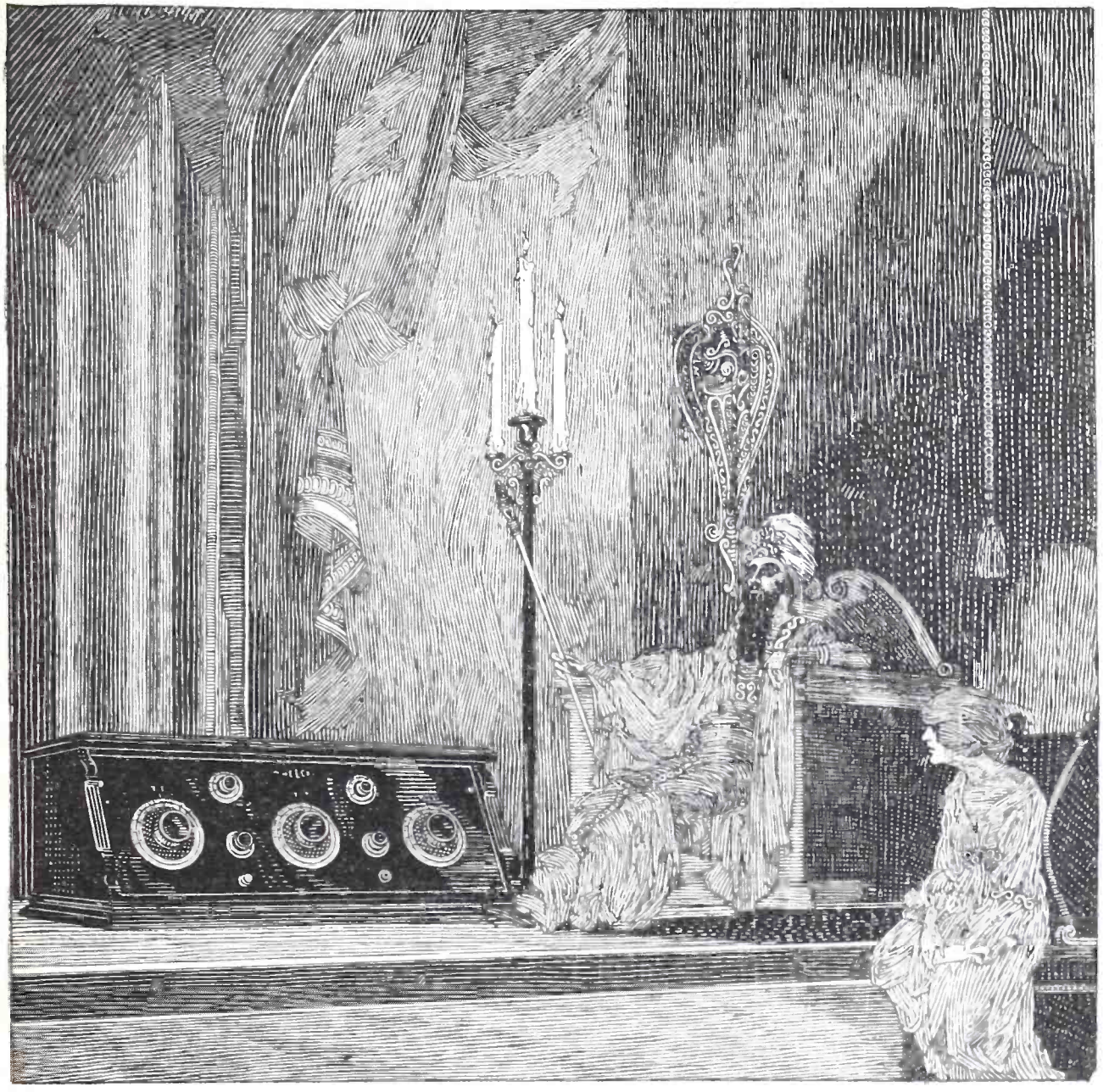
All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY



A THOUSAND AND ONE NIGHTS ENTERTAINMENT

The MELCO is a silver-tongued Scheherezade—offering a thousand and one nights entertainment.

Reception without interference, noises, and fade-aways. Supreme radio—full-toned, clear-throated, true to life.

The New "Five"

