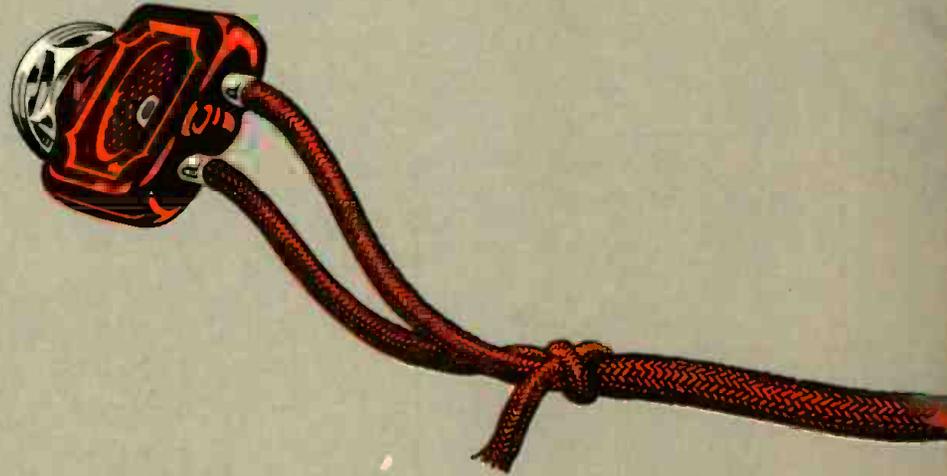


Popular Radio

MARCH · 1927

25¢



How to Build a One-Tube Receiver
for use with a Loud Speaker—

and

How to Build the Loud Speaker

BY AIRPLANE
OR
MULE-BACK

There's a radio station in Honduras, six thousand feet high, upon a mountain top. They use Radiotrons there, high power Radiotrons, for transmission. More than once in an emergency, the Radiotrons have had to be delivered by airplane. Usually they are carried up the rough mountainside by mule-back.

These great Radiotrons cost a few hundred dollars apiece, and as not many "spares" can be kept on hand at that price, each one must perform exactly to standard—each one must be sturdy of build in spite of its delicate accuracy.

The laboratories that design these high power transmission tubes design the Radiotrons you use. The same factories make them. The same test laboratories test them. RCA produces the tubes for all sorts of high power transmission and learns from these tubes many a lesson of making and testing that gives you a better Radiotron for your receiving set! Benefit from this experience by using only genuine RCA Radiotrons, no matter what type of tube you use.



RADIO CORPORATION
OF AMERICA
New York Chicago
San Francisco



Every tube in your set counts!

Every tube in your set has its "finger in the pie." The faint signal that comes in from the broadcasting station goes through each tube, and it's magnified hundreds of thousands of times before it gets to the loudspeaker.

It's not only important to get the "special" Radiotrons that give you bigger distance and bigger volume. But it's just as important to stick to genuine Radiotrons straight through the set, if you want to keep up its performance. RCA research makes Radiotrons better and better every year!

Bring your storage battery set up-to-date with
a power RADIOTRON UX 171 or UX 112
a detector RADIOTRON UX 203-A

and RADIOTRONS UX 201-A for all-round quality.

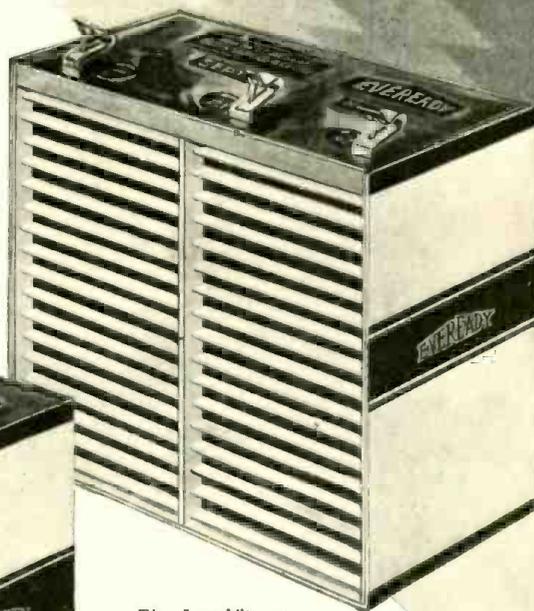
Bring your dry battery set up-to-date with
a power RADIOTRON UX 120
and RADIOTRONS UX 122 for all-round quality.

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

NEW!

Eveready Layerbilt
"B" Battery No.
486, the Heavy-
Duty battery that
should be specified
for all loud-speaker
sets.



The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

DIFFERENT!

For greatest economy all loud speaker sets require the new Eveready Layerbilt "B" Batteries

IT WILL pay you, in convenience and reliability as well as in dollars and cents saved, to use this remarkable battery.

The reason for the Eveready Layerbilt's surprising performance lies in its exclusive, patented construction. No other battery is like it. It is built in flat layers of current-producing elements, making practically a solid block. The layers make connection with each other automatically, and occupy all available space inside the battery case. Layer-building packs more active materials in a given area, and makes those materials produce more electricity.

Every loud-speaker set should use Heavy-Duty batteries, for they alone offer economy on modern receivers. When you buy new "B" batteries, be sure to get the Heavy-Duty size, and remember that the Eveready Layerbilt has proved to be the longest lasting, most economical of all Heavy-Duty batteries.

Our laboratories are continually testing batteries, and in all our tests we have yet to find a battery that is equal to the new improved and radically different Eveready Layerbilt "B" Battery No. 486. The development and perfecting of this remarkable

battery is an outstanding battery-building achievement. It is the result of many years' experience plus the facilities and resources of the pioneer manufacturers of all dry cell batteries.

NATIONAL CARBON CO., Inc.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night
—9 P. M., Eastern Standard Time, through
the following stations:

WEAF—New York	WTAM—Cleveland
WJAR—Providence	WWJ—Detroit
WEEI—Boston	WGN—Chicago
WTAG—Worcester	WOC—Davenport
WFI—Philadelphia	WCCO—Minneapolis
WGR—Buffalo	WLS—St. Paul
WCAE—Pittsburgh	KSD—St. Louis
WSAT—Cincinnati	WRC—Washington
	WCV—Schenectady

Popular Radio

EDITED by KENDALL BANNING



FOUNDED 1911

VOLUME XI

March, 1927

NUMBER 3

CONTENTS

(Cover design by Frank B. Masters)

- Radio in 1950 A. D.**
Some of the amazing possibilities that are visualized
by the world-famous scientist and inventor—
Dr. Lee de Forest PAGE 229
- How to Build
the Univalve Receiver**
Here, at last, is a stable one-tube receiver
that will operate a loudspeaker satisfactorily
*By A. J. Haynes and
Laurence M. Cockaday* PAGE 232
- The Coming Reformation of Third
Degree Methods by the "Radio Detective"**
How experiments with highly sensitive electrical
apparatus reveal the consciousness of guilt to
the inquisitors of the police department
By Thomas Elway PAGE 237
- Popular Radio Circuits**
INSTALLMENT No. 8:
The New "Ultimax" Receiver
The Improved "Controllodyne" Circuit
The Technical Staff PAGE 240
- How to Increase the Range of
Ammeters and Voltmeters**
Simple ways by which the experimenter may make two
meters take the place of many expensive instruments
By K. B. Humphrey PAGE 242
- Popular Delusions About Radio**
By Charles Magee Adams PAGE 244
- The Unique "Retrosomic" Receiver**
A new three-tube receiver with a circuit
that is mysterious to the inventor himself
By A. Dinsdale PAGE 246
- How to Build Your Own
36-Inch Cone Loudspeaker**
By Laurence M. Cockaday PAGE 249
- What Every Fan Should Know
About Audio Amplifiers**
The first article in a new series on the
principles underlying truthful reproduction
and amplification at low frequencies
—written by an authority in terms that
everyone may understand
By Professor E. L. Bowles PAGE 253
- A Real Radio "Interference Patrol"**
By James Montagnes PAGE 257
- What's New in Radio**
The Technical Staff PAGE 259

DEPARTMENTS

- In the World's Laboratories** *E. E. Free* 267
- The Possibilities of Television
The "Opaqueness" Theory of Radio
"Death Rays" and the Coolidge Tube
A Small Portable Compass
Radio Measures the Earth's Waistline
Another Human "Aura" Claimed
Static Messages from the Sun and Their
Mythical Effect on Human Wars
- What Readers Ask** *David Lay* 290
- The Beginner in Radio** *Armstrong Perry* 294
- The Yes and No Man** 302
- Broadcasts** *Charles L. Reese, Jr.* 304

VOLUME XI

MARCH, 1927

NUMBER 3

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Counterphase - Eight

- 1—REJECTOR STAGE.
For Selectivity.
- 2—SIMPLICITY.
One Selector.
- 3—VISUAL INDICATOR.
Each Set Calibrated.
- 4—UNIQUE CABINET DESIGN.
Controls Concealed When Not In Use.
- 5—COUNTERPHASE CIRCUIT.
Covered By B-T Patents.
- 6—LONG RANGE.
Recognizes No Superior.
- 7—TONE.
Equal To Any Reproducing Instrument Known.
- 8—SUPERIOR WORKMANSHIP.
The B-T Standard.

HERE are a few of the features of the Counterphase-Eight. Any one of them is enough to command your attention. Combined in one Receiver they account for the performance which has caused so many users to write enthusiastic testimonials.

If you are interested in Radio you cannot afford to pass up the opportunity to learn all about the Counterphase-Eight. We have prepared the 11th Edition of our booklet "Better Tuning" for those who want to know the whole story. It's yours for the asking. Use the coupon.



No guess work with the B-T Unit

It is on sets using power tubes that a B-Eliminator is needed and economical. Unless the B-Unit delivers sufficient voltage the main purpose for which it is used (better reception) is defeated. The Bremer Tully Unit delivers the correct voltage without guess work. There are no

knobs to turn—no variable resistances. You simply "plug in" on the front panel according to the number and kind of tubes in the set. The correct voltages are automatically delivered at the touch of the switch. Price complete with Raytheon tube.....\$49.50

Other B-T Products

Power-Six Kit for the home constructor.

U X A Sockets, Dials, Condensers, Output and Audio Transformers, etc.; also described and discussed in 11th Edition "Better Tuning".



MANUFACTURING CO.,
520 So. Canal St.,
Chicago.

Please send me the 11th Edition "Better Tuning."
I am interested in Counterphase Receivers, Power-Six Kits, B-Power Unit, Parts.

(Print Name)

PR-3

(Address)



A PAGE WITH THE EDITOR

IN the next issue of POPULAR RADIO (for April) will appear an innovation that the editors have reason to believe will prove of exceptional interest and value to all classes of readers—a greatly expanded list of the outstanding broadcast features for the ensuing month.

* *

THIS forecast of what may be properly considered as “gold star” events (which has been published in condensed form in this magazine for several months) is being carefully compiled with the special assistance of the broadcast stations; the dates, the hours, the stations, and the designations of these features as established by their sponsors will all be listed for ready reference—and will be augmented by personal items about the artists, the program sponsors, the station directors, the announcers, the composers and by other details of outstanding interest.

* *

WHEN the February number of POPULAR RADIO made its appearance on the newsstands with its article “Will Radio Kill the Wild Savageries of Jazz?” by Earl Reeves, we discovered—not greatly to our surprise—that we had stirred up what is euphonistically described as a “hornet’s nest.”

* *

THE effect that the broadcasting of jazz has had and is having upon the sales of sheet music, phonograph records and piano rolls is, apparently, little less than devastating; if broadcasting hasn’t killed jazz, it has half killed it—if the reports that reach us are correct.

* *

“OUR experience supports the conclusions reached by the author, that the too frequent repetition of music in broadcast renditions operates to decrease and in some cases entirely destroy the sale of sheet music, records, and piano rolls; also that the life of any popular composition, if it is broadcast at all extensively, is shortened at least fifty percent,” reports Jerome H. Remieck & Company of New York, one of the largest publishers of sheet music.

* *

WHILE from Mr. E. C. Mills, Chairman of the Board of the Music Publishers Protective Association, comes a more comprehensive report. He writes in part:

* *

“RADIO broadcasting has had a tremendous effect upon the music publishing business generally. While, on the one hand, it undoubtedly brings to the attention of millions of people with much greater rapidity than was previously possible the merits of any certain work, on the other hand, through the constant broadcasting by hundreds

of stations of any work in which the public evinces an interest, the taste and desire for it is so quickly satisfied and satiated that almost before any commercial reward can be reaped by the composer, author and publisher of the composition, the demand for it has faded almost to the vanishing point.

* *

“IN 1924 a tremendous interest in radio programs depreciated our general business nearly fifty percent. In 1925 the effect was somewhat less noticeable and during 1926, though the gross sales position has been improved, in order to accomplish this the production of a great many more compositions with the resulting vastly increased overhead has been found necessary.”

* *

IT was inevitable that the composers and publishers of jazz should seek to obtain at least partial compensation for their losses from the broadcasters. Exaggerated rumors of the fees paid for radio talent—rumors which the ubiquitous press agent perhaps unwisely has made no effort to stop—have created the impression that there is “big money” in broadcasting. And the creators of jazz are at present engaged in an effort to get their fingers in the pie and to extract some plums in the form of royalties.

* *

THE subject is of such importance, not only to the composers and publishers but to the broadcasters and to the radio public, and is so fraught with misconceptions, as to justify an unbiased investigation by POPULAR RADIO—beginning with the collection of some authenticated facts. Readers who have such at their disposal are invited to submit them to the Editor of this magazine.

* *

ON page 112 of the January issue of this magazine appeared a short item that told of the “first case of vandalism directed against a broadcasting station,” when the cable leading to the antenna of WRNY was maliciously cut during the broadcasting of a Jewish religious service.

* *

THIS item inspired an anonymous reader to postcard in: “This is to inform you that the antenna of WRNY was cut during a Jewish performance by a rabbi’d fan.”—Which is *our* idea of a perfectly terrible pun!

* *

THE attitude of the Actor’s Equity Association in forbidding its members to participate in the performance of a play that is broadcast—even though the broadcast is picked up direct from the stage during a regular performance before an audience—except upon the

payment of a bonus of one-eighth of their weekly salaries, has been subject to criticism not only by the radio fans but by many of the theatrical profession themselves.

* *

JUST what effect this broadcasting of one play, “Wildflower,” had upon the paid attendance (and few can deny that a large audience benefits not only the producer but the actors as well, is revealed in a statement recently made by the well-known advertising man, William H. Rankin, of New York.

* *

“WHEN we were called in,” reports Mr. Rankin, “the play was having a bad slump and box office receipts had fallen off seriously.

* *

“HECTOR FULLER wrote a twenty-minute talk, selling the play. He gave these talks himself, and immediately afterward the play was broadcast from the stage. At the end of the play the announcer said that anyone who had listened in on the radio and who went to the box office during the next week and bought a ticket would be given an autographed photograph of Edith Day, who was then starring in ‘Wildflower.’

* *

“THE next day 500 people bought tickets, as the result of the radio publicity. From that time ‘Wildflower’ played to full houses. Every day people crowded to the box office; many of them had to be told there was a standing room only.”

* *

BUT as we stated in the January issue of POPULAR RADIO, the broadcasting of a play direct from the stage is probably of greater value to the producer and to the actor than to the broadcast listener, and the ban imposed by Equity is more likely to hurt than to help the very people it is designed to benefit.

* *

FOR the experimenter the coming issue of POPULAR RADIO will contain two contributions of particular and timely interest.

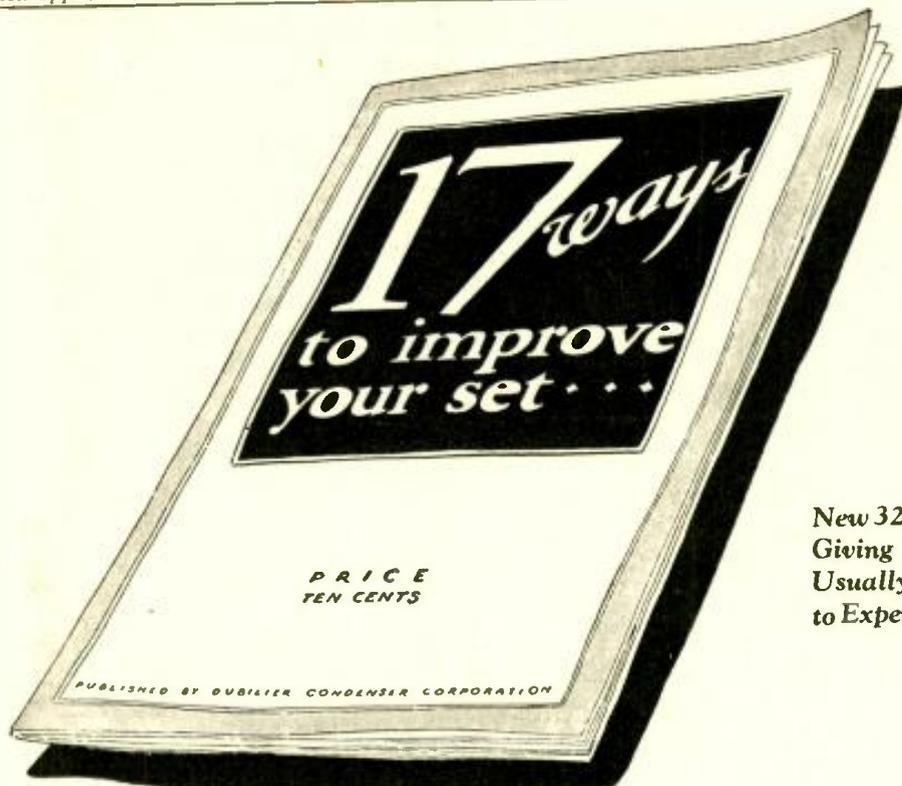
* *

ONE article will give the complete constructional details of the new Brown-Ing-Drake set—contributed by the inventors themselves.

* *

THE other article will tell how to build the new SC-II receiver—which is a development of the popular SC receiver described in the March, 1926 number.

Kendall Tramming
Editor, POPULAR RADIO



New 32-Page Booklet
Giving Information
Usually Known Only
to Expert Set Builders

Just off the press!

Every radio set contains from one to a dozen fixed condensers. Do you know what they are for? Do you know how to test them to see whether they are working properly? Do you know that there is a way of changing the range of your tuning condensers?—of getting greater selectivity—of improving the tone? All through simple applications of fixed condensers.

The Dubilier Condenser Corporation is now supplying radio fans with a complete and authoritative explanation of the correct use of fixed condensers.

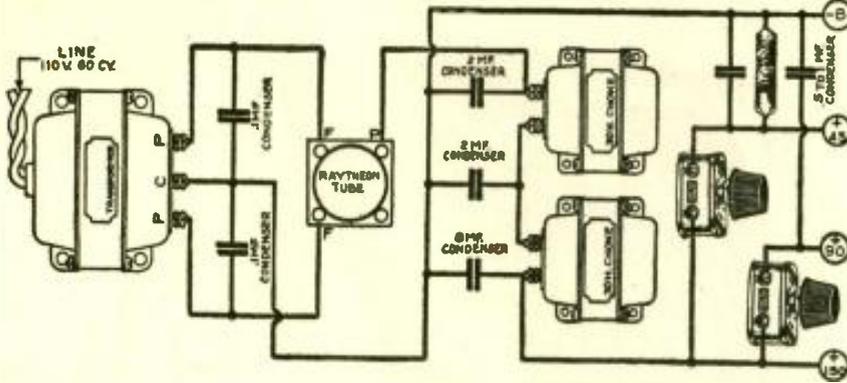
You have often envied the man who could look over your set and by inserting a small fixed condenser somewhere, greatly improve its tone and operation. Do this yourself. Perhaps some defect in reception that you always thought unavoidable is due to imperfect condensers.

Besides telling you all about fixed condensers, this new booklet will also give you the most recent information on power amplifiers, filters and battery eliminators. Send 10 cents in stamps or coin for your copy.

Dubilier

CONDENSER CORPORATION

4377 BRONX BLVD., NEW YORK, N. Y.



Build Your LC-27 Receiver

by the aid of
Popular Radio
SIMPLIFIED
Blue Prints

Easy, Quick and Accurate

POPULAR RADIO believes that this new circuit; which is the outstanding contribution of Laurence M. Cockaday to the experimental set-builder for this year, constitutes not only one of the most important advances that has so far been made in the radio art, but that it is distinguished by a tonal quality—particularly in the lower registers—that is unsurpassed.