Write for interesting literature

MELCO SUPREME RECEIVER

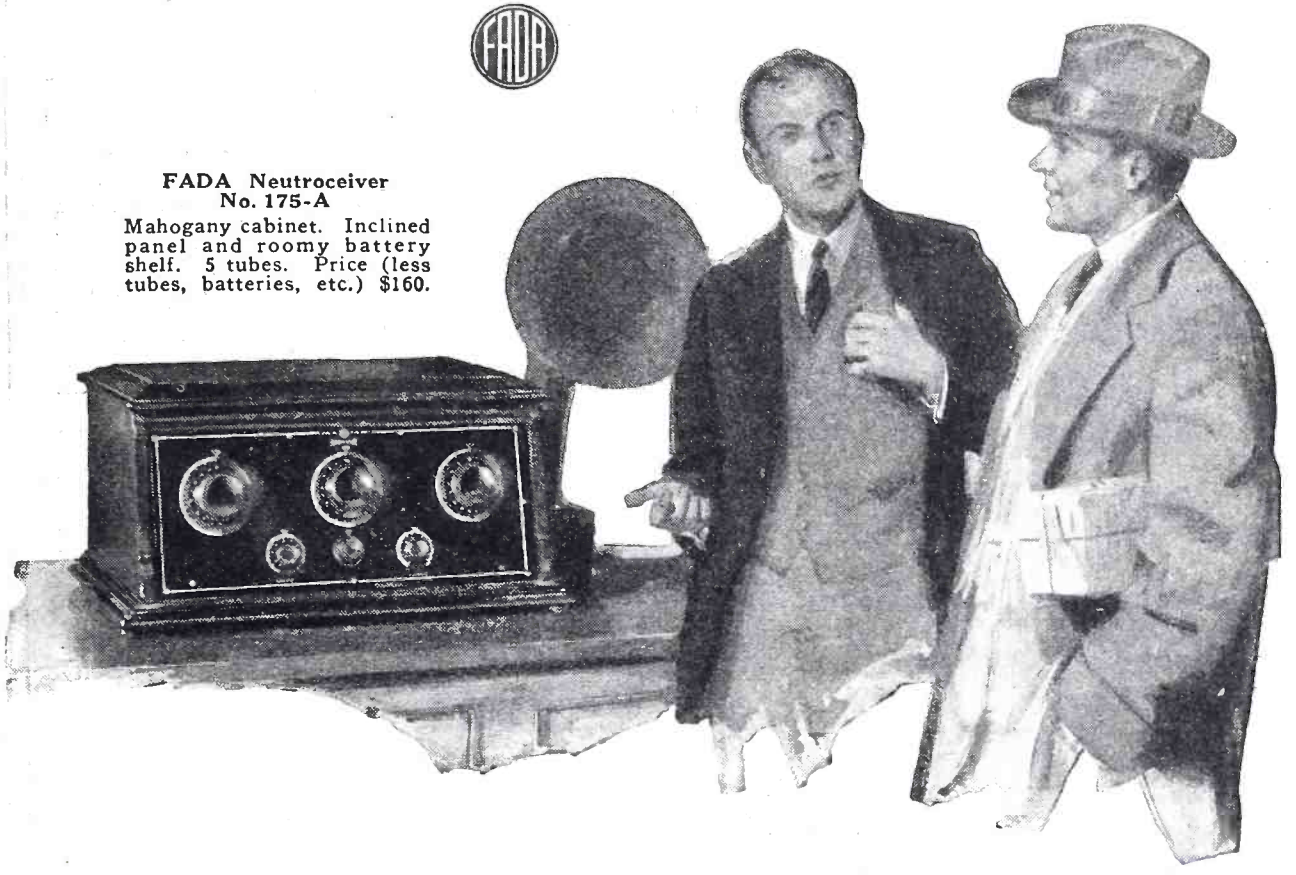
TUNED RADIO FREQUENCY

AMSCO PRODUCTS INC. BROOME & LAFAYETTE STREETS. N.Y.

MELCO AMSCO

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

FADA Radio

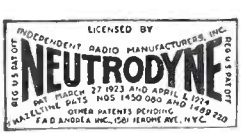


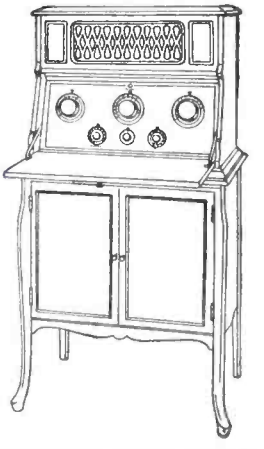
FADA Neutroceiver No. 175-A
Mahogany cabinet. Inclined panel and roomy battery shelf. 5 tubes. Price (less tubes, batteries, etc.) $160.

Indecision vanishes when you hear the FADA

RADIO shopping ends triumphantly when you find the FADA. People who know radio and have conducted comparative tests say that the Neutroceiver is the best they have ever tried. Have the FADA Neutroceiver demonstrated in your home. Listen to its marvelously faithful reproduction. Tune in a distant station yourself loud and clear and see how easy it is. Observe the beautiful cabinet design. You will exclaim: "At last! This is just the radio set I want!"

If you prefer a set with self-contained loud speaker, the FADA Neutrola Grand meets your desire in this respect, as in all others. Whether FADA Neutrodyne receivers are the first or the fifteenth make you investigate, they will be your final choice. Through the FADA Neutrodyne your radio wishes become realities. See your dealer.





FADA Neutrola Grand No. 185/90-A
The five-tube Neutrola 185-A, mounted on FADA Cabinet Table No. 190-A. Price (less tubes, batteries, etc.) $270.

F. A. D. ANDREA, INC., 1581 JEROME AVENUE, NEW YORK

POPULAR RADIO
Simplified Blueprints

save time—money—and labor

UNDER the personal supervision of Laurence M. Cockaday, *Simplified Blueprints* have been prepared for seven of POPULAR RADIO's most popular circuits.

Each set consists of three separate *actual size* Blueprints, consisting of a Panel Pattern, Instrument Layout and Picture Wiring Diagram.

The Panel Pattern can be laid on the panel and all holes drilled as indicated. No scaling to do and so accurate there is no danger of ruining the panel through faulty calculation.

The Instrument Layout placed on the sub-base permits you to indicate by pinpricks the exact location of every screw.

The Picture Wiring Diagram gives every instrument in exact size and position with every wire clearly indicated from one contact to the other. With no knowledge of radio symbols you can assemble every part and complete your wiring with no chance of error.

This brief description should explain why these Blueprints are Simplified in every sense of the word.

Simplified Blueprints will be supplied for any of the following circuits at $1.10 for a Set of three Blueprints as described. We cannot break sets to supply single prints.

Set No. 1—"*The 'Improved' Cockaday Four-Circuit Tuner*" (five tubes, employing "push-pull" amplification as described in the January 1924 issue of POPULAR RADIO).

Set No. 2—"*Non-Regenerative Tuned Radio-Frequency Receiver*" (Simplified Neutrodyne, four tubes, three dials, as described in the April 1924 issue of POPULAR RADIO).

Set No. 3—"*Cockaday Distortionless Audio-Frequency Amplifier*" (four tubes, combination of resistance-coupled and push-pull amplification, as described in the May 1924 issue of POPULAR RADIO).

Set No. 4—"*Cockaday Four-Circuit Tuner with Resistance-Coupled Amplifier*" (five tubes, distortionless, two dials, automatic vacuum tube control, as described in the October 1924 issue of POPULAR RADIO).