This receiver embraces the 14 points of an ideal radio receiver to meet the demands of the average man's requirements.

1. A quality of reproduction that is as nearly perfect as possible;
2. A cabinet designed to blend harmoniously with the finest surroundings;
3. Consistently good performance with a minimum of care and attention, once the set is installed;
4. A tuning control so simple that any one may operate the set without special instruction;
5. A selectivity adequate to eliminate interference from stations on adjoining wavelengths;
6. An ability to operate on any type of outdoor antenna or with no antenna at all;
7. A capacity to operate on house current or batteries, as desired;
8. Adequate shielding of parts;
9. A power amplifier and output filter to supply ample volume without distortion;
10. A construction that provides for the use of nationally known tubes and parts that are easily obtainable in any locality;
11. A non-regenerative circuit;
12. A simple construction with a minimum of adjustments;
13. A sensitivity adequate to provide good reception of distant programs;
14. A fool-proof construction.

By using POPULAR RADIO Simplified Blueprints in building your LC-27 Receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model (see page 313).

If your local dealer cannot supply you with Blueprints of the LC-27 Receiver, they will be sent post-paid upon receipt of \$1.00.

A full description of this Receiver, with detailed directions for building, was published in the October 1926, issue of POPULAR RADIO. Send 35 cents for a copy.

We also have Blueprints of The LC-Senior Power Pack, The LC-Intermediate Power-Pack and The LC-Junior Power-Pack which were designed to operate The LC-27 Receiver.

POPULAR RADIO

Service Bureau 34-B

627 West 43rd St., New York City

Improve Your B-Eliminator with Allen-Bradley Resistors

WHEN you build a B-Eliminator, be sure that your kit contains Bradleyohm-E for plate voltage control and Bradleyunit-A for the fixed resistors. Then you will be assured of perfect plate voltage control.

Bradleyunit-A

PERFECT FIXED RESISTOR

This solid, molded fixed resistor has no glass or hermetic sealing in its construction. It is a solid unit, molded and heat-treated under high pressure, that is not affected by temperature, moisture and age. The end caps are silver-plated, and can be soldered without affecting the accuracy of the Bradleyunit. By all means, use Bradleyunit-A when you need a fixed resistor in your radio hookup.



Bradleyohm-E

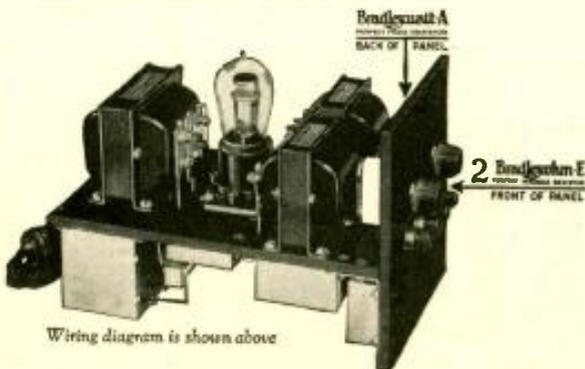
PERFECT VARIABLE RESISTOR

This oversize variable resistor is used as standard equipment for accurate plate voltage control by leading B-Eliminator manufacturers. The scientifically treated discs in Bradleyohm-E provide stepless, noiseless, plate voltage control, and the setting will be maintained indefinitely. Ask for Bradleyohm-E.



Always insist that Bradleyohm-E and Bradleyunit-A are included with your B-Eliminator kit. You then will be assured of perfect voltage control.

ALLEN-BRADLEY COMPANY
276 Greenfield Ave. :: Milwaukee, Wis.



Write for
Folder
Giving Seven
B-Eliminator
Hookups.

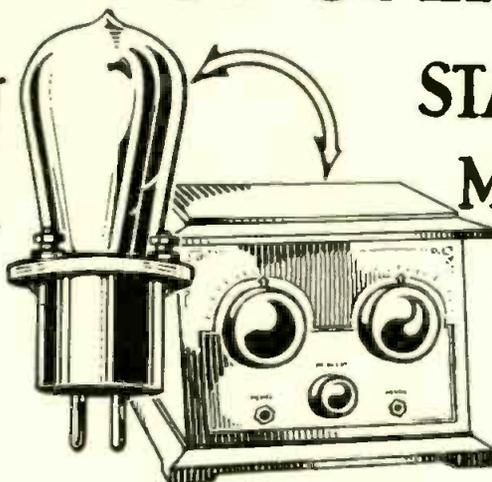
Use **Allen-Bradley** Perfect Radio Devices

UNBELIEVABLE!

*This MULTIVALVE operates this SET
on the LOUD SPEAKER*

EMERSON MULTIVALVE

Patent
Pending



STANDARDYNE MULTIVALVE RECEIVER

ONE MULTIVALVE EQUALS MANY TUBE PERFORMANCE

THINK of it! With one EMERSON MULTIVALVE and the Standardyne Multivalve Receiver you get both local and distant stations with ample volume and amazing tone ON THE LOUDSPEAKER! Is it any wonder that this marvelous combination, the EMERSON MULTIVALVE and the Standardyne Multivalve Receiver have aroused such tremendous interest and enthusiasm wherever they have been introduced? Here is a one tube set which with one EMERSON MULTIVALVE will outperform many of the multiple tube

radio sets now on the market. You must HEAR this amazing combination with your own ears in order to appreciate it. The EMERSON MULTIVALVE is an outstanding radio achievement. The Multivalve is a seven element tube having a 201A filament, three plates and three grids. It can be used with dry cell or storage batteries. Operates on 5 volts. Draws only 1/4 ampere. In Multivalve you find detector, radio frequency and audio—all in one. Fits any standard socket. Can be used with many standard circuits. **LIST PRICE \$6.50**

Standardyne Multivalve Receiver, List \$25.00

The Combination, List \$31.50

Complete kit of parts to build the Multivalve Receiver, including drilled panel, sub-panel, etc. **\$19.50**

[DEALERS: Surely you can't afford to miss this unusual opportunity. Big profits await you. Write or wire for our proposition TODAY.]

EMERSON RADVAL CORP.

Exclusive Licensees and Manufacturers

25 West 43rd St.

New York City

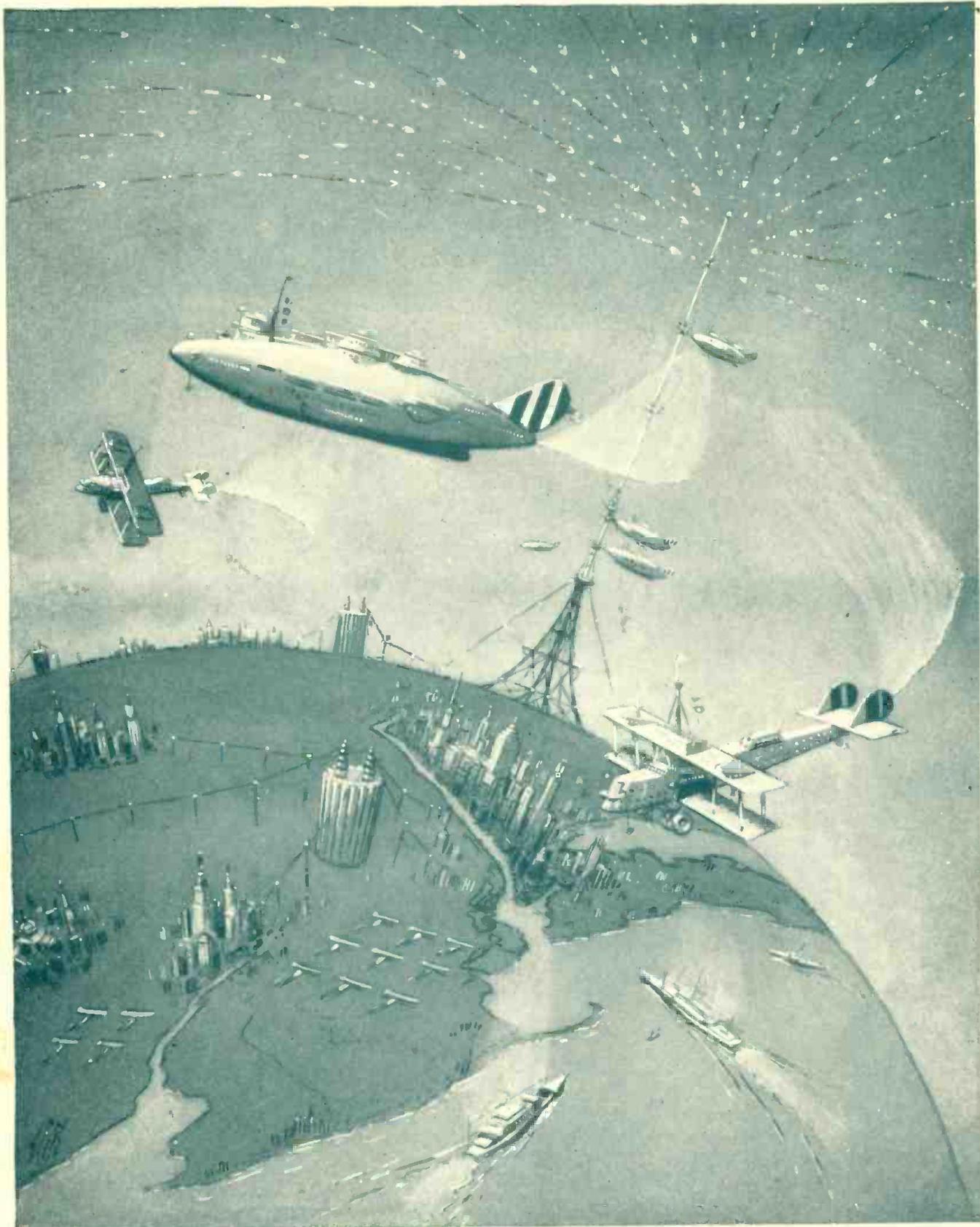


Kadel & Herbert

Interesting in Its Technical Features as
Well as in Its Human Appeal

"I would like to write a whole story about POPULAR RADIO. I will only say, however, that I read it every chance I get and find it most interesting, not only from a technical standpoint but from the human standpoint."

("ROXIE")



From a drawing by Arthur Merrick for POPULAR RADIO

When the World's Motive Power Is Collected by Antennas

Science may discover a new form of radiant energy and inventors may design machinery that can harness this force and put it to work—to run our factories, to heat and light our homes, and to drive air, sea and land craft at incredible speeds.

Popular Radio



VOLUME XI

March, 1927

NUMBER 3

Radio in 1950 A. D.

Some of the amazing possibilities that are visualized by a world-famous scientist and inventor—

DR. LEE DE FOREST

TO the workaday experimenter in the field of radio, absorbed in the practical problems of the next immediate advance along the path of discovery, imagination is a working tool.

But the imagination of the experimenter soon finds itself beyond the bounds of radio phenomena; it ranges out into the realms of the ether. Radio is but one small step in the exploration of an infinite progression of vibrations which quickly get beyond anything but mathematical calculation.

This earth of ours is literally bathed in radiant energy from interstellar space; it bowls along on its way fairly immersed in seas of cosmic force.

"We have actually succeeded in our lifetimes in finding more new relations in physics than had come to light in all the preceding ages put together, and the stream of discovery as yet shows no sign of abatement," says Dr. R. A. Millikan, who is himself playing an important part in it all.

Let us for a moment speculate upon some of the possibilities and probabilities that lie ahead of us—basing our speculations not upon mere fancy but upon the accomplishments of the past in the new field that radio has opened up.

One of the most important is the possibility that some day we may learn how to draw electricity from the upper air in amounts to suit the individual need of the moment.

Some day it may become possible to build and maintain conductors ten

miles high, with a series of antennas to gather in and store up the vast energy that exists in the form of enormous potentials between the upper atmosphere and the surface of the earth. When that time comes we will be able to utilize this exceedingly high potential energy for performing work for mankind. If this power were harnessed, local power stations could be established wherever desirable to supply large zones with electricity and power—and the human race would be immensely wealthier.

When that time comes any one of us—the manufacturer, the railway executive, the newspaper owner, the electrical engineer, the farmer, the housewife—can get power with ease. Questions of warmth, of light, of transportation—age-old problems fundamental to human progress—will cease to exist. Never again will we be bothered by speculations over the time when our reserves of coal and petroleum would be exhausted, as they must, some day.

To speculate further:

We may discover a new radiation which follows the surface of the earth. Or perhaps some other form of radiant energy will be brought to light that can be directed in intense streams as accurately as a man plays a hose. The nozzle of such an imaginary hose located on the Atlantic coast and with its streams of energy directed due west across the United States, may furnish energizing power to airplanes that will thus be

made capable of many times the speed now possible; a thousand miles an hour may well be within reach. We may cross the American continent after breakfast and lunch on the Pacific coast—and return in time to dine in New York! Or we may cross to London in 3 hours. Indeed, streams of energy may be played in whatever direction that there will be traffic; we may literally go "rolling down to Rio" between luncheon and dinner!

Mammoth planes may then travel far above the storm belt as we speed across the sky; disturbances of the air would mean no more in that case than international boundaries. And how long will international boundaries be regarded as important when London is practically in New York's front yard and San Francisco out by the garage?

The electrical frequencies used in radio, which have become a commonplace in our lives at present, are about a million times greater in cycles per second than the audible frequencies upon which humanity had depended for communication for thousands and probably hundreds of thousands and possibly millions of years. The speed of light, as is now generally accepted, is about the same as for radio waves, or approximately 186,000 miles a second. Now comes Dr. Millikan with a new ray that is said to have a frequency 10,000,000 times that of the highest light rays—and light waves constitute the fastest phenomena that is perceived.

tible to the human senses! This new ray goes around the earth some 75,000,000 times in a single second!

What is the use of trying to put such a frequency into terms comprehensible to the human mind? And, conversely, why regard anything in natural phenomena as "impossible?"

These "cosmic rays" discharge the electroscope even though it be sheathed in lead, which we know is not possible even with the X-ray. They have a frequency 1,000 times greater than that of the X-ray. When the electroscope is plunged into water with an absorption coefficient equal to the atmosphere above it at that point, these cosmic rays show the infinitely tiny wavelength of .0004 angstrom units.

Only a vivid imagination can gain even a relative conception of this!

But even within the band of the high frequencies used in radio there is ample room for speculation and for development.

The short wave for transmission and reception is receiving a lot of attention and may help us over some difficult places. The transmitting amateur experimenters may properly feel that at last they are coming into deserved recognition. The "short-wave beam" offers a fruitful field to the constructive and experimentally inclined radio enthusiast.

It has long been evident that a dependable means of directing waves from 2 or 3 meters up to 50 meters without fading, bending, or defraction, would be a great advance in radio.

Only a slight amount of power in kilowatts is required to operate on these short wavelengths. They may be sent out at a diffusion angle small enough so that the sender can at least control their direction to a considerable extent; this factor gives a degree of secrecy hitherto unattainable. The more this directional factor is developed, the greater will be the secrecy that can be obtained.

We probably will hear much of over-coming atmosphere troubles and disturbances by means of the short wave. We have been seeking a solution of static—or "atmospherics," as the Englishman calls it—at the receiver for the past twenty-five years. Progress along this line is steady, if it does seem rather slow.

By using the photo-electric cell and boosting its sensitiveness many thousand times with the audion tube, we can now transmit pictures and writing by radio.

Transmitting pictures, however, is not true television.

When we can sit in a darkened theatre or in our home, in New York, and watch on the screen the movement

of the holiday crowds in Chicago, or when Chicagoans can see a New York theatrical performance on the screen; when we can see the seals disporting themselves on the rocks off Golden Gate Park in San Francisco; when the film magnate in Manhattan can actually oversee the work of his directors on "the lot" at Hollywood, or a congregation in an American church with its own eyes can view the Pope celebrating mass in the Vatican—when any of these experiences actually come to pass, then we shall have true television.

Mechanical difficulties in the way are great, but the necessary "speeding up" processes are being studied and slowly evolved in scientific laboratories. Physically, television—the ability to see over long distances—is perfectly possible,

Some Day We May Be Able—

To eliminate static;

To "see by radio," to attain true television;

To run the clocks of the world by radio impulses;

To draw electricity from the atmosphere and to put this power to work for man;

To direct streams of radiant energy that will drive airplanes at tremendous speed.

but the transmission and reception details are complicated and need further working out.

It is easy to let imagination rove—and whatever we imagine may come to pass almost before we are aware of it. I am ready to agree that television may sometime come—and what a marvelous stride ahead civilization will take when it does!

What may soon be done in the regulation of watches and clocks by radio seems of more immediate interest.

It is possible, even at this date, to use a simple receiving set for this with a relay which corrects itself once or twice a day, or to adjust the escapement in watch or clock so that it will register an impulse from a master station every second or two. This is actually little more than the Western Union Telegraph Company is doing now with myriad clocks which are electrically

operated and regulated. An impulse is sent by wire every ten seconds. In the case of our watches we should doubtless have to arrange to pull these from the pocket at a prearranged moment—say on the hour or half hour, or oftener—and hold them steady in a certain position.

There is no reason why the desk clock in one's office should not be thus kept accurately on the second with Greenwich time.

Meantime some of the most vital advances in radio will come in developments of broadcasting. One day soon the ordinary audion (or vacuum tube valve) may be used to extend the hearing power of the human ear around the globe—to enable us to listen to audible sounds anywhere else.

Think, for instance, of listening in on a tiger hunt in India, or on an elephant hunt in Africa—or on a Henley regatta in England! Or of hearing the balls click on the gaming tables at Monte Carlo, or the sounds of war and all that goes with it!

Broadcasting is already becoming highly specialized and will become more so. We may now listen in on Congress or State legislatures in their sessions; we are beginning to be taken into the homes, the clubs and the offices of public men and women.

It will be hard on the politicians when their constituents generally have this check on what they do and say, but it will make for a realization of pure democracy such as no nation has ever had.

One pleasure we have now in some measure we shall ere long have much more of—the radio drama.

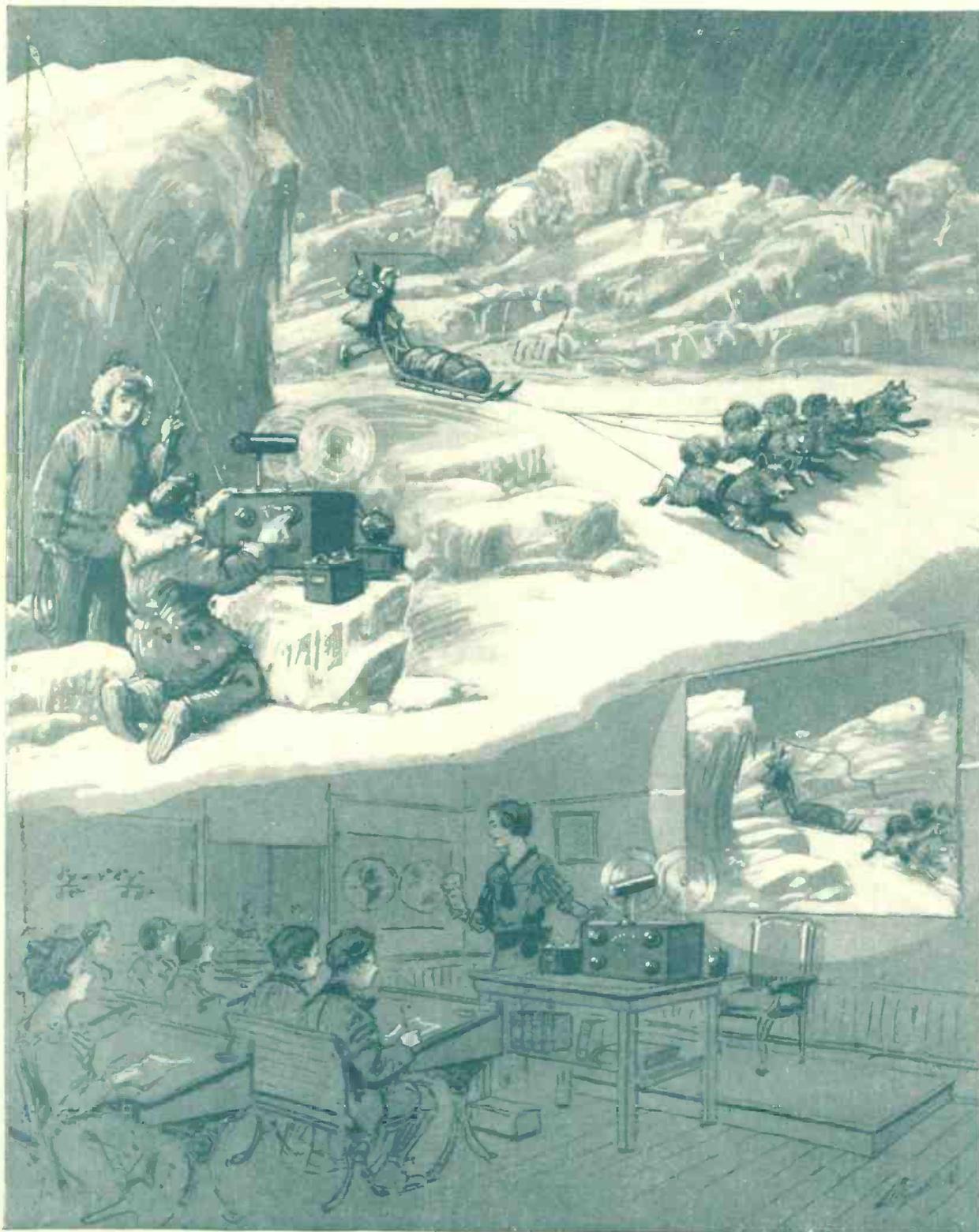
Instead of listening in on bits from plays, striking scenes or even a whole act, why not both hear and see the whole play by radio? Or sporting events?