Set No. 5—"*The 7-tube Non-radiating Superheterodyne Receiver*" (seven tubes, two dials, non-radiating, as described in the December 1924 issue of POPULAR RADIO).

Set No. 6—"*The Cockaday 8-tube Super-heterodyne Reflex Receiver*" (eight tubes, two tuning dials, loop, non-radiating, distortionless, as described in January 1924 issue of POPULAR RADIO).

Set No. 7—"*The Craig 4-Tube Reflex Receiver with the New Sodion Detector*" (four tubes, two tuning dials, short antenna, non-radiating as described in February 1924 issue of POPULAR RADIO).

POPULAR RADIO, INC.

627 West 43d Street **Dept. 24** **New York City**

POPULAR RADIO, Inc., Dept. 24
627 West 43d St., New York City Date.....

Enclosed is my remittance of $....., for which kindly send me Blueprint Set (s) consisting of Panel Pattern, Instrument Layout and Wiring Diagram as checked below:

☐ Set Number 1 ☐ Set Number 4
☐ Set Number 2 ☐ Set Number 5
☐ Set Number 3 ☐ Set Number 6
☐ Set Number 7

Name.....

Address.....

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

Note to dealers: Write for terms on these fast selling Blueprints. An attractive Display Chart free with orders.

The Red Seal Map Loop Aerial

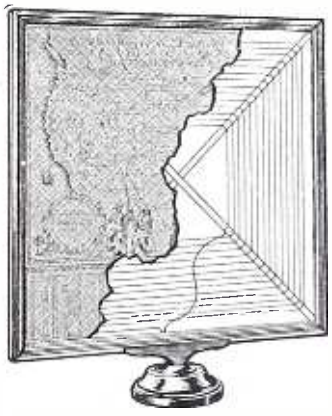
A Beautiful Loop for a Beautiful Set

Especially adapted to operate with the "Radiola Superheterodyne"

A Red Seal Map Loop added to your Radiola Superheterodyne will increase the range of your set many times. The winding used is such that your dial setting will be approximately the same as when the self-contained aerial is employed.

In addition to this added efficiency the Red Seal Map Loop constitutes a fitting companion for the finest set from the standpoint of appearance. The beautifully colored broadcasting maps which conceal all wiring and are enclosed in a solid mahogany frame are done in the inimitable style of the 17th century map makers—masters of their craft. Upon each map, the broadcasting stations throughout the United States are located and listed with their respective wave lengths and call letters.

Your home and your set deserve a Red Seal Map Loop Aerial. The price is twenty dollars.



The above shows the construction of this interesting, new type of loop aerial. The spider-web is concealed between the broadcasting maps and enclosed in a handsome mahogany frame. This construction, of course, in no way interferes with the electrical efficiency of the loop.

MANHATTAN ELECTRICAL SUPPLY CO., INC.
NEW YORK CHICAGO
ST. LOUIS SAN FRANCISCO

MADE BY THE MAKERS OF THE FAMOUS RED SEAL DRY BATTERIES

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

This Service Is Free

EVERY subscriber is urged to take full advantage of the facilities afforded by the Technical Service Bureau. Under Mr. Cockaday's personal supervision is a staff of experienced radio investigators. If you have any radio problems that have not been covered in POPULAR RADIO, they will give you a complete answer by return mail. To readers not subscribers there is a nominal charge of 50c. per inquiry. But as a subscriber you are privileged to write as often as you wish at no expense whatever.

Possibly the answer to some of your questions has been published, in which case you would not expect us to repeat in a personal letter. A condensed index appears below and we shall be glad to furnish any issues you wish at 35c. a copy.

May, 1922
—Harnessing waves to wire.
—How to tune a Regenerating Receiver.
—Symbols that help in reading diagrams.
—How to make soldered connections.
—How Radio waves are sent and received.

June, 1922
—Wireless that we can see.
—Can we talk to the dead by Radio?
—How electricity is generated.
—Tones that do and don't broadcast.
—How to make a simple tube Receiving Set

July, 1922
—Steinmetz on ether waves.
—How to learn the code.
—How to make a two-circuit Receiving Set.
—How high frequency currents are generated.
—Pointers for preventing interference.
—How to make a loose-coupler coil.

August, 1922
—How machines are controlled by Radio.
—How Radio circuits are coupled and tuned.
—What "call letters" mean.
—How to make a variable condenser.

September, 1922
—How to build the Armstrong Circuit Receiver.
—A resonance wave coil for reducing static.
—How to make a rotary plate condenser.
—The simplest receiving antenna.

October, 1922
—How to make a spider-web tuner.
—How to make your own grid condenser.
—Don'ts for Radio fans.
—How to use a Regenerative Set as a transmitter.
—How to restore worn-out crystals.

November, 1922
—Sir Oliver Lodge on ether waves.
—How to add a Vacuum Tube to your crystal set.
—The most popular transmitting aerial.
—How to make a novel variocoupler.

December, 1922 (Out of Stock)

January, 1923 (Out of stock.)
(A Reprint of Mr. Cockaday's article describing the DX Regenerative Receiver may be had for 25 cents.)

February, 1923 (Out of stock)

March, 1923 (Out of stock)

April, 1923 (Out of stock)

May, 1923 (Out of stock.)
A reprint of Mr. Cockaday's original 4-Circuit Tuner will be found in POPULAR RADIO'S HANDBOOK. See page 130.

June, 1923
—How the Microphone Transmitter Works.
—How to Build a Good Single Tube Receiver.
—How to Make a Crystal Detector Stand.

July, 1923
—The ratio in size between your antenna and your coil.
—Useful facts about ear-phones.
—How to make a dry-cell tube Regenerative Set.
—How to keep up your storage battery.

August, 1923 (Out of stock.)
A reprint of the Tuned Radio Frequency Receiver will be found in POPULAR RADIO'S HANDBOOK. See page 130.

September, 1923
—How to get a radio license.
—How weak signals are regenerated.
—How to make a battery charging rectifier.
—How to build the Haynes DX receiver.

October, 1923
—Practical hints for Coil Calculations.
—How to make a Two-stage Audio-frequency Amplifier.
—Ten good rules for Broadcast Listeners.
—How to make a simple Honeycomb Receiver.

November, 1923
—The 100 Best Hook-ups (Part 1).
—Receiving without Antennas.
—How to build the New Regenerative Super-heterodyne Receiver (Part 1).
—How to build a combination Short and Long-wave Receiver.

December, 1923
—How to Select your Radio Parts.
—The 100 Best Hook-Ups (Part 2).
—How to Read a Diagram (Part 1).
—How to build an efficient Crystal Receiver.
—How to Build the Super-heterodyne Receiver (Part 2).

January, 1924 (Out of Stock)

February, 1924
—How to add "Push and Pull" amplification to the 3 tube Cockaday 4-Circuit tuner.
—The original 4-Circuit Tuner as a Portable Set with Loop.
—The 100 Best Hook-ups (Part 4).
—How to build a 3-tube Reflex Receiver.

March, 1924
—Hoffman Transformer Measurement Chart.
—The 100 Best Hook-ups (Part 5).
—How to Build an Amateur Transmitter.
—A 3-tube Reflex Receiver (Part 2).

April, 1924
—How to Build a Simplified Neutrodyne Receiver.
—The 100 Best Hook-ups (Part 6a)
—How NOT to Tune the Single Circuit Receiver.
—A Novel Substitute for "B" Batteries.

May, 1924
—A Compact Radio Kit for a Spring Hike.
—How to Get the Maximum Radio-frequency Amplification.
—100 Best Hook-ups (Part 6b).
—Wave Interference Comes In.
—How to Make an Audio-frequency Amplifier that Does Not Distort.

June, 1924
—How to Install a Receiver on your Boat.
—The 100 Best Hook-ups (Part 7).
—How to Build a Regenerative Receiver for Use with an Indoor Antenna.
—How to Make a Two-Slide Tuner.

July, 1924
—How to Avoid Local Interference.
—How "Resistance" Affects Radio Circuits.
—An Ideal Set for Summer-time Reception.
—100 Best Hook-ups (Part 8).
—How to Do Your Soldering Correctly.
—How to Build the POPULAR RADIO Portable.

August, 1924
—How to build a single dry-cell tube, four-circuit tuner.
—How to build a two tube reflex receiver.
—Helpful hints for the broadcast listener

September, 1924
—How to build a single dry-cell tube reflex receiver.
—How to build a multi-wave tuner.
—How to improve broadcast reception.

October, 1924
—How to Build the (Cockaday) Four Circuit Tuner with a Resistance-coupled Amplifier.
—How to Select a Ready-made Receiver.
—How to Build a Detector-amplifier.
—A Radio Set to Pack in Your Suitcase.
—Harnessing the Radio and the Movie.

November, 1924
—How to Locate Interference from Power Lines.
—Cockaday Article for Beginners.
—How to Build a Low-Loss Tuner for Short-wave Reception.
—The New Type of Superheterodyne.

December, 1924
—How to Build a Non-radiating 7-tube Superheterodyne Receiver.
—Cockaday Article for Beginners.
—How to Get the Most Out of Your Ready made Receiver.

January, 1925
—How to Build the Cockaday 8-tube Superheterodyne Reflex Receiver.
—How to Improve Broadcast Reception.
—Cockaday Article for Beginners.

THE NEW MODEL C-7

"The Rolls-Royce of Reception"

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

Important Today

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 Janeiro, 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.

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.

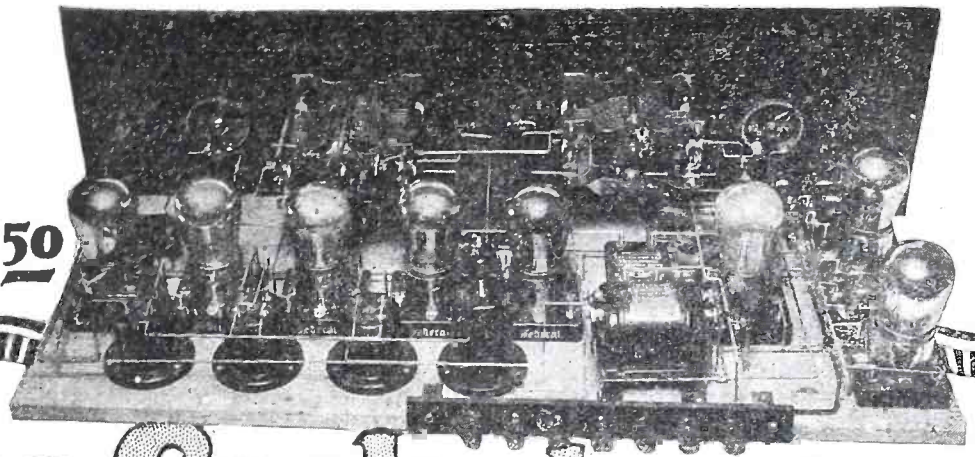
Blueprints giving all construction data $1.00

EXPERIMENTERS INFORMATION SERVICE, Inc.

Designers of the Highest Class Radio Apparatus in the World

476 Broadway, New York, N. Y.

C. R. LEUTZ'S NEW BOOK, "MODERN RADIO RECEPTION"
325 Pages **200 Illustrations** **$3.00 Postpaid**



$77.50

The Cockaday (8 tube) Super-het. reflex

As Cockaday Specifies!

ANOTHER AMPLEX KIT triumph! All the parts for the Cockaday Super-heterodyne Reflex, exactly as specified, in a handy kit. Everything is there! You can start right in to build the minute you get the kit—and you won't be bothered with buying anything else in the line of parts.