I believe, also that radio is destined to play a big and significant role in our scheme of education.

Even now the radio set is no uncommon thing in schoolrooms, but real radio schools are coming—a system of education in which much of the instruction will be given radio, with a curriculum specially arranged with that end in view. That will mean more than schoolrooms where receiving sets are installed; it will mean that students can then receive such educational advantages in their own home towns or even in their homes, as no single college or university can give them now.

Radio is developing its own technic and, instead of being an afterthought, will be a leading thought in the preparation for any event where the medium of expression is vocal or instrumental.

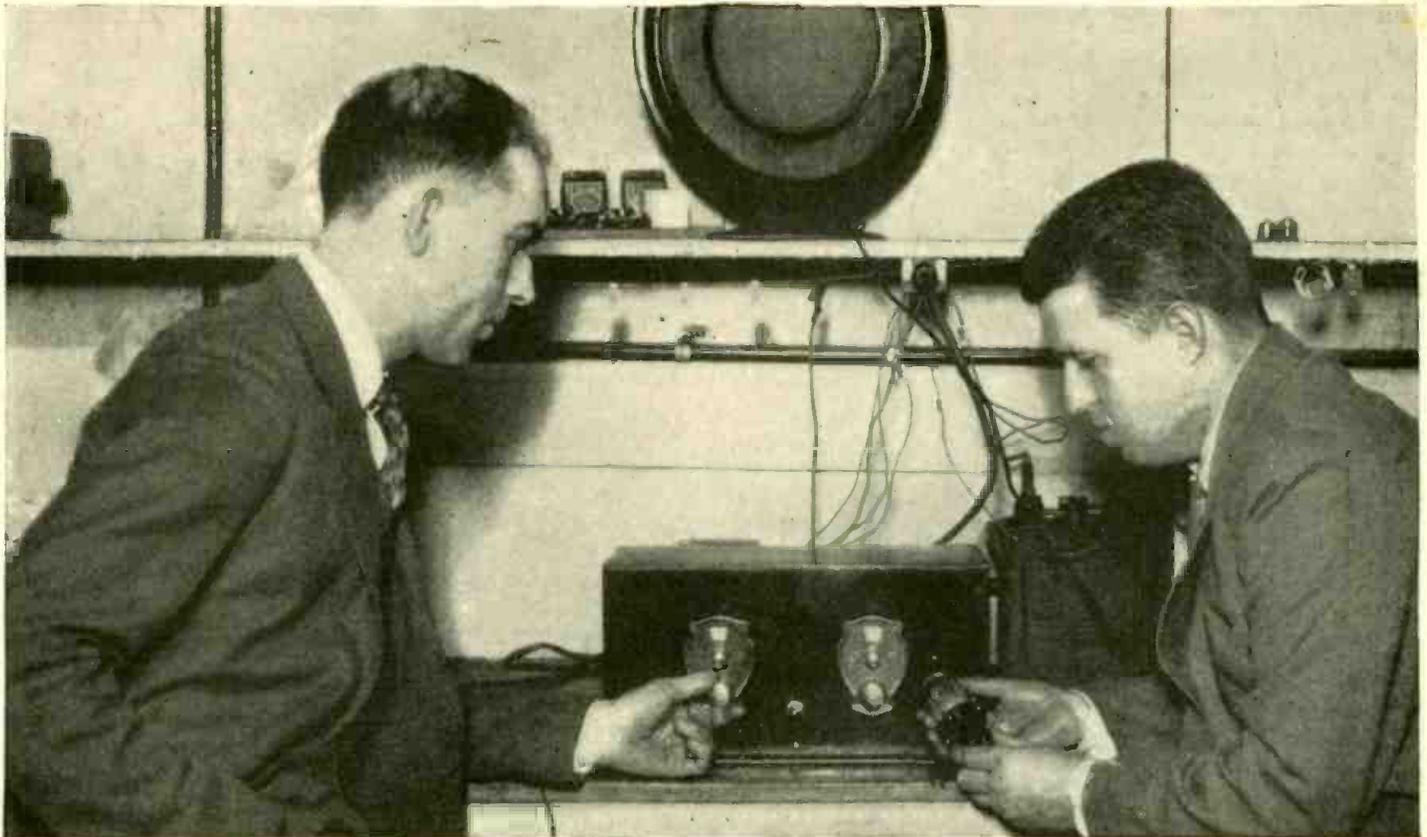
(Continued on page 279)



From a drawing by Arthur Merriek for POLAR RADIO

When Radio Permits Us to Look In as Well as to Listen In on the Rest of the World

The time is approaching when receiving sets will be regarded as a regular part of the physical equipment of our schools and universities; many of us may yet see television apparatus similarly installed for "looking in" not only upon class-room demonstrations but also upon explorations in foreign lands, legislative bodies in session and world-events of interest.



From a photograph made for POPULAR RADIO

TESTING THE FINAL MODEL OF THE RECEIVER

This picture shows how the completed laboratory model of the receiver looked during the final test on its operating characteristics. In the foreground may be seen the multivalve; this tube has made possible the remarkable results obtained with this receiver.

HOW TO BUILD

The Univalve Receiver

Here, at last, is a stable one-tube receiver that will operate a loud-speaker satisfactorily on local stations without the use of crystal detectors or microphone amplifiers. The circuit was developed to utilize the new multi-valve—a single tube that does the work that has heretofore needed several tubes.

By A. J. HAYNES and LAURENCE M. COCKADAY

COST OF PARTS: *Not more than \$40.50*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS RECEIVER—

- | | | |
|--|--|---|
| A and B—Hammarlund autocoilplers; | I—any approved mica fixed condenser with grid-leak clips, .00025 mfd., (Electrad condenser illustrated); | N—bakelite front panel, 7 by 15 by 3/16-inch; |
| C and D—Cardwell SLF variable condensers, .00035 mfd., equipped with Cornell etched vernier dials; | J—any approved mica fixed condenser, .0001 mfd. (Electrad condenser illustrated); | O—hardwood sub-base, 7 by 14 by 1/2-inch; |
| E—Karas Harmonik low-frequency transformer; | K—any approved mica fixed condenser, .0005 mfd., (Electrad condenser illustrated); | P—bakelite binding-post strip, 1 by 9 by 3/16-inch; |
| F—Thordarson low-frequency transformer 2 to 1 ratio; | L—any approved grid-leak, 4 megohms (Polymet grid-leak illustrated); | Q1, Q2, Q3, Q4, Q5, Q6 and Q7—any approved binding posts, marked Ant., Grnd., A Minus, A Plus, B Minus, B Amp. Plus, B Amp. Plus, respectively (Eby binding posts illustrated); |
| G—any approved battery switch (Carter switch illustrated); | M—any approved small single-circuit jack (Electrad jack illustrated); | R1 and R2—small brass brackets; |
| H—any approved automatic filament control, .25 amp. (amperite No. 1A illustrated); | | S—Benjamin vibrationless socket. |

Q The list of parts given above includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by POPULAR RADIO and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units, POPULAR RADIO SERVICE BUREAU, 627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.

HERE is a new set that employs only a single vacuum valve (or tube) with which local reception at full loudspeaker strength is possible!

This is accomplished by the use of the new Multi-valve, a vacuum valve that takes the place of all the tubes in an ordinary set.

The design of the receiver incorporates one stage of high-frequency amplification, a detector and two stages of low-frequency amplification.

No crystal is used in the set; all of the amplification and detection is done by means of the single valve.

The circuit used is a new development, incorporating the little-known but highly efficient shunt reflex that eliminates all of the howls and squeaks that accompany the more common form of reflex circuits.

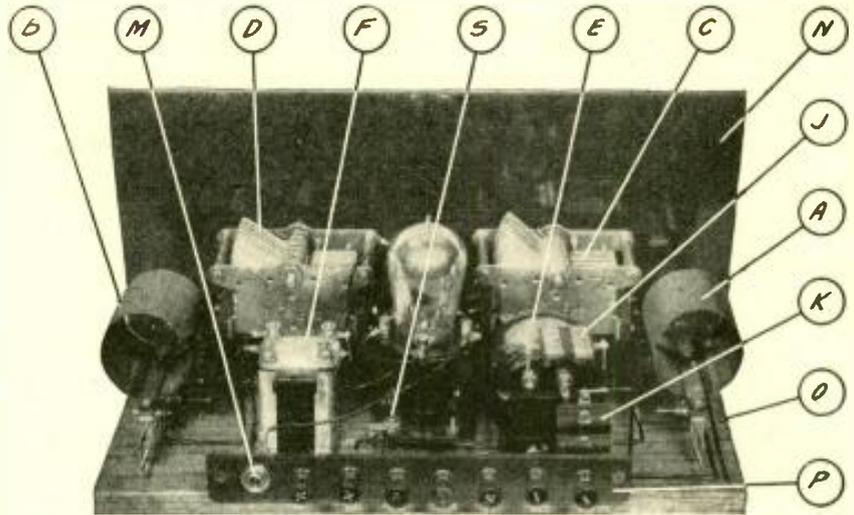
The apparatus chosen for use in this set was carefully picked with the proper electrical constants, so that the maximum volume and the best tone quality of which this system is capable might be obtained.

In initial tests on this receiver, listeners, who were invited to hear it, were both mystified and surprised at its performance, for while an ordinary one-tube receiver furnishes only enough volume to operate headphones, this set gives good loudspeaker volume.

The wiring diagram for the receiver is shown in Figure 4.

How to Construct the Set

When all of the instruments and materials for building the set, as listed at the head of the article, have been



A VIEW OF THE SET FROM THE REAR

FIGURE 1: This view shows the general arrangement of the instruments that are mounted on the wooden sub-base and on the panel itself; notice that the loudspeaker jack is connected to the binding-post strip in the rear.

procured, the front panel, N, should be prepared.

First, cut the front panel, N, to the correct size, 7 by 15 inches. Then square up the edges smoothly with a file. The centers for boring the holes by means of which the instruments are mounted should then be laid out on the panel, as shown in Figure 6. A convenient method is to lay out all center holes on a piece of paper the same size as the panel; then the piece of paper may be fastened on the panel and the centers marked directly on the panel by punching through the paper with a sharp, pointed instrument.

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

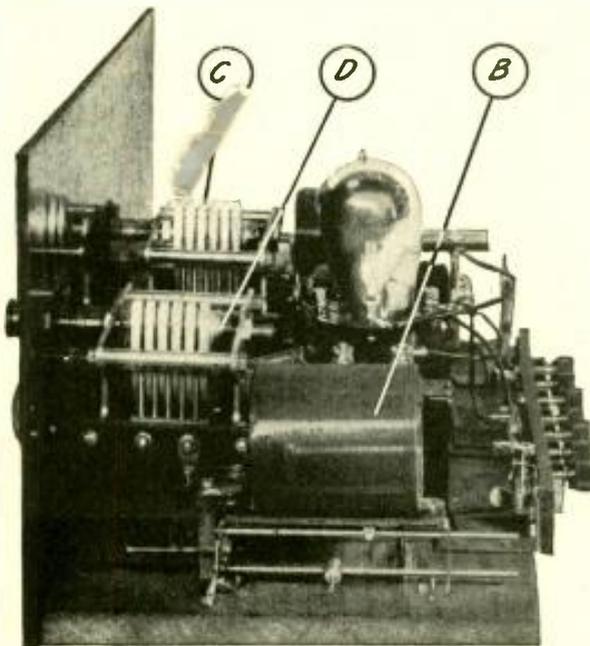
After the panel, N, has been prepared, the two condensers, C and D, should be mounted on it by means of the flat-head machine screws that come with the condensers. Figures 1 and 3 show the position occupied by these two condensers and by the switch, G, which is mounted at the lower part of the panel, N, between the two condensers, C and D.

Next, attach the two vernier dials to the condenser shafts and the construction work on the panel is completed.

The next job will be to cut the hardwood baseboard, O, to the proper size, as given in Figure 5, and to mount coils A and B. These are fastened to the baseboard, O, by drilling two holes directly through the baseboard and by countersinking the bottom side of the holes, so that screws may be inserted through and fastened into the brass legs that are used to mount the coils. Be sure that the holes are countersunk deep enough, so that the heads of the screws will not project beyond the under surface of the baseboard.

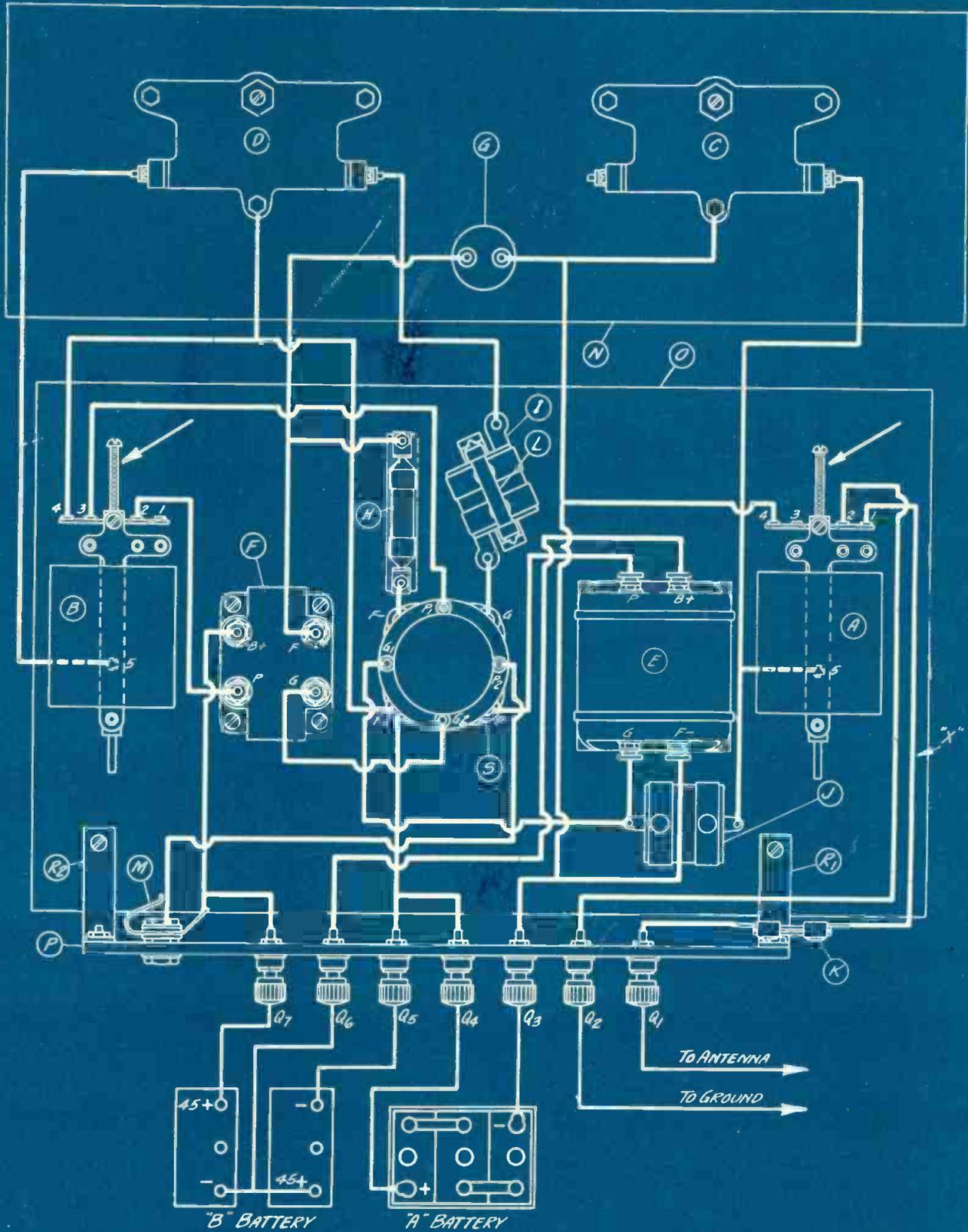
Next, mount the vacuum-valve socket, S, by means of two screws and mount transformer E and transformer F. The other instrument to be mounted directly on the baseboard is the automatic filament control, H, which is mounted by a single screw. The condensers, I, J and K, and the grid leak, L, are supported by the wiring; this job may be left until later.

Next, prepare the binding-post strip, P, as shown in Figure 7 and mount the seven binding posts, Q1 to Q7 inclusive, in their proper positions, as



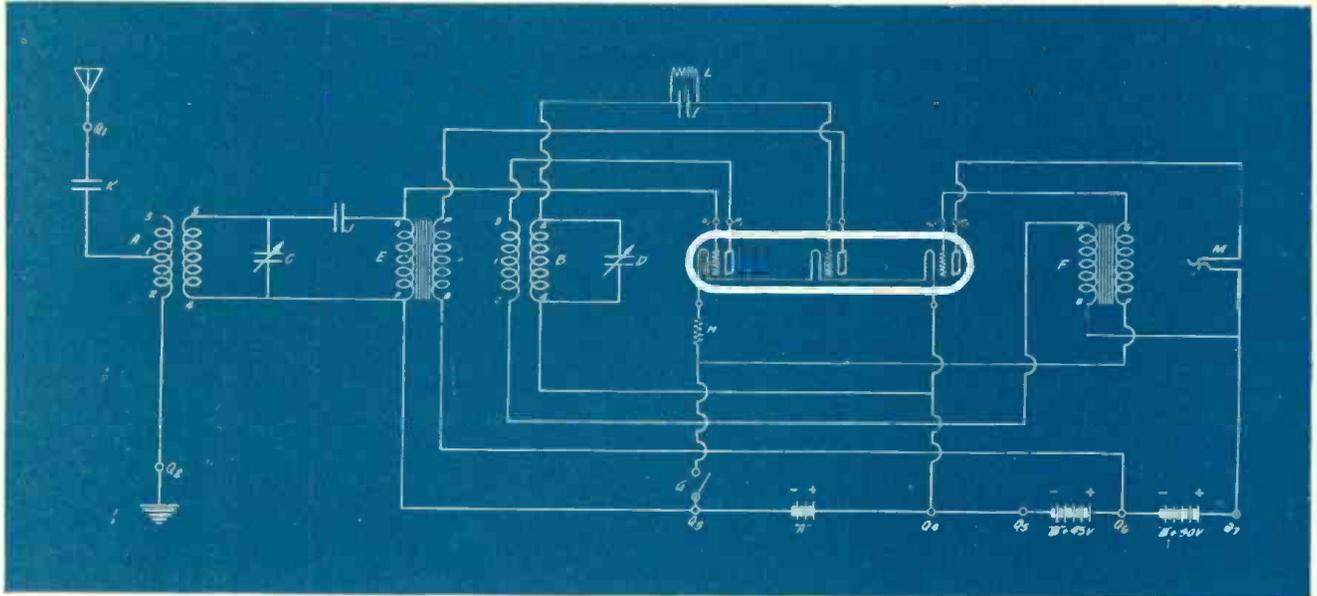
AN END VIEW OF THE RECEIVER

FIGURE 2: The method of mounting the coils, condensers and the binding-post strip are shown here as seen from the left end of the Univalue-receiver; note the flexible connections to the valves.



THE PICTURE WIRING DIAGRAM

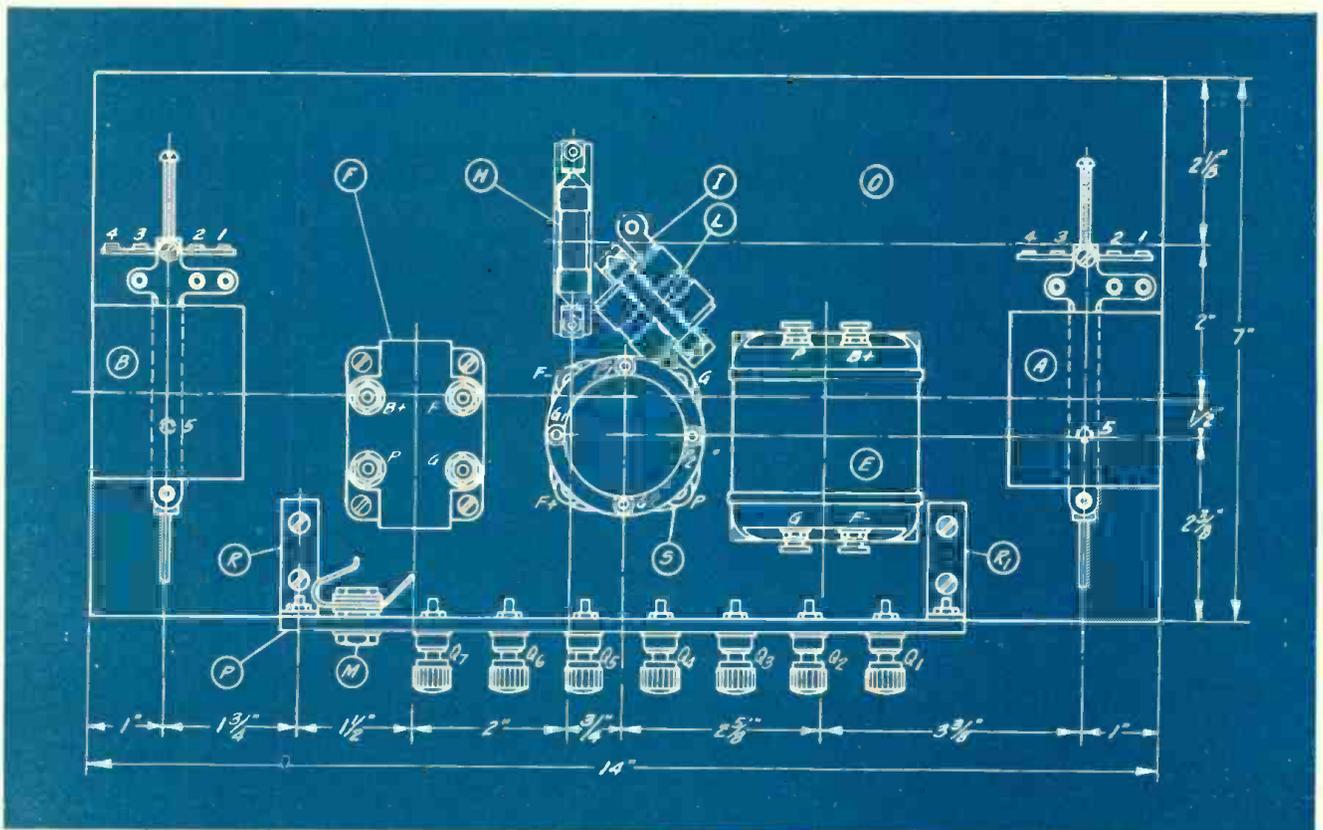
FIGURE 3: The instruments, in the above diagram, are drawn in about their relative positions on the baseboard, panel and binding-post strip. The heavy white lines show exactly where to run the wires in wiring up the receiver; the dotted lines running to terminal 5 on coils A and B merely indicate the wire runs underneath the coil. The connections that run to terminals G1, P1, G2 and P2 of the multivalve should be made with flexible wire. At the bottom of the diagram will be found the connections for the "A" and "B" batteries as well as for the antenna and ground. All of the parts in the diagram are designated by the same letters that appear in the text and other diagrams and in the list of parts at the head of the article. No trouble should be experienced in wiring the set if this diagram is carefully followed.



THE SCHEMATIC CIRCUIT DIAGRAM

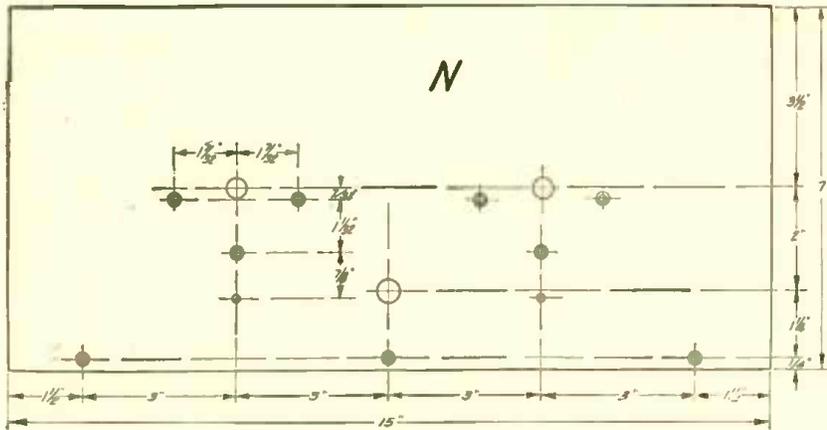
FIGURE 4: In this drawing the three sets of elements within the tube are clearly shown together with the proper connections. The first set of elements on the left are for the high-frequency amplifier; the elements on the extreme right are for the last stage of low-frequency amplification. The middle set of elements are used as a detector.

For the benefit of the experimental set builder who may prefer to assemble the Univalue Receiver from larger diagrams than can be reproduced within the limited space of these magazine pages, a set of simplified blue prints in actual size have been prepared. This set includes (1) the working drawing for construction, (2) the panel layout, and (3) the picture wiring diagram, in addition to (4) the schematic circuit diagram and the complete list of parts used in the laboratory model. If this set of blue prints cannot be obtained from your dealer, it will be furnished upon receipt of a remittance of \$1.00 sent to the POPULAR RADIO SERVICE BUREAU, 627 West 43rd Street, New York City.



THE WORKING DIAGRAM FOR CONSTRUCTION

FIGURE 5: The exact size of the sub-base with the exact spacing for the coils, transformers and other instruments are given here. The arrangement of the connection block on the sub-base is also indicated.



HOW TO DRILL THE PANEL

FIGURE 6: The exact positions for the holes that are used to mount the instruments are given in this drawing. The sizes for the holes should be determined by examining and measuring the instrument shafts or the screws that are to fit in the holes.

receiver, the switch, G, should be set on the "on" position, which lights the filament of the valve; then the two dials connected to condensers C and D, should be rotated so that the stations are brought in. The volume is controlled by setting the first dial, C, slightly off resonance in cases of very loud local stations. The condensers are of the straight-line-frequency type so that the dials will read near 100 at high frequencies and near zero on a low frequency.

The coils, A and B, are equipped with a small screw that varies the coupling. These screws are designated with arrows in Figure 3. By revolving them, the primary coils may be brought out at a distance from the secondary or close to the secondary coil. These coils should be set according to local conditions where the set is to be used. When they are set "way out," the receiver will be very selective, but when they are set "close up," the receiver will tune more broadly and the volume will be increased.

If the set is to be used at a distance of say ten or fifteen miles from the local stations, they should be set close up. Also the lead marked "X," in Figure 3 should be connected to terminal No. 3 instead of to terminal No. 1, if the signals from the stations are not loud enough when the set is more than fifteen miles from the station.

The condenser, K, is used in series with the antenna to add to the selectivity; but in tuning in at greater distances than actual local reception, this condenser may be short circuited; this, again, will increase the range. These adjustments of the coils and the variation of the wire "X," from one terminal to another need only be made once when the set is installed. For ordinary local conditions the connections given in Figure 3 will be found satisfactory in most cases.

shown in Figure 5. Also fasten on the strip the jack, M.

Then mount the binding-post strip, P, on the wooden baseboard, O, by means of the two small brass brackets, R1 and R2.

The constructional work is now completed and the set is ready to be wired.

How to Wire the Set

The design of this set is such that the wiring of the grid circuits and other critical wiring that carries high potential currents, is made extremely short and is isolated from other parts of the circuit. In fact, this idea has been employed throughout and the leads are so arranged that the shortest connections may be used. The set should therefore be wired with bus-bar.

Either a tinned-copper bus bar or an insulated bus wire such as "Celatsite" may be used for the connections. All connections should first be shaped so that they will fit; they should then be soldered in place.

The wiring that goes to the four upper terminals of the multi-valve should be done with flexible "Celatsite" wire.

Start the wiring on the baseboard, O, by referring to the picture wiring diagram in Figure 3, putting in place all wires except the four leads that go to the two variable condensers, C and D, and the two leads that go to the switch, G.

When you are ready to connect the leads to the four upper terminals of the multi-valve, cut them to approximately the right length and solder lugs to the ends that go to the valve, so that these may be inserted under the binding posts of the valve when the set is ready for actual installation.

Next, attach the front panel, N, to the baseboard, O, by means of three flat-head screws inserted through the three holes already drilled in the panel, into the edge of the baseboard.

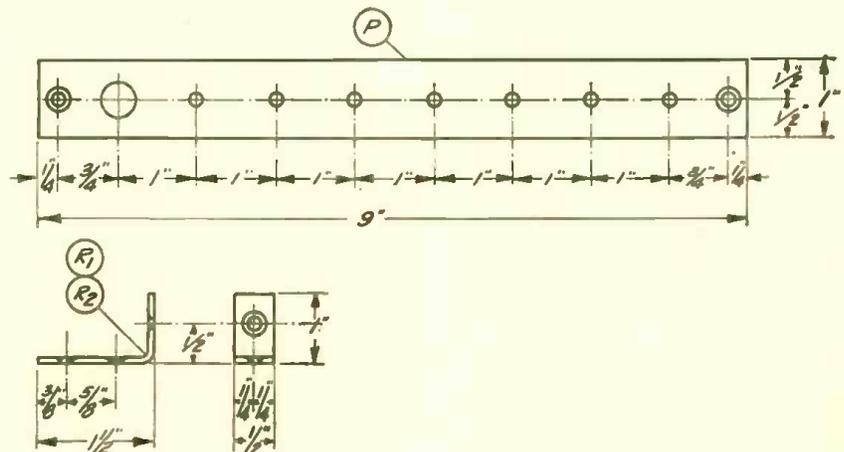
Then, wire up the four leads to the variable condenser, C and D, and the two leads to the switch, G.

This completes the wiring and the set is ready for installation.

How to Install the Set

Insert the receiver in a standard cabinet for this size of panel and connect up the batteries to the binding posts, as shown in Figure 3. Next insert the multivalve and attach the leads to the extension terminals G1, P1, G2 and P2. The antenna and ground should also be attached to the proper binding posts on the receiver. The set will work with almost any type of antenna.

Next, attach the cone reproducer by means of a plug into the jack, M, on the binding-post strip, P, and the receiver is ready to function, provided the vacuum valve is in position and properly connected. The reproducer that was found most successful with this receiver was the Rola cone; the characteristics of this cone seem to suit this form of amplification best. In tuning in the



HOW TO MAKE THE SMALL PARTS

FIGURE 7: These drawings give the dimensions for the bakelite binding-post strip and for the brackets that are used to fasten it to the baseboard.



Courtesy New York Electrical Society

A SCIENTIFIC THIRD DEGREE THAT USES ELECTRICAL APPARATUS

In conducting an investigation by this new method the examiner is seated at the end of the table, facing the reader; the "criminal" is at his left. The others are assistants operating the electric devices which record the outcome of the tests. Radio devices, says Mr. Elway, might have been used instead in making the various measurements.

THE COMING REFORMATION OF "THIRD DEGREE" METHODS BY

The "RADIO DETECTIVE"

Experiments with highly-sensitive electrical apparatus reveal the consciousness of guilt to the inquisitors of the police department.

By THOMAS ELWAY

THE famous "third degree," still sometimes administered to criminals by unscrupulous detectives well armed with clubs and brass knuckles, is rapidly vanishing from American criminal procedure. Too many citizens believe that even criminals deserve treatment as humane as that which we demand for animals.

To replace the old-time brutal methods of eliciting confessions, science is offering what has been nicknamed the "psychological third degree." Tests devised by modern psychologists and designed to trap the suspect into unwary or unconscious admissions of guilt, are applied to everyone under examination,

even to witnesses not suspected of actual complicity. Electric apparatus is used largely in these new tests.

At a recent meeting of the New York Electrical Society, a Society famous in that metropolis for the novelty and popular interest of its programs, Dr. A. P. Link, of the department of psychology at Washington Square College of New York University, described and demonstrated some of the new electro-psychological methods for science's painless variety of the third degree.

The high point of Dr. Link's demonstration was the commission and detection of what he called a "sample crime." Three persons selected from

the audience were sent from the room with sealed instructions. After leaving the room these persons determined by lot which one of them was to be the "criminal." The unfortunate holder of the evil lot then opened his instructions, which told him to proceed to another room in the building and commit a "robbery." To add interest and verisimilitude, the instructions informed the amateur robber that if, on his return to the auditorium, he could conceal from Dr. Link the fact that he was the one among the three who possessed a sense of guilt, the sum of money involved would then remain his own. It was real money. An incentive was thus

provided for success in concealing the guilty knowledge.

The crime successfully completed, all three suspected persons returned to the auditorium together. Neither Dr. Link nor the audience knew which one of the three was guilty. Psychological tests were applied, most of them electrical in nature. By means of ingenious devices constructed especially for the occasion, the results of these tests were made visible or audible not only to Dr. Link and his assistants, but to the audience as a whole. As was expected, and as the psychologists insist will always happen, the guilty knowledge of the one person who was really the robber became immediately apparent, so much so that the audience voted overwhelmingly to select this person as the criminal.

In an actual criminal case it would have been necessary, Dr. Link explained, to conduct much more thorough and comprehensive tests than were possible in the brief time available at a demonstration meeting. Also, it would be unwise to depend upon the mere impression of the observers or upon a vote of the audience. Detailed quantitative data, carefully accumulated and submitted to mathematical analysis, are necessary for any important decision. Even under these circumstances, Dr. Link did not urge the tests as absolutely final or as conclusive legal evidence. What these tests can do, however, is to assist in the uncovering of facts which someone is endeavoring to conceal. A knowledge of these by the officers of

the law may assist the solution of many criminal mysteries.

Dr. Link made use of radio methods only in connection with the demonstration of his tests to the audience, not in the tests themselves. One of the things tested is the heart-beat of the subject. It is well known to physiologists that excitement of any kind will increase the rate of the heart-beat. If a heart-beat recorder is attached to the subject while questions are being asked, any especial excitement aroused by a question touching on guilty knowledge is apt to be indicated by a sudden quickening of the heart-beat.

At the Society's meeting the heart-beats of the three suspected criminals were made audible to the entire audience by what is essentially radio equipment, the electrical stethoscope perfected by the Bell Telephone Laboratories and already described in the columns of POPULAR RADIO.

Another of the testing methods used in the psychological third degree is the so-called "association test." In this test a list of words is read, word by word, to the person under examination. He is instructed to respond, as quickly as possible, with some other word which the first word suggests. For Dr. Link's demonstration this test also was given a radio assistant. In front of the suspected criminal under examination was a microphone. Connected with this were the amplifiers and loud-speaking telephones of a public address system. Thus the entire audience, not merely

the examining psychologists, heard even the tiniest whisper with which the "criminals" replied to questions or to association words.

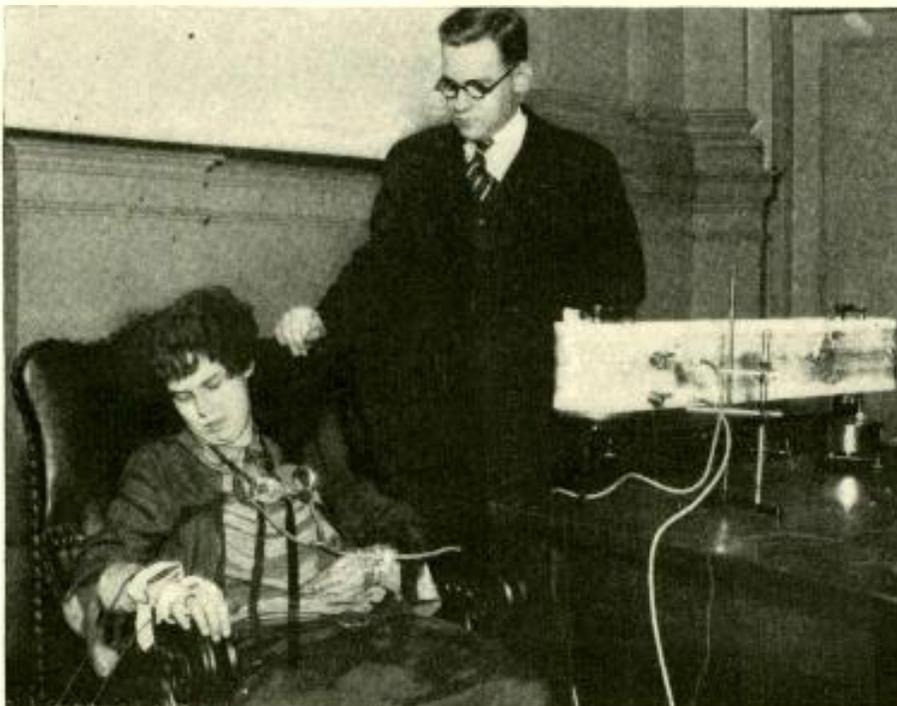
This use of microphones and amplifiers and of the electrical stethoscope, while probably unique insofar as the demonstration of such matters is concerned, was not really an application of radio to the psychological third degree, but merely an application to the demonstration of this procedure to an audience. But is it not possible to go farther? Does not radio have something much more important to offer to the electrical and psychological experts who are now so active in developing these tests?

One of the important practical difficulties with the psychological third degree as demonstrated by Dr. Link is the fact that it requires the knowledge and cooperation of the subject. If a suspected person refuses to submit to the psychological tests most courts will support him in this refusal. Furthermore, it is possible for a person having advance warning of the nature of the tests to control, in some degree at least, the responses which his body makes. There exist, for example, individuals who are able at will to quicken or to retard the beating of their hearts. It is a great need of criminalologic practice to find some method by which the electro-psychological tests may be applied to witnesses or suspects absolutely without the knowledge of the person being tested.

Suppose, for example, that you could have in the office of the District Attorney an ordinary-looking office chair. A person whom the officers wish to question is received pleasantly and is ushered to a seat in this comfortable piece of furniture. Questions are asked and answers given, as they might be in any casual conversation in a business office. There is no appearance that anything special is going on or that any psychological tests are being given. The victim, seated comfortably in his treacherous chair, is the last person to suspect that he is being subjected, invisibly and unconsciously, to a scientific third degree.