AMPLEX has always been first in the field of kits. The Cockaday Super-heterodyne Reflex kit clinches the leadership. It contains every authorized part to build this circuit, and just like the 4-circuit tuner kit, it is the product of co-operation between POPULAR RADIO, the manufacturers of the various specified parts and Amplex Engineers.

This set is a wonder. On a loop you can span the continent. And the AMPLEX KIT takes all the guesswork out of building it. The demand is already tremendous. Send your remittance today for prompt delivery.

No.	Item	Each	Total
1	General Instrument "Isolantite" Condenser .001.	$6.00	$6.00
1	General Instrument "Isolantite" Condenser .0005	5.50	5.50
1	Haynes-Griffin "Input" Transformer (new type)	Matched Set 20.00	20.00
3	Haynes-Griffin Intermediate Transformers (new type)		
1	Precision Autodyne Coupler	3.50	3.50
1	Karas Harmonic Transformer	7.00	7.00
1	Amplex Grid-Denser	1.25	1.25
1	Benjamin Cle-ra-tone Socket	1.00	1.00
7	Federal Sockets No. 16	1.20	8.40
1	Pacent Jack D.C.	.60	.60
1	Pacent Jack S.C.	.50	.50
2	Naald Dials 4 in.	.75	1.50
1	Amsco Rheostat 2 ohms	1.35	1.35
1	Amsco Potentiometer 400 ohms	1.50	1.50
2	Daven Resisto-Couplers	1.25	2.50
1	Daven Leak Mounting	.40	.40
2	Daven Resistors .5 Meg.	.50	1.00
1	Daven Resistor 5 Meg.	.50	.50
1	Daven Resistor .005 Meg.	1.00	1.00
2	Daven Resistors 25 Meg.	.50	1.00
2	N. Y. Coil Condensers .0001	.35	.70
4	N. Y. Coil Condensers .006	.75	3.00
1	N. Y. Coil Condenser .00025 G	.45	.45
1	Duratran R. F. Transformer	4.00	4.00
1	Walbert Battery Switch	.50	.50
1	Baseboard	1.00	1.00
1	Connection Block 1 x 9 in.	.25	.25
7	Eby Binding Posts	.20	1.40
2	W Brass Brackets	.05	.10
1	Set POPULAR RADIO Blue Prints	1.10	1.10
	Bus Bar, etc.	.50	.50
	Official Total List Price		**$77.50**

FREE A genuine Bakelite panel. Complete drilling and engraving. A beautiful mahogany cabinet.

Kit Division No. P 2 K

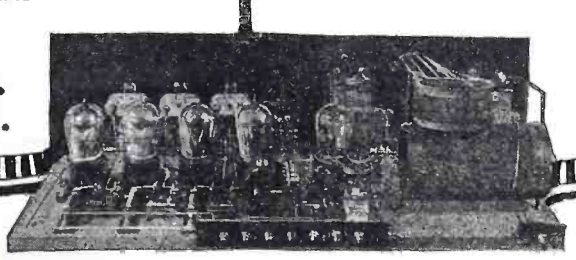
The NEW Four Circuit Tuner

THIS AMPLEX KIT has already made a tremendous hit. Thousands of set builders loudly sing its praise. It contains every single part, blueprint, wire and bracket for building the 5-tube New Cockaday Four-Circuit Tuner And exactly as Cockaday specified it.

1	"Precison" Cockaday Coil Set	$5.50	$5.50
1	"Cardwell" Veri. Cond. .0005	5.00	5.00
1	"Cardwell" Vari. Cond. .00035	4.75	4.75
2	"Accurtune" 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 Jack	.70	.70
1	"Improved" Battery Switch	1.00	1.00
1	"Precise" Transformer	5.00	5.00
3	"Electrad" 2 meg. Leaks	.50	1.50
3	"Electrad" Mountings	.35	1.05
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 genuine Bakelite panel completely drilled and engraved.

Amplex Instrument Labs.
88 West Broadway N.Y.C.



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

BRIGHTSON

True Blue

LABORATORIES, INC.

SETTING NEW AND HIGHER STANDARDS FOR RADIO TUBES

GEORGE E. BRIGHTSON, Founder of Sonora Phonograph Co., by bringing together an organization of trained engineers, has made an achievement as great in radio as that marked his bringing new standards of perfection to the talking machine industry with Sonora.

The advent of TRUE BLUE Radio Tubes means that owners of radio receivers are through with matching or testing tubes to secure the perfect radio reception their sets can give when uniform and superior tubes are used.

George E. Brightson knew that somewhere there were men who had witnessed the birth of the first three element vacuum tube. He also knew that such men had dreamed improvements in vacuum tube design that no mere uninspired theorists could hope to equal.

Mr. Brightson found these men. He said to them, "Select the best machinery, here is the money, take your time, make the tube you have dreamed of. Then—make it better than you dreamed any tube could ever be made —Build to perfection, not to price."

True, it has taken considerable time to bring TRUE BLUE Tubes to such perfection that Mr. Brightson is willing to present them to the public. But the finished article proves that the time was well spent.

The finest radio tube factory in America now stands back of TRUE BLUE Radio Tubes with an absolute GUARANTEE *in writing* that these tubes will give the kind of satisfaction that good radio receivers are capable of giving.

TRUE BLUE Radio Tubes are not an imitation of any other radio tube. They have many exclusive features not found in ordinary tubes.

One of the many new and exclusive features of the TRUE BLUE Radio Tubes is a filament that lasts two or three times longer than any ordinary tube. This makes TRUE BLUE Tubes the most economical radio tube—even at $6 each.