Can anything of this kind actually be accomplished? We cannot be sure. Nothing of the sort has been done. So far as I know it has never been tried. Certainly the exact tests used by Dr. Link before the New York Electrical Society cannot be so applied, for these tests require the seating of the witness in the midst of a veritable forest of electrical and other apparatus. It is necessary, even, to attach to the witness's chest the recorder for the heart-beat and to his arm the electrodes for

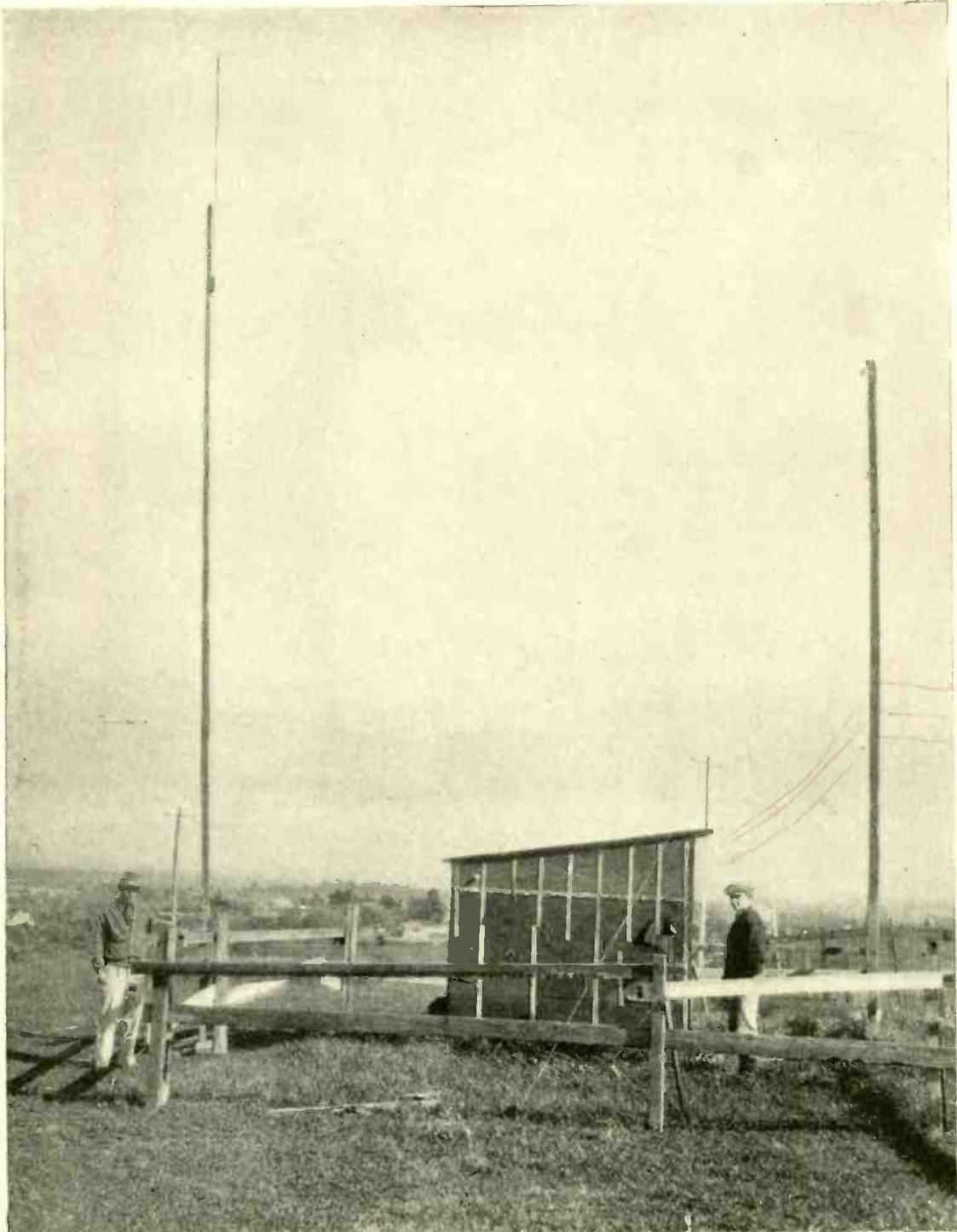
(Continued on page 284)



Courtesy New York Electrical Society

WHERE RADIO MIGHT REPLACE HYPNOTISM

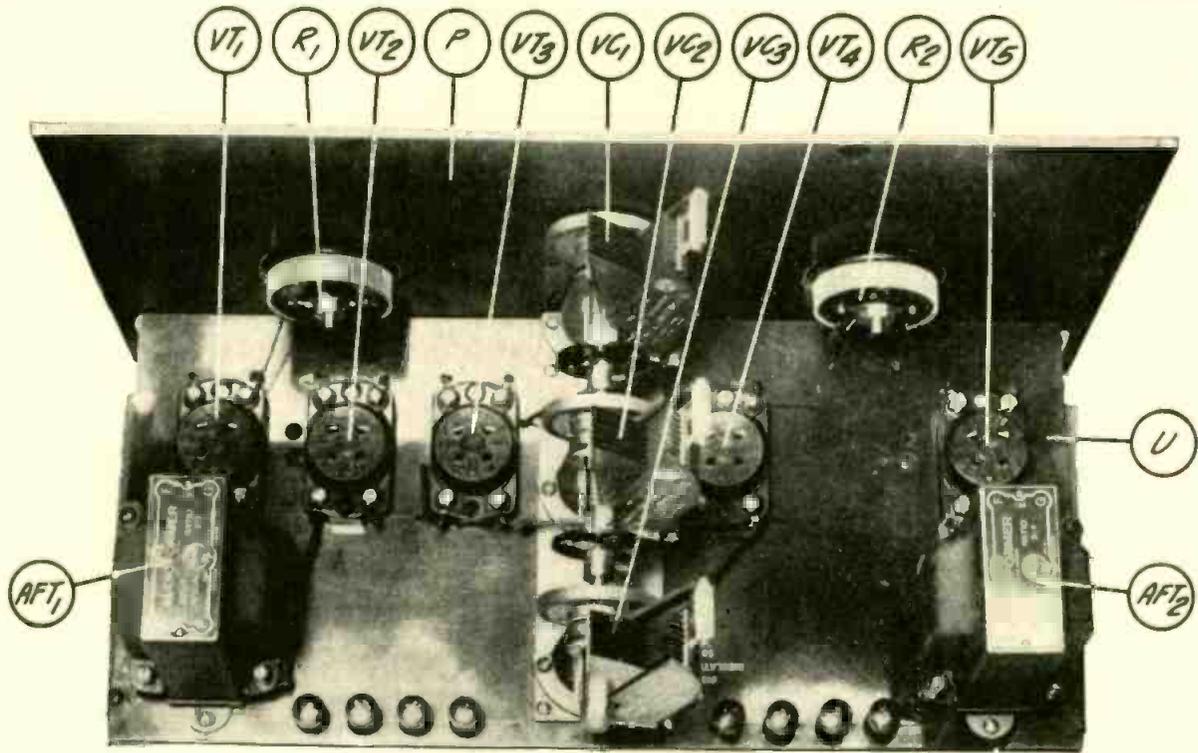
Variations in the heart-beat of the hypnotized subject are being tested by the apparatus on her chest, connecting with the recorder at the right. A radio recorder similar to those used for making code reception graphs in commercial radio telegraph stations would probably be simpler than the apparatus used here.



A. R. Boone

The Starting Point for the Radio Waves That Were "Heard Round the World"

From this flimsy shack overlooking San Francisco Bay and with a home-made transmitter Brandon Wendworth (U-601), a nineteen-year old college student, has sent out signals that have been picked up in nearly every civilized country on the globe from South Africa and the British Isles to Australia and the Philippines. He transmits on the 20 and 40 meter bands using a 50-watt tube in a three-coil Meissner circuit of the tuned plate, tuned grid, low-loss type on a normal input of 200 watts. The mast at the left supports his vertical, 30-foot, transmitting antenna; the one at the right, a 100-foot receiving aerial.



The New "Ultimax" Receiver

This receiver consists of two stages of high-frequency amplification, a non-regenerative detector and two stages of low-frequency amplification. The unique feature of this circuit lies in a novel coupling arrangement that maintains the amplification at its highest efficiency. Both of these stages, including the antenna coil, are controlled by a single knob. Suitable jacks are provided to conveniently take the output from either four or five tubes.

Popular Radio Circuits

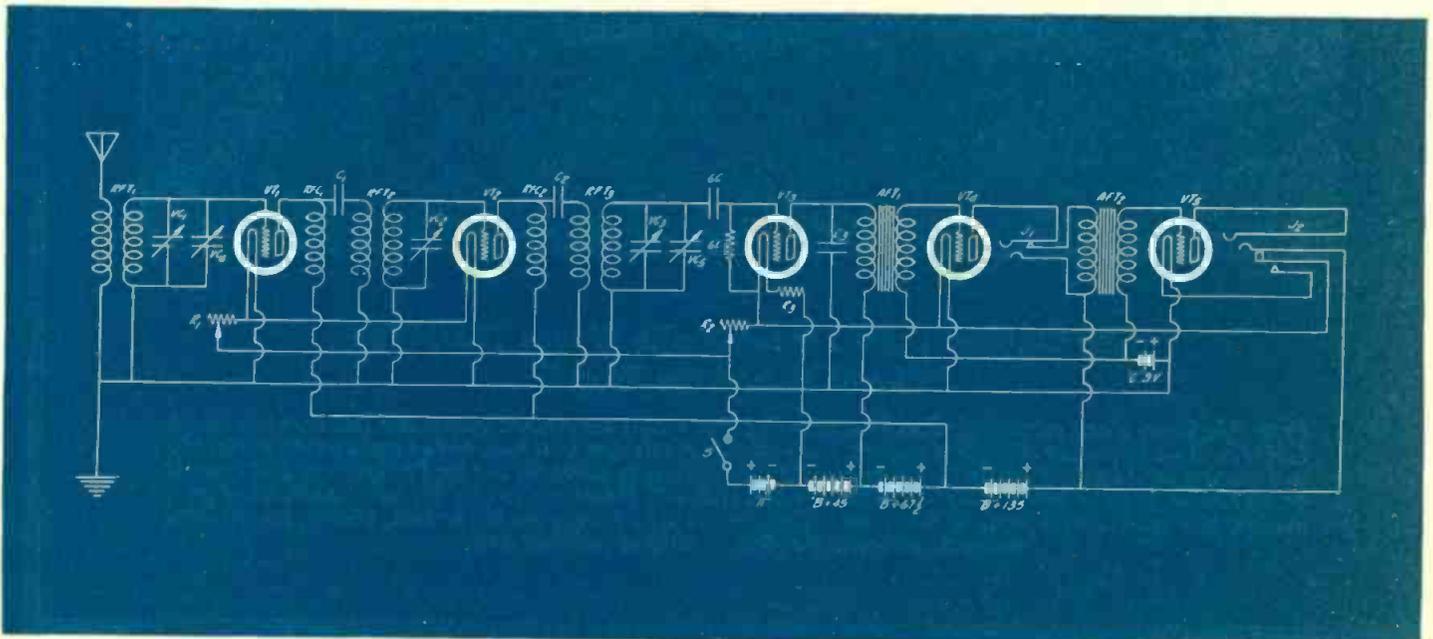
INSTALLMENT NO. 8

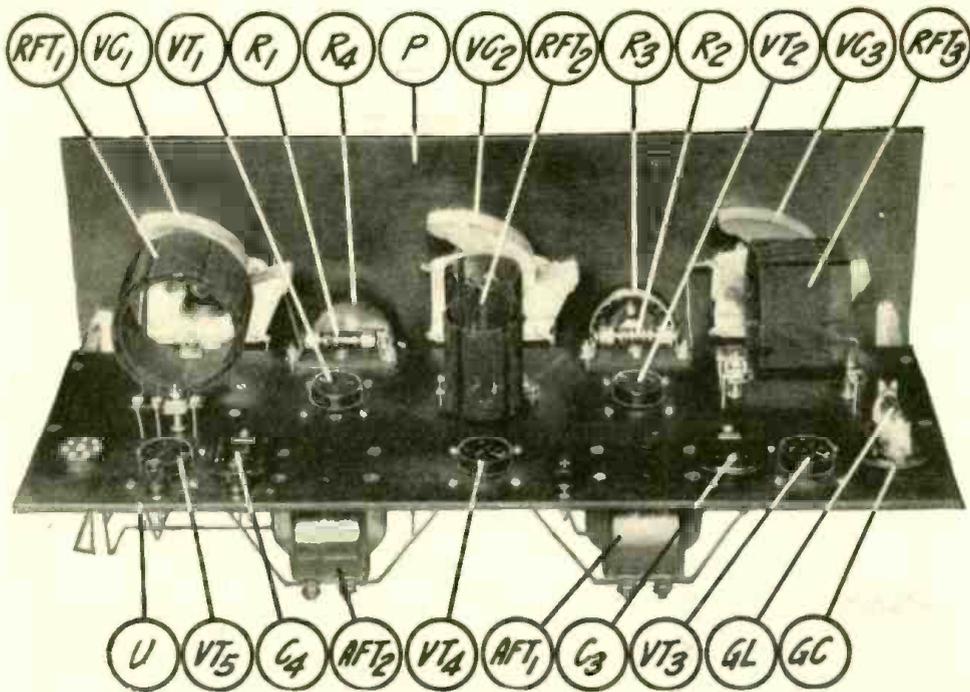
THE PARTS THAT ARE RECOMMENDED FOR USE IN THIS RECEIVER ARE—

- RFT1, RFT2 and RFT3—Ultimax coil set;
- RFC1, RFC2, C1 and C2—Ultimax unit;
- C3—Dubilier Micadon fixed condenser, .002 mfd., No. 601;
- VC1, VC2 and VC3—Pacent triple-gang straight - line - frequency condenser, No. 3251;
- VC4 and VC5—Hammarlund Jr. midget condensers, No. MC5, .000016 mfd.;
- AFT1 and AFT2—Pacent Superaudio-

- formers, No. 27-A;
- VT1, VT2, VT3, VT4 and VT5—Pacent "Universal" cushion sockets, No. 83;
- R1—Pacent rheostat, 6 ohms, No. 95-A;
- R2—Pacent rheostat, 10 ohms, No. 95-B;
- R3—Yaxley resistance unit, 4 ohms, No. 804;
- GC—Dubilier Micadon fixed condenser; .00025 mfd., No. 601;
- GL—Electrad metallic resistor, 2 meg.;
- J1—Pacent single-circuit jack, No. 62;

- J2—Pacent double-circuit jack, No. 65;
 - P—Insuline panel, friezed, 8½ by 16 by 3/16 inches;
 - U—Insuline, sub-panel, 15 by 7 by 3/16 inches;
 - S—Pacent battery switch, No. 16;
 - 2 Benjamin sub-panel brackets;
 - 1 Kurz Kasch vernier dial No. 591;
 - 8 Eby binding posts;
 - 1 Grid-leak mounting.
- COST OF PARTS: \$65.00.**





The Improved "Controllodyne" Circuit

This receiver consists of two stages of high-frequency amplification, a non-regenerative detector, and two stages of low-frequency amplification. Due to the construction and location of the coils employed, interaction is reduced so that the circuits are inherently stable. A high-resistance rheostat in the plate circuit of the first two tubes serves as an oscillation and volume control. Type UX-201-a tubes are used throughout except in the last stage, which utilizes a UX-171 type power tube.

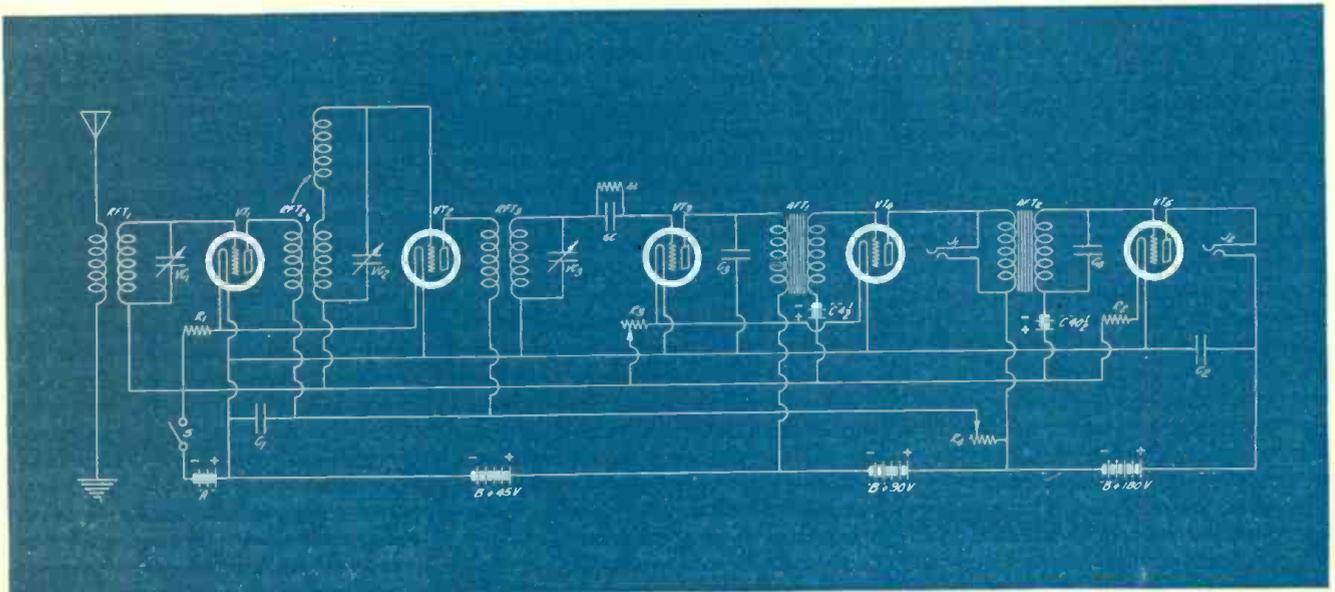
THE PARTS THAT ARE RECOMMENDED FOR USE IN THIS RECEIVER ARE—

- RFT1 and RFT3—Benjamin "Lekeless" tuned - high - frequency transformers, No. 8621;
- RFT2—Benjamin "Lekeless" tuned-high-frequency transformer, No. 9072;
- AFT1—All-American low-frequency transformer, ratio 5 to 1, type R15;
- AFT2—All-American low-frequency transformer, ratio 3 to 1, type R14;
- VT1, VT2, VT3, VT4 and VT5—Benjamin UX-type sockets;
- J1 and J2—Yaxley single-circuit jacks, No. 1;
- VC1, VC2 and VC3—Benjamin straight-

- line-frequency variable condensers, .00035 mfd., No. 9061;
- R1 and R2—Amperites No. 112;
- R3—Yaxley rheostat, 10 ohms, No. 110-K;
- R4—Centralab Radiohm, 200,000 ohms;
- S—Benjamin battery switch, No. 86-40;
- GL—Lynch metallized resistor, 2 meg.;
- GC—Sangamo mica fixed condenser, .00025 mfd., with grid-leak clips;
- C1 and C2—Tobe paper condensers, 1 mfd., No. 708;
- C3—Sangamo mica fixed condenser, .001 mfd.;

- C4—Sangamo mica fixed condenser, .00025 mfd.;
- P—Insuline drilled and engraved front panel, 7 by 21 by 3/16-inch;
- U—Insuline drilled sub-panel 7 by 20 1/4 by 3/10-inch;
- 2 Benjamin shelf-supporting brackets, No. 8629;
- 1 Jones multiplug, type PM;
- 3 Eby binding posts, two marked "C" (-), one marked "C" (+);
- 3 Marco vernier dials, scale zero to 100, No. 192.

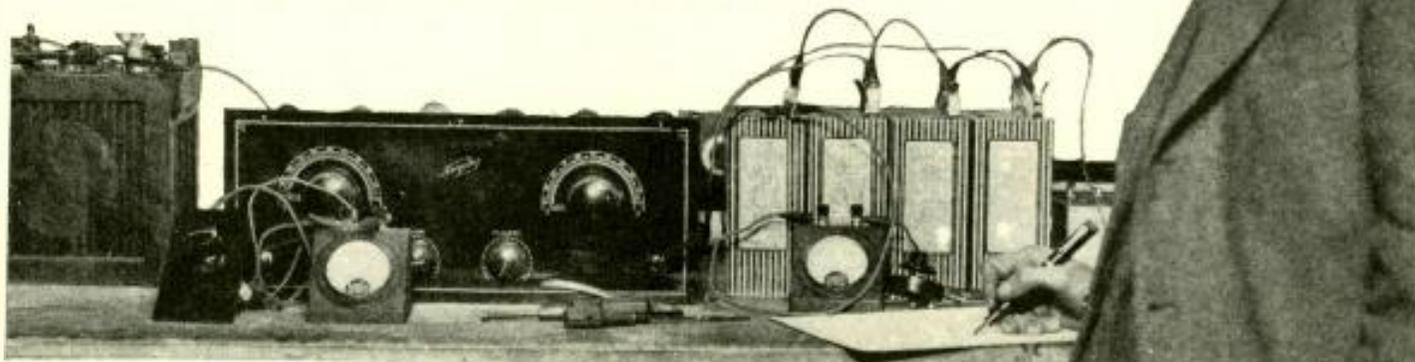
COST OF PARTS: \$66.00.



How to Increase the Range of Ammeters and Voltmeters

Simple ways by which the experimenter may make two meters serve the same purpose as a large and expensive assortment of instruments

By K. B. HUMPHREY



THERE is a growing tendency among radio fans to make use of various electrical measuring instruments in order to gain an idea of what is taking place in a circuit or combination of circuits and networks.

For the fortunate fan whose financial resources are not too limited it is an easy matter to purchase the correct instrument to make any measurement desired; the investment in meters alone may run into considerable figures. But for the majority, with somewhat limited means, one or two good instruments are all that can be afforded at one time. By a judicious choice of instruments however, and a knowledge of how their ranges may be increased or decreased at will, it is possible to make two instruments serve the purpose of several different ranges and thus do away with the necessity of buying a separate instrument for measuring different voltages and currents.

A great many of the measurements to be made in radio circuits are of a comparative nature. That is, the figures on the scale need not register volts, amperes, or milliamperes, but may be simply a reading such as 1.5 or 1.8; the difference in readings in this case then indicates the relative efficiency.

When it is at all possible, tests with standard meters should be made for comparison but for many purposes this is not at all necessary.

Either a voltmeter or an ammeter may be made to take readings far above their

registered scales and with a fair degree of accuracy when combined with the proper resistances. These figures refer especially to direct-current meters, as they have a scale which is for all practical purposes uniform over the entire range for which they are calibrated.

How to Increase the Range of a Voltmeter

A voltmeter measures the voltage drop, or difference in potential, between any two points in a circuit. While there must be a small current flowing in order to get a reading, this current is so small in proportion to the voltage that it may be neglected in most cases, and does not enter into consideration except in a few instances such as the measurement of voltage from some source of supply which is limited (for instance, a "B" eliminator.)

Glancing at Figure 1, it will be noted that a voltmeter should be connected directly across the circuit. This meter has a certain resistance, say, R1.

If, as illustrated, another resistance is placed in series with the resistance R1 (such as R2), the voltage of the line will not be changed in any way, but the voltage as indicated by the meter will be changed. The reading will be lower because instead of measuring the entire voltage across the line, the voltage drop of the resistance of the meter only is measured. We might refer to these two voltage drops as V1 and V2, and the sum of these two would give the amount of voltage across the line V.

The voltage drop is directly in proportion to the resistances, and it may easily be seen that if we make the resistance R1 equal to R2 we have a condition where the meter will register exactly half of the voltage.

If, for instance the meter showed 50 volts when this arrangement was used, it would mean that the total voltage was 100.

This external resistance is known as a multiplier, and is often used where the voltage to be measured exceeds the scale reading of the instrument. Many manufactured instruments are made for which these multipliers are obtained. A reading is taken and the result multiplied by the ratio of the resistances in each case.

While the resistances should be obtained from the manufacturer for the particular instrument in use a pretty fair result may be obtained in a very simple fashion.

Suppose, for example, we wish to measure voltages up to 100 and our voltmeter only registers 50.

Suppose again that we do not know what the resistance of the meter is.

In that case the meter may easily be calibrated by the use of a variable resistance placed in the circuit such as is shown in Figure 2.

To start with, we must have a source of voltage which is within the range of the meter. A battery is provided which gives 40 volts; this is just an arbitrary figure and any voltage at all may be

MARCH, 1927

used though it is usually best to take a voltage which is near the full scale reading of the meter in order to reduce the probable error. This reading is taken without the resistance in the circuit. The resistance is then cut in until the reading of the instrument is reduced to 20 volts or just half of the first reading whatever it might be.

We know now that the voltage has not changed from the source, yet our reading is just half what it was before. Multiplying by 2 gives us the actual voltage as first measured without the resistance.

Without in any way changing the value of the resistance, other voltages may be measured. But we must always remember to multiply the result by two in order to get the correct voltage.

If the voltmeter reading with the resistance set for half-scale deflection was found, in measuring an unknown voltage, to be 35, we would know immediately that the voltage was actually 70, or if it was 42 the voltage would be 84.

In a like manner the resistance may be adjusted until the reading is just one fourth of the total. In this case the multiplier would be 4 and with a reading of 35 the actual voltage would be 140 or in the case of 42 volts, 168.

The extreme range with a 50-volt meter would be 200 with a multiplier of 4. It may easily be seen that a small voltmeter of (say) 50 volts range may easily be used to measure voltages a great deal in excess of the rated scale reading. The better the meter in most cases the higher the resistance. For very expensive meters the resistances required in series would be considerable. The Carter Hi-Ohm variable resistance may be used for this purpose; doubtless there are many others on the market which would serve as well. *Caution:* after the resistance is once set for a certain multiplier, do not change it while readings are being taken.

How to Increase the Range of an Ammeter

An ammeter is built along the same line as a voltmeter but it is of low resistance so that the voltage drop across it is always kept small. This instrument may also be used to measure higher values of current by placing the correct value of resistance in shunt with it as shown in Figure 3.

The current flowing in a given wire is to be measured. Suppose we are using a milliammeter which is capable of registering only 25 mills and we want to measure 50 mills.

With a given voltage and some resistance in series with the circuit, so that the meter will not be burned out, a reading is taken with the milliammeter. The shunt resistance is then placed at

such a value that the reading is halved. That is if the reading were to be 20 mills the resistance should be adjusted until the reading is reduced to exactly 10 mills.

It might be noticed and viewed with alarm by some that the resistance of the circuit is being changed by the introduction of this resistance in shunt with the meter. However, it must be remembered that the reduction in the resistance of the circuit is small in proportion to the total resistance of the circuit and should not make enough error to disqualify the results except in the case of extremely fine precision measurements. In reducing the current through the meter by half the other half is going around the meter *via* the shunt resistance and now currents of twice the strength may be measured by simply multiplying the reading by two.

In a like manner other multipliers may be found, though as a rule the higher the multiplier used the more likelihood there is of errors being introduced into the measurement.

(It might be well to state here that meters of the more expensive type are manufactured which have a large number of different shunts to go with them by means of which extremely accurate results may be obtained).

Another way of calibrating the low-

reading meter is to place a higher reading instrument in the same circuit, as shown in Figure 3, and then calibrating directly. This involves the borrowing of another meter or the purchase of one, and for most practical purposes is not at all necessary. The resistance to be used in shunt may be of the ordinary low-resistance type of rheostat used in a receiving set. For a milliammeter shunt an ordinary 5-ohm rheostat serves the purpose while a lower resistance should be used where an ammeter of higher reading is to be employed in this manner.

Care should be taken that the resistance used is of sufficient capacity so that no heating will result; otherwise the resistance of the rheostat may vary slightly with each change in temperature and the results thrown off accordingly.

Thus it may be seen that the experimenter who is limited to a small number of instruments may still do a great deal with only two low-reading instruments when they are properly hooked up with suitable resistance. In fact, it is possible to get a number of desirable combinations that may help any fan or experimenter to conclude experiments which at first glance might seem entirely beyond the range of the instruments on hand.

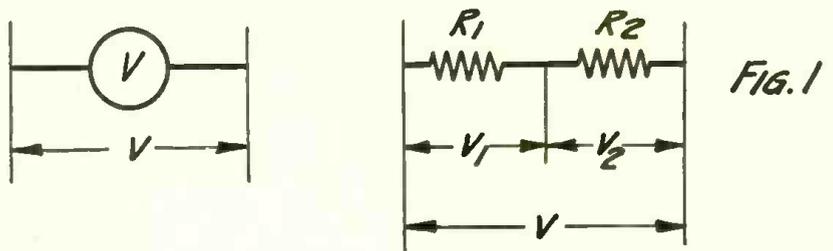


FIG. 1

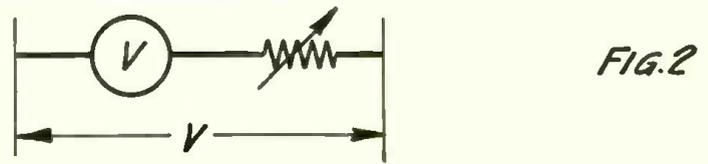


FIG. 2

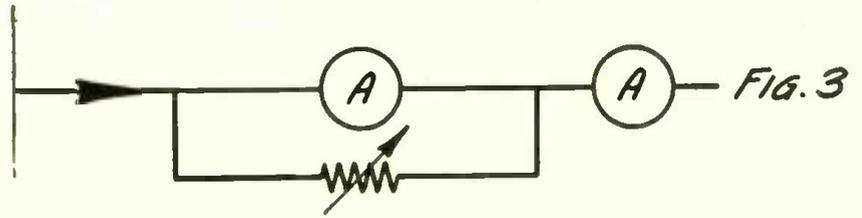
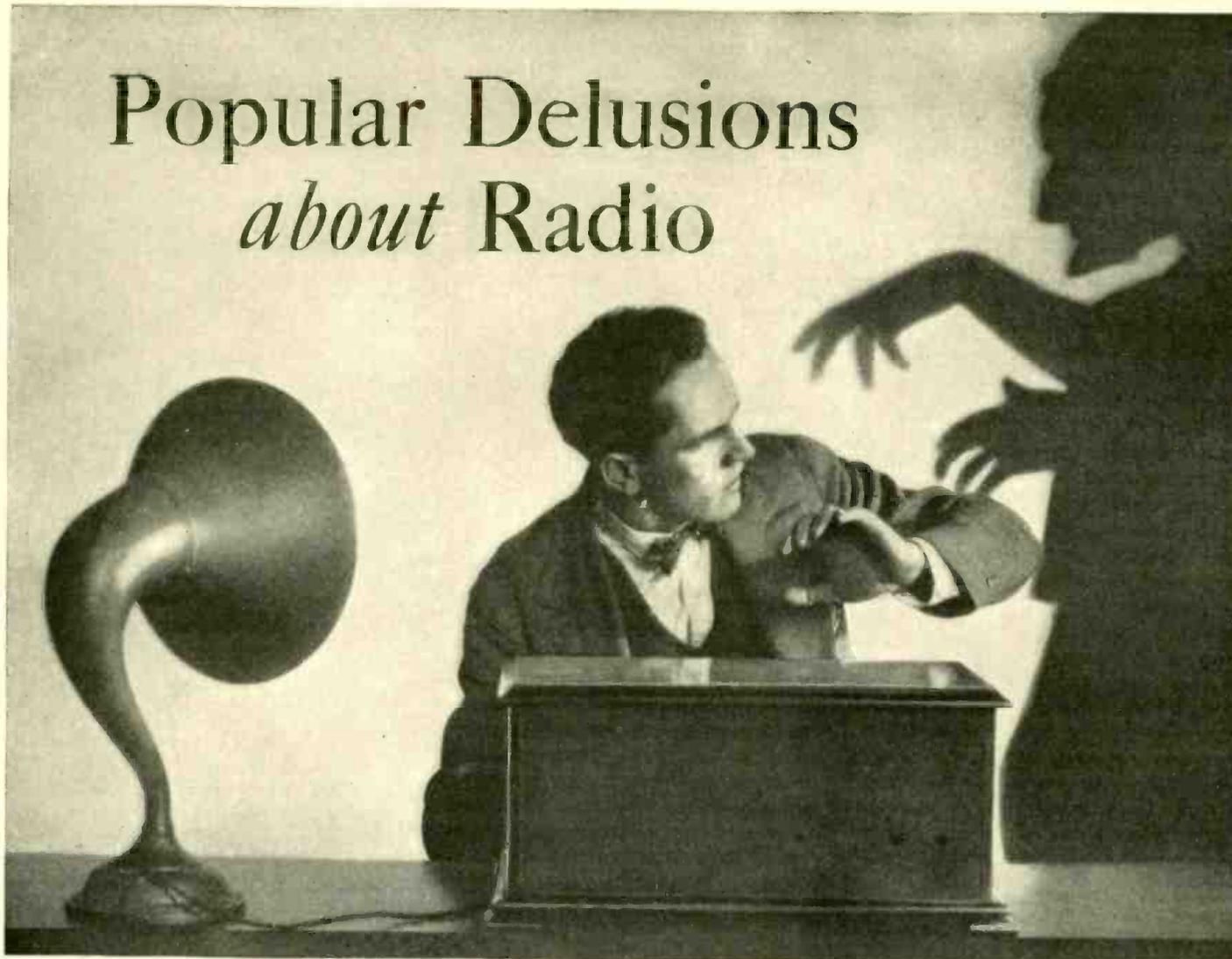


FIG. 3

HOW METER RANGES MAY BE INCREASED

Figure 1 (top left) shows a voltmeter connected across an electrical circuit to measure the voltage, *V*, across that circuit and (top right) two resistances in series across a similar circuit with the voltage divided equally between the two resistances. In Figure 2 a voltmeter has been substituted for one of the resistances; the voltmeter is now capable of measuring double the voltage that its scale indicates. Figure 3 shows an ammeter with a resistance shunted across it to obtain higher readings; it may be calibrated by means of a second ammeter in series with the first ammeter and its resistance.

Popular Delusions *about* Radio



By CHARLES MAGEE ADAMS

MOST of us have been assured since childhood that if we touch a toad we will get warts. We have been told that "lightning never strikes twice in the same place," we have been warned that the combination of fish and milk is poison, and that when a swimmer has gone down for the third time his case is hopeless. Most of us have since learned that these statements are popular delusions—misstatements which have been repeated so long they have come to have almost the weight and authority of truth.

So perhaps it is only natural to find that radio is encrusted with a good collection of such delusions also.

Even experienced engineers have fallen victims to some of these misconceptions. It is to be expected that when the layman is regaled with one or more of these various delusions, he is not in a position to challenge its accuracy. Often, no particular damage results, either to him or his equipment, but there is frequently a considerable loss of time and sometimes valuable apparatus is discarded or ruined.

It is the purpose of this article to

point out some of the commonest of these popular delusions.

The delusion most frequently encountered has to do with reception conditions. And chief among these is the delusion that distance reception is possible only late at night.

I have frequently tuned in KGO, the powerful California station, at nine o'clock in the evening, from my home in Milford, Ohio. Other listeners have doubtless had similar experiences. Distance reception is apparently better late at night only on account of certain contributing causes.

For eastern listeners, one of these is the difference in time.

Obviously it is impossible to tune in a station when it is not on the air, and most of the Pacific-coast transmitters do not get into action till late in the evening because of the three-hour difference in time.

Further, nearby stations that operate on wavelengths which interfere with distant broadcasters are usually off the air late in the evening, and local interference is generally at a minimum. This interference includes noises caused by

electrical appliances and street cars, and such distractions about the home as talking. The absence of house-noises alone often makes it possible to bring in a far-away station that might have been considered inaudible earlier in the evening.

It should not require an expert to prove the fallacy that atmospheric conditions are better simply because the hour is late. Everyone has had the experience of getting good distance at dusk, only to discover that this has shrunk materially at eleven o'clock. The chief physical condition necessary for distance-reception is darkness along the entire path the signal is to travel—and even this theory has been seriously threatened by some remarkable daylight records.

So if you have been sitting up late because someone told you there is a magic quality in midnight air that makes distance reception better, simply go to bed and forget it. Provided the conditions mentioned are right, you can be sure of getting as much "distance" early in the evening, as the fellow who stays up till the wee small night hours.

Another widespread delusion about reception conditions is that the greater the amount of static, the less the signal strength, and *vice versa*.

There is just enough truth in this to make it seem entirely true.

In many cases signal strength *does* decrease as static increases, and it *does* increase as static decreases. But far from always, and not as the only cause or effect. Last night, for example, "the old man of the ether" was venting his wrath in explosive bursts like machine-gun fire; yet a dozen out-of-town stations came hammering in even more energetically than the static; three nights before, with the air practically silent, these same stations had been mere whispers, when they came through at all.

The truth is that static is only one of several atmospheric forces that affect reception; while it may be unfavorable to reception these other forces may be favorable too—or *vice versa*. So no rule that will hold can be laid down regarding static as compared with signal strength.

The same is true of the often repeated assertion that "the colder the night the better the reception." This delusion is, of course, based on the fact that distance reception is better during winter than summer. But, as anyone familiar with radio should know, it does not follow that, once winter has set in, reception improves as the thermometer falls. Just recently a friend, testing a home-made receiver on a night so warm that it should have rated 2 percent for radio according to the temperature rule, tuned in a tiny 10-watt station 900 miles away!

The familiar generalization that clear nights are best for radio, too, fares no better when put to the test. Every

listener must have noticed that rainy nights, apparently hopeless for reception, have often turned out to be excellent. In my own case the supreme thrill of getting California for the first time came on a night when the air was full of a sticky snow.

We know so little about the effect that weather and atmospheric conditions have on radio that nothing like a hard and fast rule can be laid down.

Most conspicuous among another class of radio delusions are those concerning the "radiating" or "re-broadcasting" receivers.

"Yes, I've only got a crystal outfit, but I get good distance. One of the neighbors has a big tube set, and he re-broadcasts the out-of-town stuff for me," summarizes a familiar form of this delusion.

What is meant, of course, is that the neighbor has a regenerative receiver that oscillates, radiating exactly as if it were a small transmitter. But in spite of the popular assumption, *it is impossible for a set of this type to re-broadcast any program it is receiving*, because the oscillations that it would radiate would be out of phase with the original signals. Accordingly; instead of making reception in the neighborhood better, this type of set makes it considerably worse with its whines and whistles.

The explanation of results attained with crystal receivers, like those referred to, is simply that the out-of-town stations happen to be coming in with such volume that even crystal sets can pick them up.

"Of course he gets better results than I do; he has an eight-tube set, and mine's only a five." How many times has a statement of this sort been made—and accepted?

This too contains just enough truth

to be dangerous. Given equal excellence of design, construction, installation and operation, the number of vacuum valves in a receiver offers an approximate indication of its efficiency; but *only if these other items are equal*.

It has been demonstrated, for example, that a well-designed, well-constructed five-valve set, properly installed and in the hands of a skillful operator, can show all-around results superior to those secured by a poorly designed, cheaply-constructed eight-tube receiver, in an unfavorable location and clumsily handled.

So instead of judging a set by the number of tubes, try to estimate its value on the basis of how well it makes use of its tubes. No intelligent buyer attempts to rate a car merely according to how many cylinders it has; and giving the number of valves in a radio set the same importance can easily be as untrue.

Another group of generally accepted radio delusions has grown up about the installation of receivers. As an instance, a man of my acquaintance risked his neck to fasten his antenna to a hundred-foot smokestack, because he had been told the higher it was, the better his results.

It is true that an antenna should be high enough to clear surrounding objects, particularly metallic structures likely to absorb signal power. But under normal conditions, especially outside closely built cities, 30 or 40 feet is ample. And even this height is not always essential.