MANUFACTURED BY

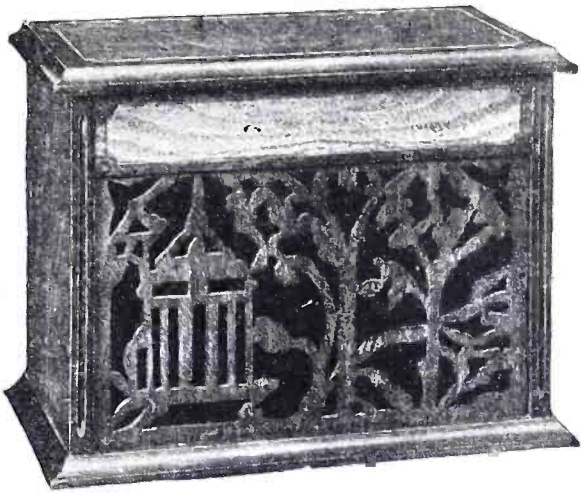
BRIGHTSON LABORATORIES, Inc.

GEORGE E. BRIGHTSON, President (Founder of Sonora Phonograph Co.)

Northwest corner Waldorf-Astoria Hotel, 16 West 34th St., New York, N. Y.

(Some Jobber Territory Still Open.)

Twenty-five years of musical experience built into a radio speaker



IN BEAUTIFUL cabinet design and finish as well as in musical acoustic properties, Royal Radio Speaker combines the experience of a quarter of a century in manufacturing high-grade pianos and organs.

With the Royal Radio Speaker you always have the best seat in the house. You never seem so near that there is discord nor so far that the delicate overtones of a symphony orchestra or the obbligato of a harp is lost.

The Tone Modulator of Royal Radio Speaker has overcome the chief problem of radio amplification, that of preserving all the naturalness of tone of headphones without the distortion or emphasis of interfering noises that is associated with ordinary loud speakers.

The necessity for maximum amplification to bring in distant stations has heretofore presented what seemed to engineers to be an insurmountable difficulty. Royal Radio Speaker has solved it well by the combination of a Scientifically Synchronized Tone Chamber coupled with the Tone Control Modulator.

So unobtrusive is the Royal Radio Speaker that whether operated directly on the radio set or at some point distant, it is never conspicuous. In two finishes either duo-tone walnut or mahogany, it will add charm to any setting in which it is placed.

Royal Radio Speaker will operate with any radio set where amplification is possible. It is particularly effective with Adler-Royal Neutrodyne and in cabinet design harmonizes perfectly with Adler-Royal instruments.

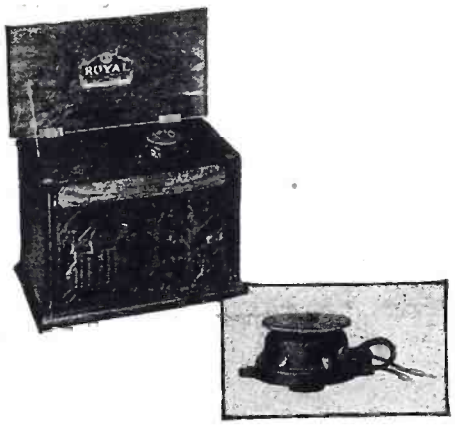
Royal Radio Speakers are on sale at high-class dealers everywhere. If your dealer does not carry it, please address us.

Price $30.00

ADLER MANUFACTURING COMPANY, INC.

General Sales Office: Dept. B2, 881 Broadway, New York City

Factories: Louisville, Ky.



The Royal Radio Speaker Modulator

THE tone modulator makes accurate shading of tone possible without distortion or magnifying interfering noises. The modulator is readily accessible merely by lifting the lid.

Adler-Royal Radio Speaker

Adler Manufacturing Co.,
Dept. B2, 881 Broadway, New York City.

Please send me description and advise me where I can get your Radio Speaker, also send me catalog and Log Record.

My dealer's name is .....

Address .....

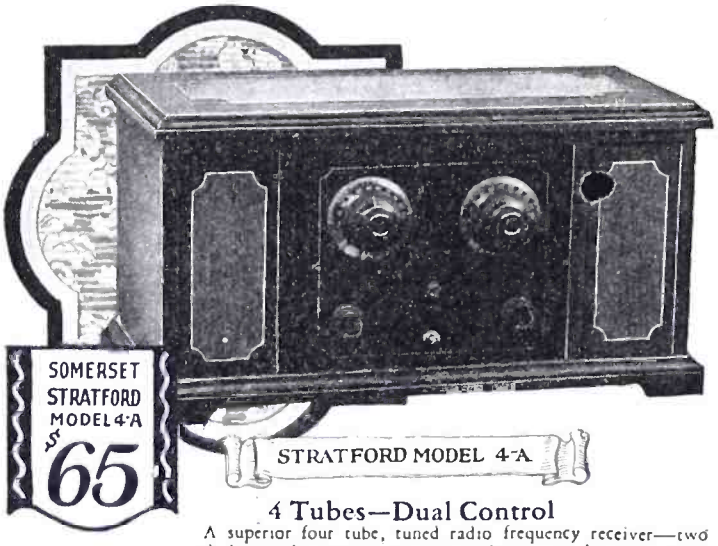
My name is .....

Address .....

Somerset

QUALITY

SOMERSET Radio Receivers have leaped into popularity immediately because they bear unmistakable evidence of superior quality, design and value—the most for the money that has ever been offered in radio. Remarkably sensitive and selective, they reach far out to get broadcast programs from incredible distances, reproducing them with precise fidelity and rich mellow tone. Infinite care with the "tremendous trifles" which are essential to fine reception has placed Somerset Radio Receivers in a class by themselves.



STRATFORD MODEL 4-A

4 Tubes—Dual Control

A superior four tube, tuned radio frequency receiver—two dial control—operates on storage battery or dry cells Automatic filament control insures long life of tubes The finest "low loss" condensers and the famous SOMERSET Calibrated Transformers are features. "A" and "B" battery space is provided in the handsome two-toned mahogany finish cabinet Size 21"x15"x11"..... **List $65**

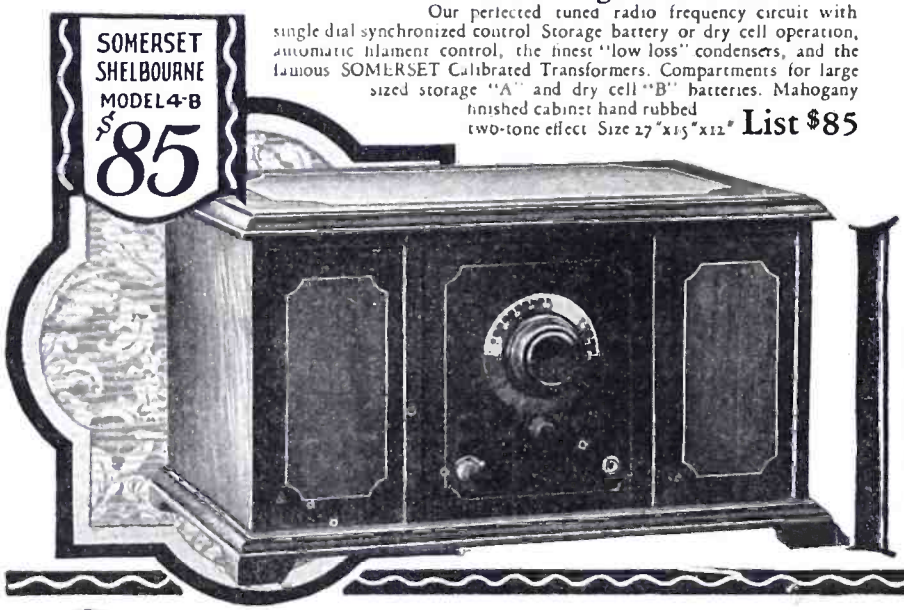
Make the Acid Test Yourself

COMPARE these big beautiful instruments of precision, feature for feature, with any other radio receivers at or near their price—*bar none.* The Somerset line consists of four models—Stratford Model 4-A, 4 tube set, 2 dials $65; Mars Model 5-A, 5 tube set, 3 dials, $75; Shelbourne Model 4-B, 4 tube set, 1 dial, synchronized control, $85; Standish Model 4-C 4 tube set, 1 dial, synchronized control, built-in loud speaker, $150.

SHELBOURNE MODEL 4-B

4 Tubes—Single Dial Control

Our perfected tuned radio frequency circuit with single dial synchronized control Storage battery or dry cell operation, automatic filament control, the finest "low loss" condensers, and the famous SOMERSET Calibrated Transformers. Compartments for large sized storage "A" and dry cell "B" batteries. Mahogany finished cabinet hand rubbed two-tone effect Size 27"x15"x12" **List $85**



Real Values

Somerset Prices are Honest Prices

Each Somerset Radio Receiver represents the best that can be produced for the money—the utmost in results and permanent satisfaction to the owner. Compare them, feature for feature, with any other at or near their price range—bar none. Fill out and mail the coupon for full information about these splendid instruments. Don't put it off—send today.

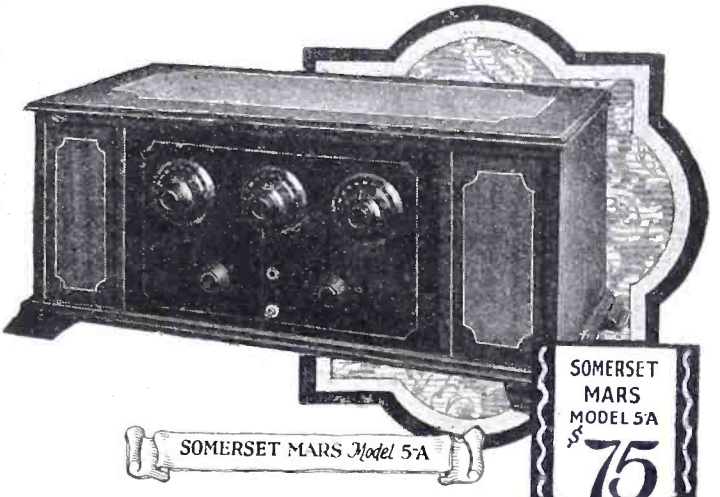
Low Prices

Somerset Radio Receivers

Radio at a Price!

Truth in Radio

SOMERSET Radio Receivers are unique—in cabinet design, mechanical features. and technical superiority. In simplicity of operation, range, selectivity and tone they have set a new standard. The single dial synchronized control, featured on the Shelbourne and Standish models is made possible only by the most painstaking selection and matching of coils, condensers and transformers. Somerset cabinets in artistic two-toned hand rubbed mahogany finish are equally notable. And every Somerset Radio Receiver bears a tag certifying that it has been thoroughly tested by the Somerset Engineering Laboratories.



5 Tubes—Three Dial Control

Two stages tuned radio frequency, detector, and two stages audio frequency. Storage battery or dry cell operation, automatic filament control, highest quality "low loss" condensers and the famous SOMERSET Calibrated Transformers. Artistic cabinet hand-rubbed mahogany finish, providing space for "A" and dry cell "B" batteries. Size 29"x14"x12". ..... List $75