The results attained by the man just referred to were little, if any, better than those with antennas 25 and 30 feet high; the efficiency of antennas as low as 15 feet has often proved so good

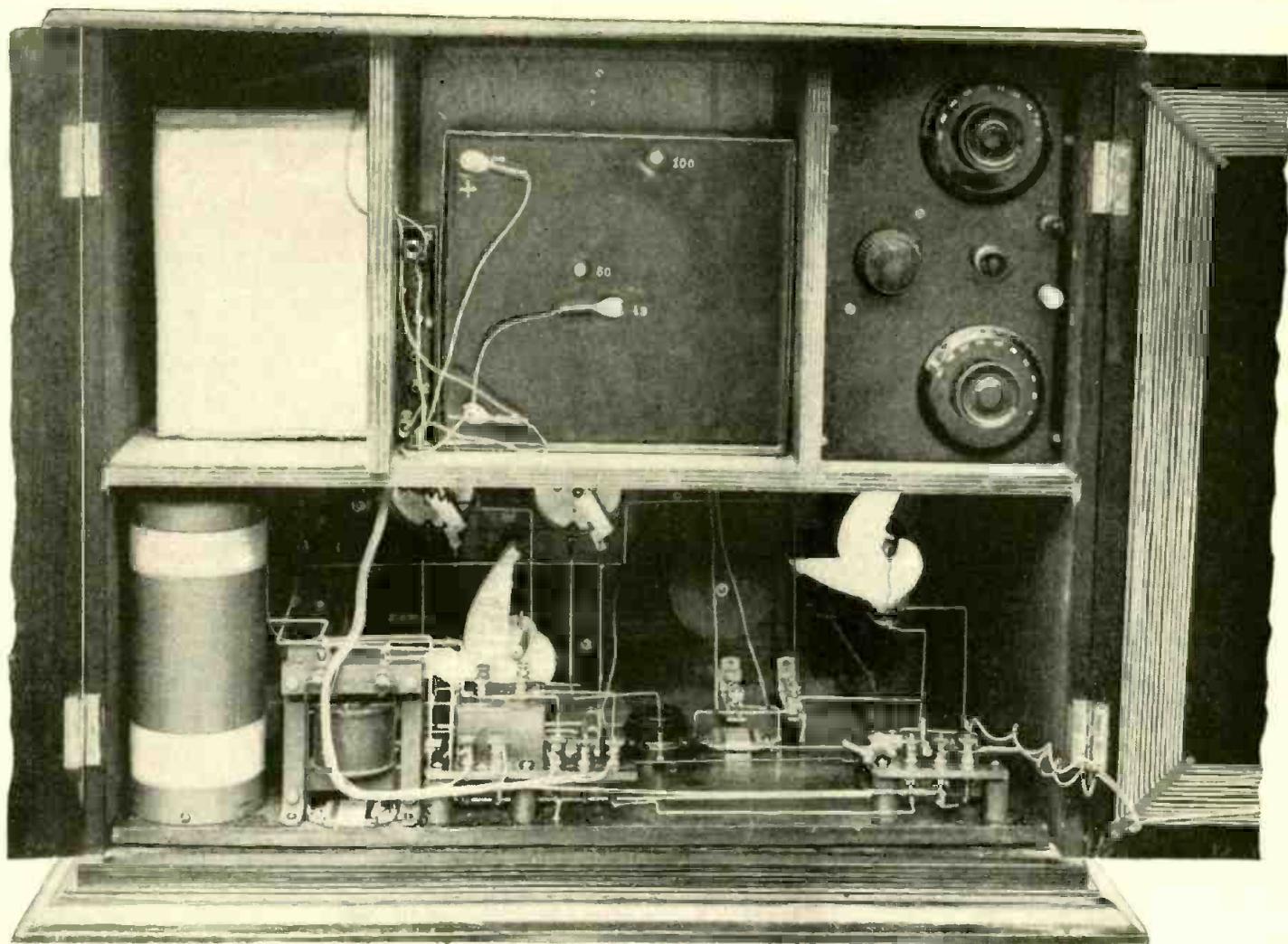
(Continued on page 280)

Eight Common Fallacies

1. *That long-distance reception is possible only at night—*
2. *That the greater the static is, the less is the signal strength—and vice-versa—*
3. *That the colder the night is, the better is the reception—*
4. *That a regenerative receiver can "re-broadcast" a program—*
5. *That a receiver with six or eight tubes must necessarily get better results than a set with four or five tubes—*
6. *That a long or a high antenna is more efficient than a short or a low one.*
7. *That better reception is attained by the burning of filaments of vacuum tubes to the limit—*

AND—

8. *That distant programs are better than local programs.*



A REAR VIEW OF THE INVENTOR'S OWN MODEL

The layout of this set is typical of British set construction in which the receiver proper is located in the lower part of the cabinet with the batteries and auxiliary devices in separate compartments. The loop is suspended on a hinged door with flexible leads taken off for connections; this is shown at the extreme right.

The Unique "Retrosomic" Receiver

The tremendous amplification obtained by means of the novel circuit in this new three-tube receiver which has excited the radio fans in England is mysterious to the inventor himself—for even he is not sure of the actual theory of operation. Read this article and see if you can explain how this receiver works.

By A. DINSDALE

FROM time to time radio experimenters achieve astonishing results by the use of unconventional circuits, which, according to all generally accepted theories, should not work at all. But they do work—and that fact frequently impells people to exclaim about the discrepancies between theory and practice.

Theory, of course, is generally in advance of practice, but occasionally practice catches up and something is demonstrated for which there is no ready-made theoretical explanation.

The Retrosomic receiver is a case in point.

Much has been heard of this receiver recently in England, and it was shown at the annual radio exhibition this year at Olympia; but no details have hitherto been available. Now, however, with the publication of the patent specification* covering the principles involved, it becomes possible to describe the circuit in detail.

The Retrosomic receiver is the product of Mr. H. W. Roberts, an amateur

*British Patent No. 256,998.

radio experimenter of Sheffield, England. The chief claim made for the circuit is an unusual range combined with an unusually high degree of selectivity. Only three tubes are employed; no reflexing, as generally understood, is used yet the results obtainable compare favorably with those given by a super-heterodyne.

Unusual Features of the Retrosomic Receiver Circuit

The circuit of the Retrosomic receiver is shown in schematic form, in Figure 1.

From this circuit it will be seen that, so far as selectivity is concerned, the characteristic feature is the tuned loop circuit, 9 and 10, which appears in the center of the circuit diagram. At first glance this seems to be an ordinary rejector or trap circuit, or tuned plate coupling. It may be all of these; but there is some peculiar characteristic attached to it which the inventor himself cannot adequately explain; and it is this characteristic which gives the set its extraordinary selectivity, a degree of selectivity much greater than that usually obtained with a similar form of trap circuit in an ordinary receiver.

The second feature that calls for comment is the fact that although the circuit is not reflexed, in the ordinary sense of the term, some form of feed-back undoubtedly takes place between adjacent tube circuits which is not of the ordinary kind.

Another interesting point is that the second tube appears to function without any direct application of "B" power voltage to the plate.

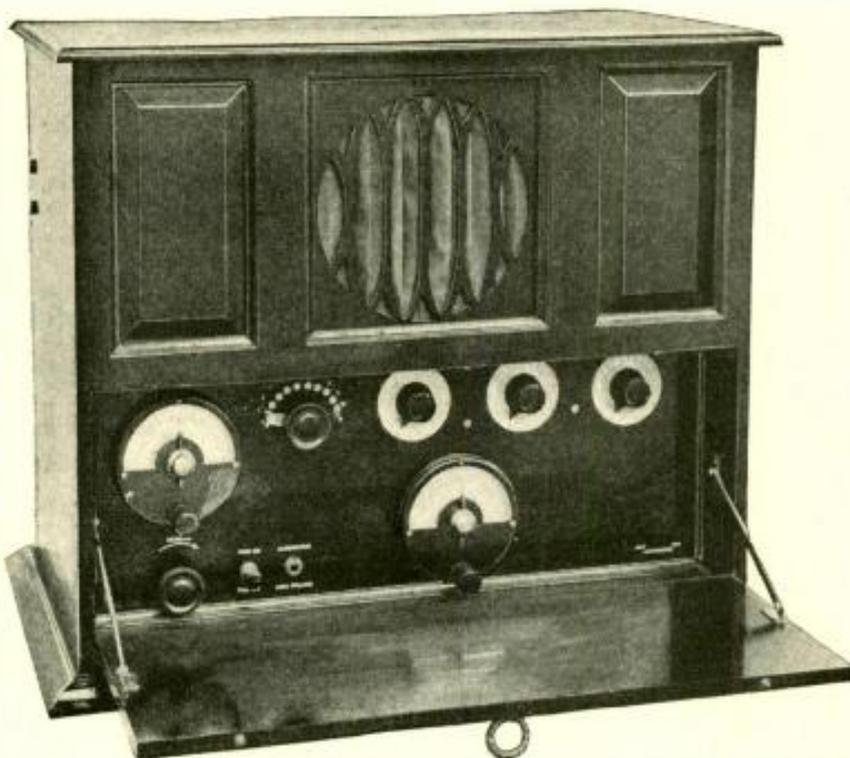
It is apparent also that the "B" power is short-circuited through the windings of the loudspeaker or telephones and the primary winding of the low-frequency transformer, 15. This, however, is not of very great moment, for the combined resistance of the phones and transformer winding is extremely high.

Finally, the most extraordinary feature of all is that there appears to be no detector! It is certain that the last tube is a low-frequency amplifier, yet there is a species of high-frequency coupling between it and the tuned loop circuit, 9 and 10.

Tracing Signal Impulses Through the Circuit

In an effort to understand the operation of the circuit, let us trace the progress of signal impulses through it.

Commencing at the antenna, it will be seen that the tapped inductance, 5,



A FRONT VIEW OF THE RECEIVER

The arrangement of the tuning dials and auxiliary controls of the receiver itself are shown here. Notice that the cabinet contains a loudspeaker behind a gridded lattice-work in the center compartment

conveys the incoming impulses directly on to the grid of the first tube through a biasing battery, 8. Considering the first tube as a high-frequency amplifier only, amplified high-frequency currents will flow through the tickler coil, 12, which is in the plate circuit of the tube.

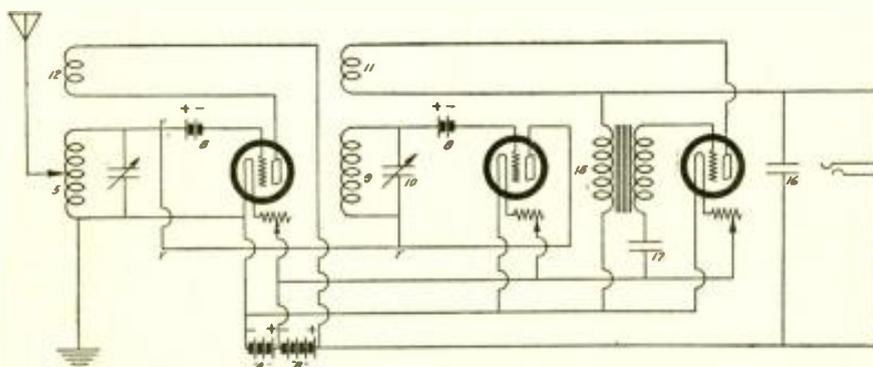
At the same time a part of the antenna energy, reinforced by regeneration from the tickler coil, 12, will find its way from the grid coil, 5, to the tuned loop circuit, 9 and 10, via the single direct lead, YY, and the loop circuit will thus be impulsed as well.

In other words, the single point connection through the lead, YY, from the grid of the first tube to the loop circuit,

9 and 10, conveys voltage impulses which build up, by resonance effect, into an oscillatory current of considerable magnitude inside the loop circuit, provided the latter is exactly tuned to the frequency of the incoming signal.

Thus, large voltages will accordingly be induced across the coil, 9, which are then applied across the grid and plate of the second tube. Correspondingly amplified currents may therefore be expected to flow in the plate circuit of that tube. It will be noticed that the grid of the second tube is also biased. This is done to neutralize any possible tendency for a positive potential to be impressed upon the grid by virtue of the biasing battery of the first tube, for there is a circuit between the positive terminal of the first grid-bias battery and the grid of the second tube.

Coupled to the coil, 9, is another coil, 11, which is in the plate circuit of the third tube. A form of high-frequency coupling results, so that impulses circulating around the tuned loop circuit induce similar currents in the coil, 11. These currents, flowing through the primary of the low-frequency amplifying transformer, 15, produce similar currents in the secondary winding, which are then impressed upon the grid of the third tube. The plate of this tube, it will be observed, is provided with a high-frequency path through the loudspeaker shunting the condenser, 16, and the tickler coil, 12, back to the plate



THE SCHEMATIC DIAGRAM OF THE CIRCUIT

FIGURE 1: In this set, the second tube is not supplied with any direct potential but is connected back to the grid circuit of the first tube for its source of power. The first tube seems to act as in a straight regenerative circuit. The plate circuit of the last tube is coupled to the grid circuit of the second tube, which has, at the same time, a tuned input circuit.

of the first tube, as shown in Figure 1.

For many years it has been known that thermionic tubes, no matter whether used for high-frequency or low-frequency amplification, have a tendency at the same time to rectify or detect signals to a certain extent, and particularly so when they are overloaded. On account of this fact it has been suggested that, in the case of certain multi-tube sets, signals are already half detected before the detector is reached, and the condition, spread over the entire circuit, is known as cumulative rectification.

There is no detector provided for in the Retrosonic circuit, as the reader may see from the circuit diagram, yet signals are detected or rectified on this receiver.

Such high-frequency impulses as are applied directly to the grid of the first

tube are rectified owing to the presence of the grid-bias battery, 8, what is known in England as "anode bend" rectification being the result. In this method of rectification, which does away with the conventional grid-condenser and grid-leak (which introduce damping and thus cause distortion and lack of selectivity), the grid of the tube is negatively biased so that it operates at the lower bend of its characteristic curve. Positive half cycles then carry the grid potential up the curve, while negative impulses are cut off altogether, thus effecting rectification.

Partial rectification occurs again at the second tube, where any high-frequency impulses reaching the grid will be rectified for the same reason as in the case of the first tube—because of the grid-bias battery.

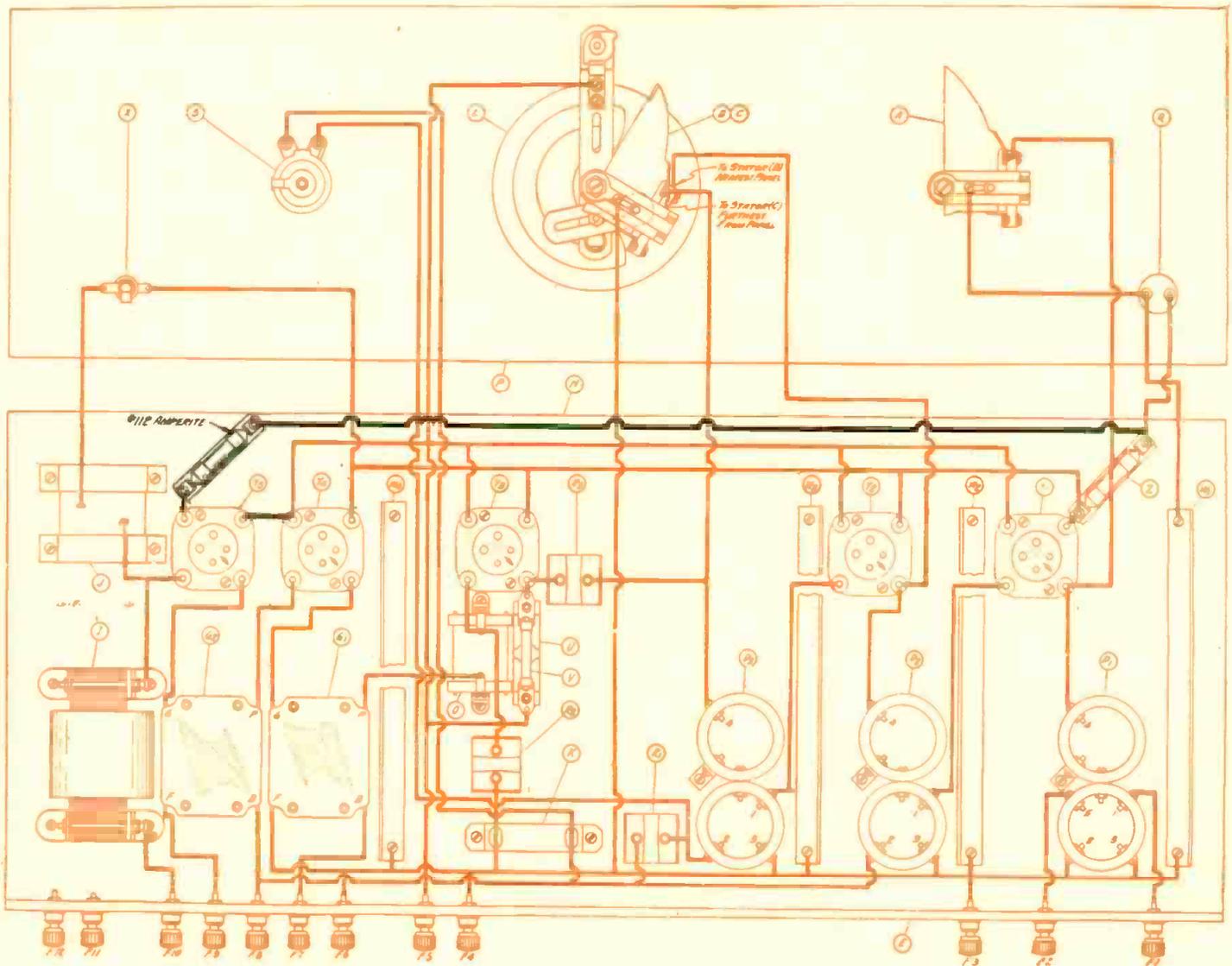
Finally, a blocking condenser isolates

the grid of the last tube, which again tends to cause partial rectification. Signal impulses therefore appear to gradually rectify themselves as they progress through the set.

That being so, we must revise our description of the progress through the set of received impulses, for the process is now complicated by the introduction of low-frequency currents into circuits which before we only considered as carrying high-frequency currents.

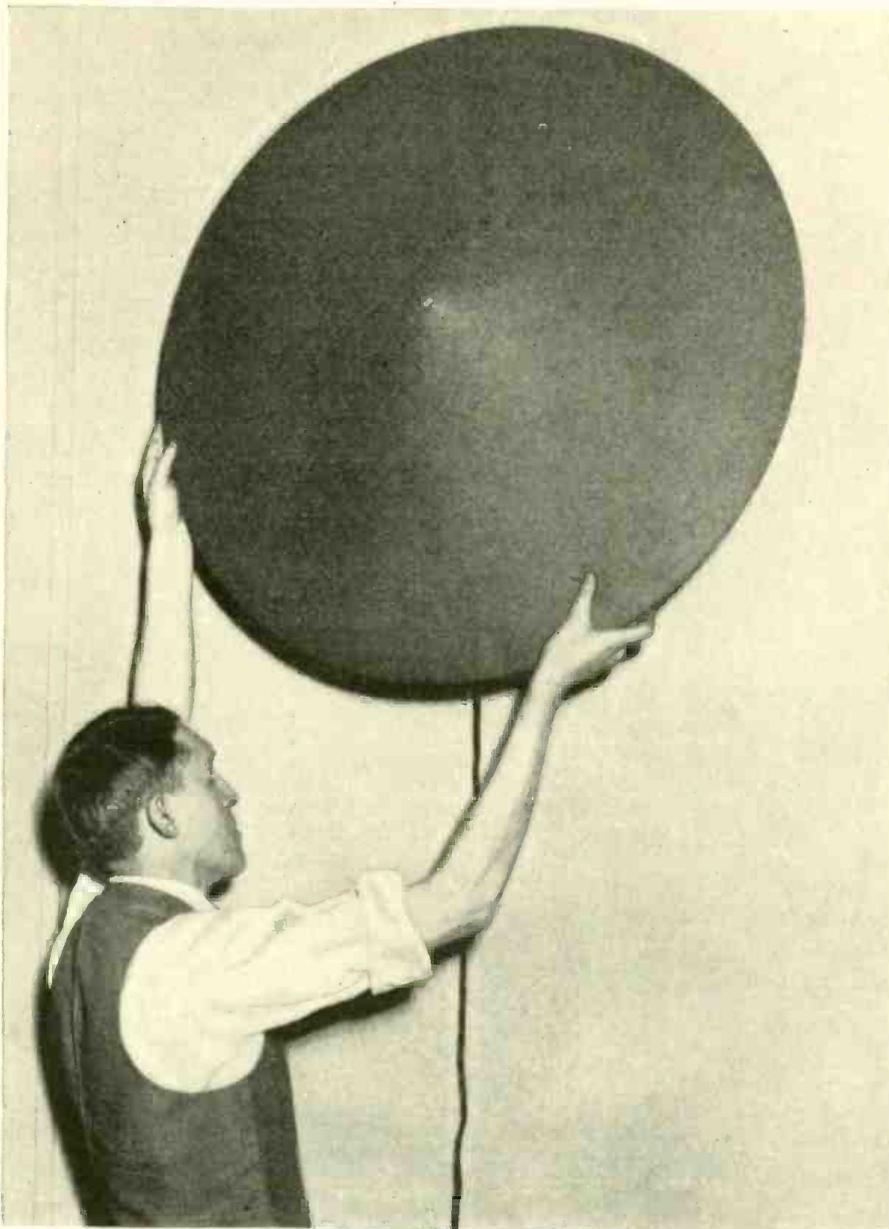
Thus, rectified or low-frequency impulses from the output of the first tube will flow through the tickler coil, 12, and because this is coupled to the coil 5, are partially transferred to the coil, 5, giving rise to a species of low-frequency regeneration between the grid and plate circuits of that tube.