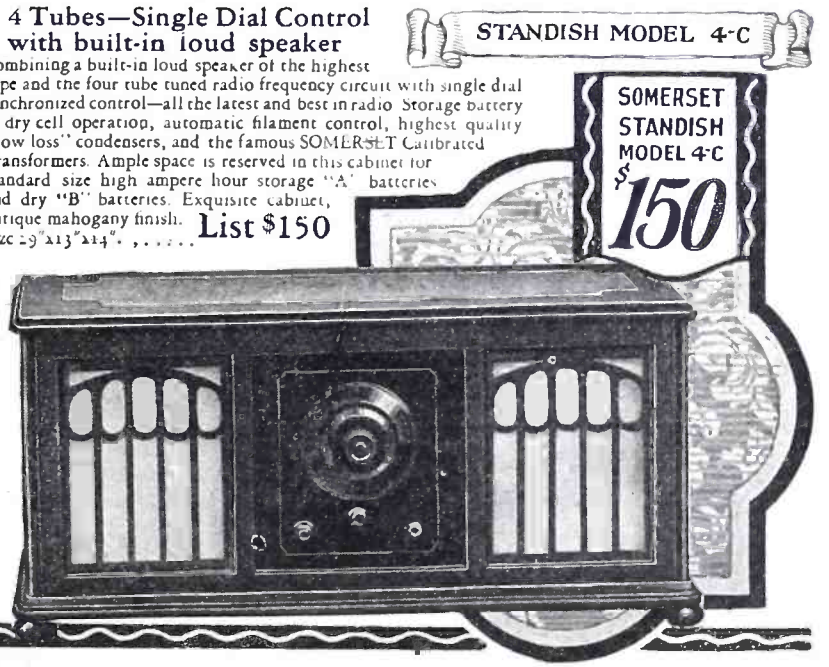
The Famous Somerset Guarantee

"YOU must be satisfied with your Somerset Radio Receiver or we do not want you to keep it. If for any reason you feel that it is not exactly as represented or that it has not the quality and value which you have the right to expect, we want you to return it for exchange or for refund, whichever you prefer. We will cheerfully and promptly make good any Somerset product which does not fully measure up to your expectations."

4 Tubes—Single Dial Control with built-in loud speaker

STANDISH MODEL 4-C

Combining a built-in loud speaker of the highest type and the four tube tuned radio frequency circuit with single dial synchronized control—all the latest and best in radio. Storage battery or dry cell operation, automatic filament control, highest quality "low loss" condensers, and the famous SOMERSET Calibrated Transformers. Ample space is reserved in this cabinet for standard size high ampere hour storage "A" batteries and dry "B" batteries. Exquisite cabinet, antique mahogany finish. Size 29"x13"x14". ..... List $150



Fill Out

National Airphone Corp.
16 Hudson St., N. Y. City

Without any obligation to me, send me the Somerset Radio Primer and full details of Somerset Radio Receivers.

Name .....

City .....

State .....

Mail Today

MFD. by NATIONAL AIRPHONE CORP. 16-22 Hudson St. New York City

Prices subject to change without notice.

Prices West of the Mississippi—add 10%

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

Use Any Tube

UV-200 or C-300

Volts - - 5
Amps. - 1
Grid Leak
0.5—2
Megohms
Condenser
.00025
-.0005 M-f.

UV-201A or C-301A

Volts - 5
Amps. - .25
Grid Leak
2—9
Megohms
Condenser
.00025 M-f.

WD-12 or C-12

Volts - 1.1
Amps. - .25
Grid Leak
2—3
Megohms
Condenser
.00025 M-f.

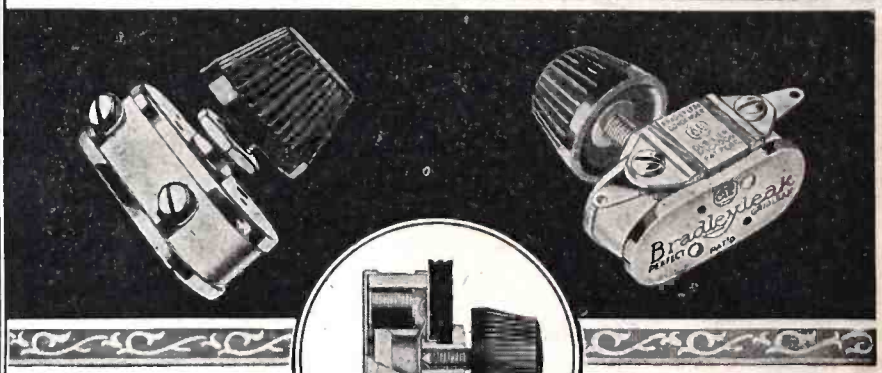
WD-11 or C-11

Volts - 1.1
Amps. - .25
Grid Leak
2—3
Megohms
Condenser
.00025 M-f.

UV-199 or C-299

Volts - 3
Amps. - .06
Grid Leak
2—9 Megohms
Condenser
.00025 M-f.

Have you used the Bradleyswitch? It saves batteries and tubes.



Bradleystat
PERFECT FILAMENT CONTROL

Bradleyleak
THE PERFECT GRID LEAK

Do You Know—

that any tube can be used in your set without changing rheostats or grid leaks?

IT sounds unbelievable, but it's true. The perplexing problem of selecting the correct rheostat or grid leak is solved by using the Bradleystat and the Bradleyleak. They offer the most marvelous range without steps or noise, and such smooth precision of control that no other rheostat or grid leak can approach them in performance.

The Bradleystat has a resistance range from approximately 1/4 to 100 ohms, by merely turning the adjusting knob that varies the pressure on the graphite discs. It will handle *all tubes* without change of connections, and provide ample control in every case.

The Bradleyleak, with a range from 1/4 to 10 megohms, can be adjusted instantly for any tube, indicated in the adjoining table of tube ratings, by turning the adjusting knob.

Be ready to use any tube in your radio set. Install Allen-Bradley Radio Devices, throughout.

Allen-Bradley Co.

ELECTRIC CONTROLLING APPARATUS

Sales Offices:
Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Knoxville, Los Angeles, New York, Philadelphia, Pittsburgh, Saint Louis, Saint Paul, San Francisco, Seattle

General Offices and Factory: 276 Greenfield Ave. Milwaukee, Wis.

Manufacturers of graphite disc rheostats for over 20 years

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

PRESS OF WILLIAM GREEN, NEW YORK