Also, some of the low-frequency cur-
(Continued on page 232)



How to Adapt the LC-27 Receiver for Use with UX-171 or UX-112 Type Tubes

The diagram in red shows the original connections for the LC-27 receiver except that the filament circuit of the last tube has been omitted. The heavy black lines show the connections for the 1/2-ampere automatic filament control that should be added when the set is to be used with the UX-171 or the UX-112 type power tube in the last stage of low-frequency amplification.



From a photograph made for POPULAR RADIO

THE FINISHED PRODUCT

*After the loudspeaker has been built and the unit adjusted, it should be hung high on the wall—
or from the ceiling—out of harm's way, by means of the small hook on the back.*

HOW TO BUILD YOUR OWN 36-INCH
CONE LOUDSPEAKER

By LAURENCE M. COCKADAY

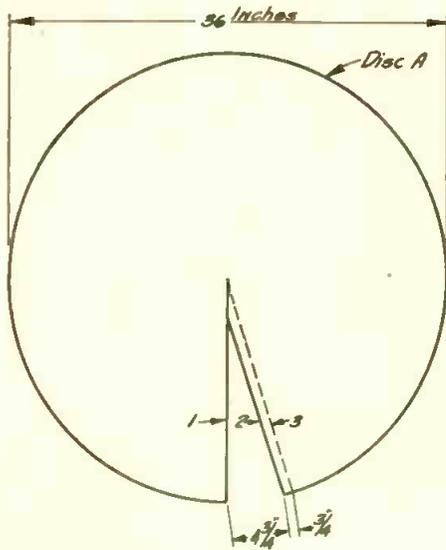
THE PARTS REQUIRED FOR BUILDING THE CONE REPRODUCER—

- | | |
|---|--|
| A and B—one package of Fon-O-Tex paper for the discs, A and B; | E—one Penn reproducer unit, equipped with three mounting brackets, bolts, nuts, washers and other accessories; |
| C and D—two back rings, stamped and drilled ready for mounting; | F—one can of special Ambroid cement. |

UP to the present time the experimentally inclined radio fan would have had little success in trying to build a reproducer of the cone type—because he has had neither the proper design for laying out the paper cone nor the facilities for mounting a reproducer

unit within the apex of the cone itself. Although there have been several efficient reproducer units on the market, few of them have been easy to mount on a cone. Furthermore, they have not been equipped with a suitable “pin” for attaching to the cone apex itself.

By coordinating the efforts of manufacturers of the proper kind of parchment paper and the manufacturers of reproducer units especially made for use in cone reproducers, as well as of manufacturers of smaller accessories in building the cone reproducer, the



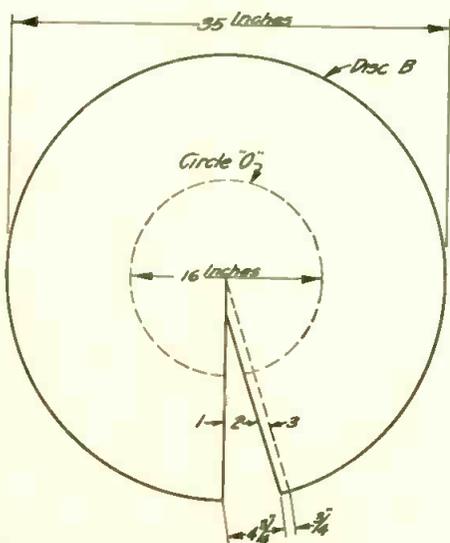
HOW TO MAKE DISC A

FIGURE 1: The front disc of the cone should be cut out exactly as shown above. First cut out the circular piece with a diameter of 36 inches; then cut out the segment that lies between the heavy lines, 1 and 2. To form the cone, line 1 is then cemented directly over line 3.

POPULAR RADIO LABORATORY has at last made it possible for the experimenter to make a good cone, that will reproduce the low tones with great volume and fullness, and that may be built by any one.

Only four tools are necessary; (1) a pair of scissors, (2) a small paint brush, (3) a screw driver and (4) a ruler.

After the parts listed at the head of this article have been procured, the fan should prepare the paper cutouts for the front and back of the cone, as illustrated in Figures 1, 2, 5 and 6. The kind of paper used for this purpose comes in sheets 38 inches square. Two



HOW TO MAKE DISC B

FIGURE 2: The back disc of the cone should be made in the same manner as disc A; the disc, however, has only a 35-inch diameter. The circle, O, should be marked before the cone is formed; but it should not be cut out until after line 1 has been firmly cemented over line 3.

of these sheets are required for cutting the circular discs, A and B, in the making of the cone.

How to Make the Disc A

First, lay one of the sheets of paper flat on a large table and with a long ruler determine the exact center by drawing two lines crisscross from one corner to the opposite corner.

Then draw a circle, using the center already laid out, exactly 18 inches in radius, thus making a disc 36 inches in diameter (see Figure 1). Cut out the disc with a sharp knife or razor blade or with a pair of sharp scissors, making an even and clean cut as shown in Figure 5.

Next, prepare the slit as shown in Figure 1.

Examine the surface of the paper and you will notice some streaks, rather darker in color than the rest of the surface, running in one direction. Be sure that the slit is laid out in pencil in the direction in which the streaks run. Then draw the first line of the slit, No. 1, from the periphery of the disc to the center and then measure a point $4\frac{3}{4}$ inches from this slit along the circumference and make a mark at this point.

Then measure further, $\frac{3}{4}$ of an inch, and draw a line, No. 3, from this point on the periphery to the center.

Next, draw another line, No. 2, running parallel with line No. 3, until it hits line, No. 1; then cut along line No. 1 and cut out the portion of the radius that lies between lines No. 2 and No. 1 with a single straight cut along line No. 2 (see Figure 1).

Then punch a $\frac{1}{8}$ -inch hole exactly in the center of the disc. When this is done cement the edges of the slit together so that line No. 1 covers line No. 3. This should be done with Ambroid cement. (See Figure 6.)

Next, remove the nose piece from the reproducing unit, E, and cement the large brass disc to the inside of the apex of the cone, A, exactly centered over the hole. Cement the smaller brass disc in the same way over the outside of the apex of the cone.

The front cone, A, is ready and you are now ready to prepare disc B.

How to Make Disc B

Prepare the second disc, B, in a similar manner to disc A, following the instructions given in Figure 2; but do not cut out the center portion shown by the dotted circle, O, until the slit made by lines No. 1, 2 and 3 have been cut and cemented firmly together. Then cut out the dotted line, O, with a sharp-pointed pair of scissors. This leaves an outside rim of a general cone shape. The 16 inch circular disc that is left in the center is not used.

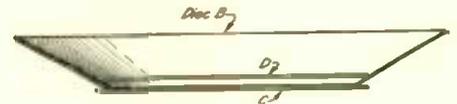
How to Mount the Back Rings, C and D, on Cone B

Place the back ring, C, on the floor or on a large level table where there is plenty of room to work. Cement the top surface of this ring, C, with the Ambroid cement and place the disk, B, quickly on top of it, being careful that it is centered properly. Press down around the inner edge and set weights around the inside edge of the cone disc, B, until the cement has dried properly, and the back ring, C, and the disc, B, are firmly held together.

After the cement has hardened, cement the second ring, D, to the inside of the cone, making sure that the edges and the four round holes meet exactly. See Figures 3 and 7 for this operation.

How to Fasten the Two Discs A and B Together

First, we will have to prepare a support for the large cone to set in with its apex facing downward, as shown in Figure 4. Take an old hat box or other



HOW THE BACK RINGS ARE INSERTED

FIGURE 3: The back rings, C and D, are cemented firmly to outer and inner surfaces respectively of the disc, B. Be sure that each ring is centered properly before it is cemented.

cardboard box and cut a circle about a foot in diameter at one side, setting the apex of the cone, A, into the opening, so that the periphery is permanently level in a horizontal plane.

Then set the cone, B, into the cone, A, being sure that it is in an even position, with the edge of cone A projecting beyond the edge of cone B at equal distances all the way around. (See Figure 4).

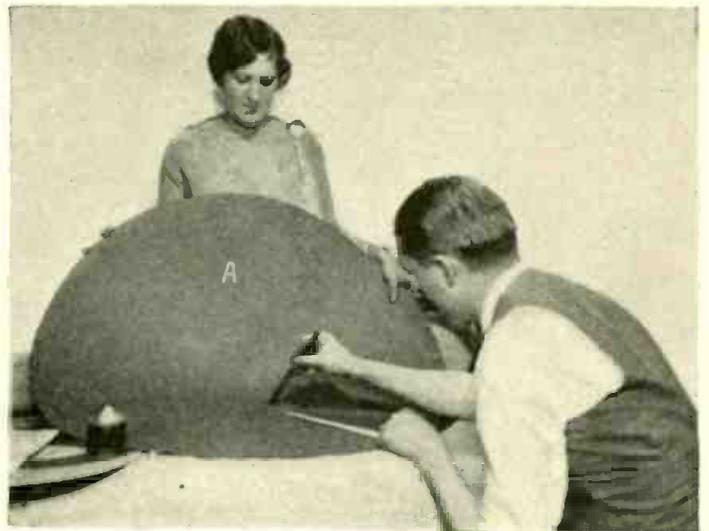
Then pour the Ambroid cement all around the edge of the smaller cone where it touches the larger cone, A, being sure that all points are covered in a neat manner. (See Figure 8.) When the cement hardens, the two cones, A and B, will be fastened together solidly.

The next job will be to fasten the unit, E, by inserting it inside one of the openings in the back ring, and fastening with the bolts that are supplied, to the three extension pieces or brackets. (See Figure 9). The brackets will first have to be fastened in position, of course, in the three holes in the back rings, C and D. When the unit has been mounted screw in the threaded brass nose-piece into the unit, E, as shown in Figure 10. Then, pull the reproducer cord through the small hole in the center of the back rings, C and D.

(Continued on page 281)



5 After the cone paper has been marked in pencil, as shown in Figures 1 and 2, the two discs, A and B, should be cut out carefully with a sharp pair of scissors, and the segment cut out between lines 1 and 2 (of the diagrams).



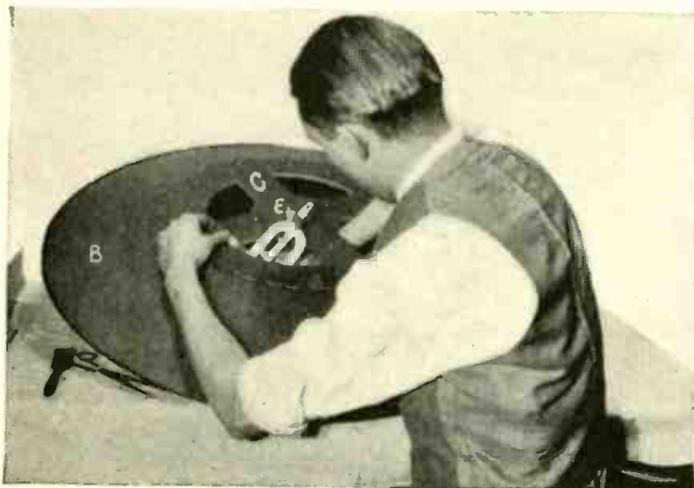
6 The next operation is to form the cone by cementing together the edges on either side of the cut-out segment. The cement should be applied with a small paint brush and the two edges of the disc pressed tightly together.



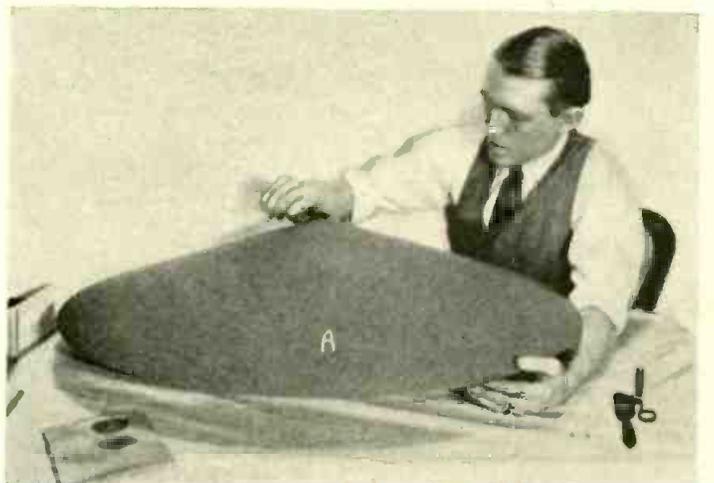
7 After the circle, O, in cone B has been cut out, the two back rings, C and D, should be carefully centered over the hole that is left and cemented to either side of the disc. Two or three heavy books should then be laid on ring D until the cement has hardened.



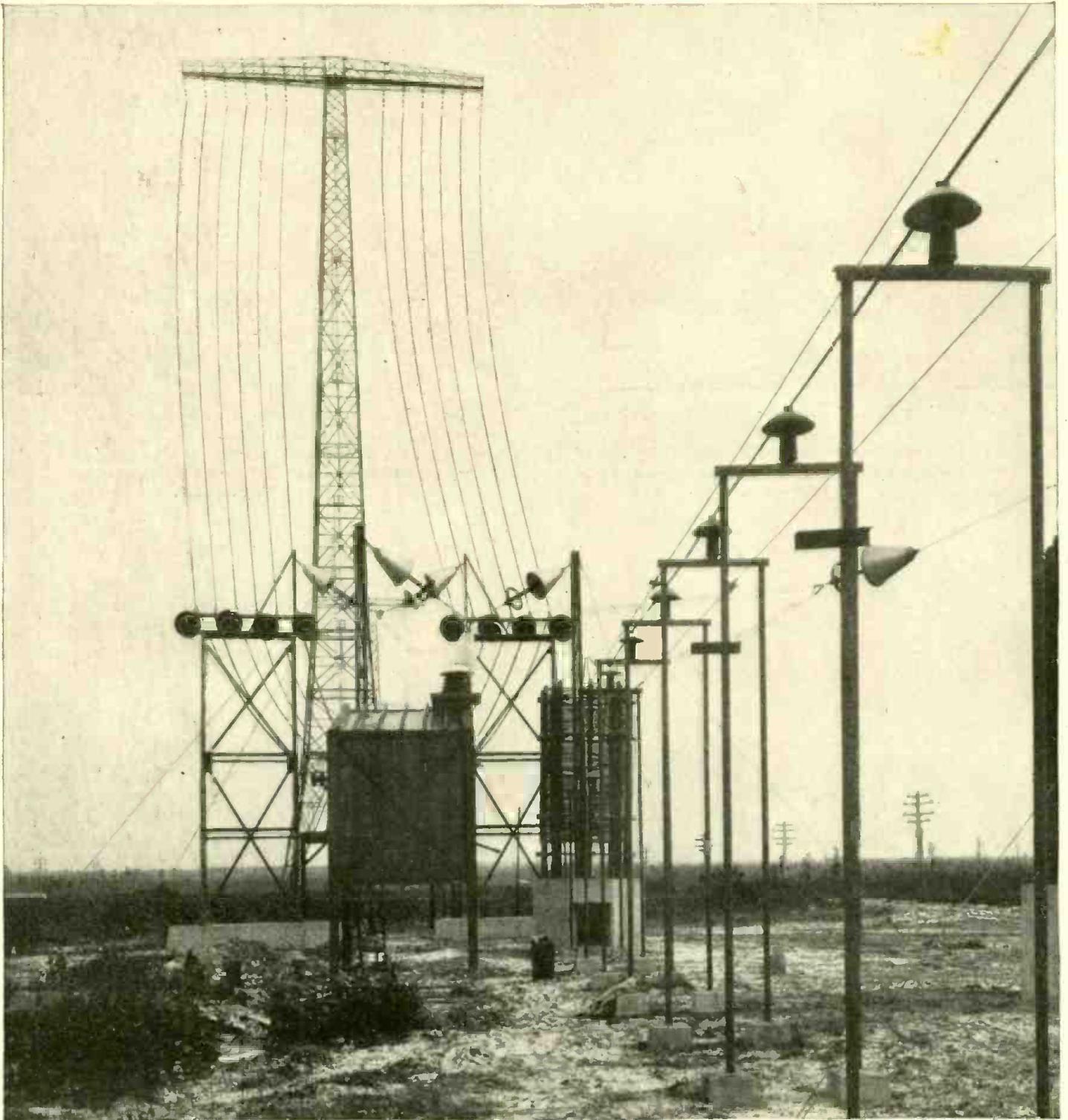
8 To cement the two discs together, disc A is set in a support, as shown in Figure 4, and disc B is set carefully into it. The cement is then evenly poured around the rim of disc B at the point where the two cones meet; this fastens the cones together solidly.



9 The loudspeaker unit, E, is inserted through the back rings, C and D, to which it is fastened by means of three brackets and bolts. The brackets, of course, should be fastened to the rings before the unit is inserted.



10 Finally, screw the threaded brass nose-piece, as shown above, through the center of cone A, into the unit, E. The loudspeaker may then be adjusted by attaching it to the receiver and turning the regulating screw in the tip.



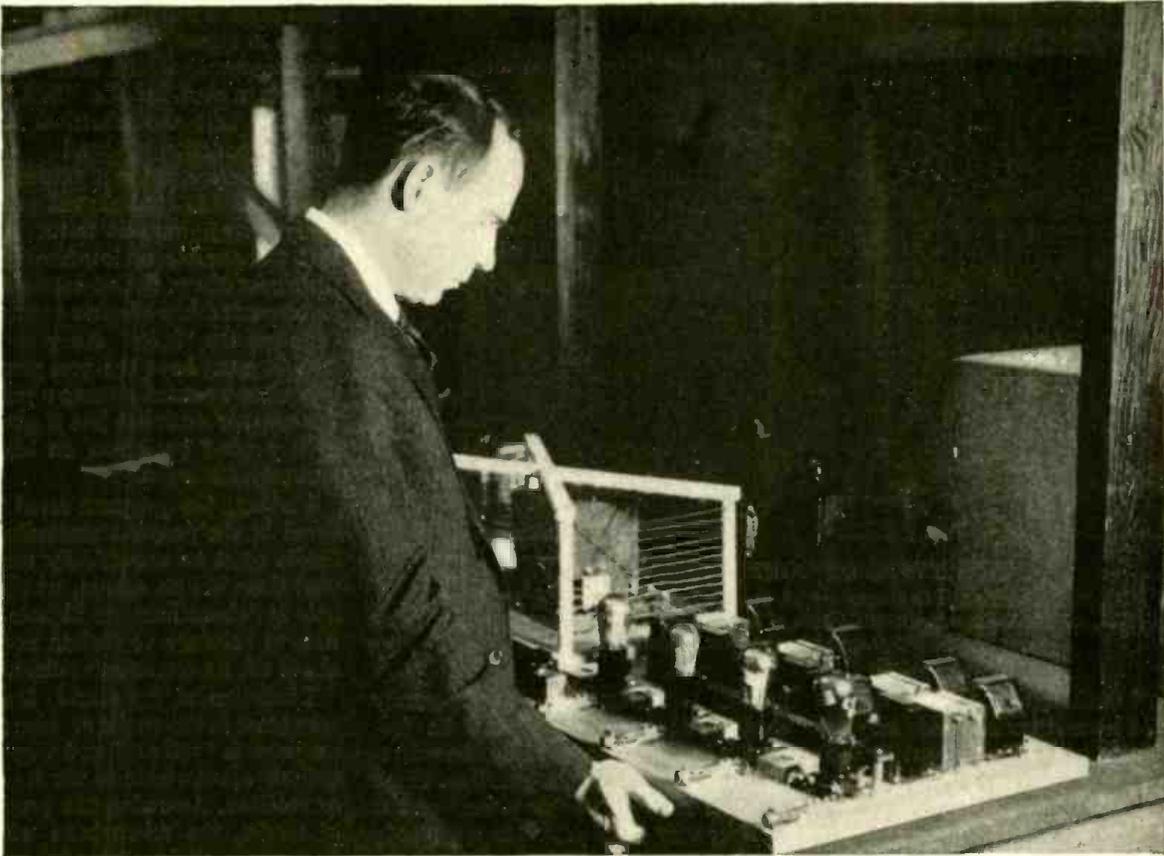
Courtesy A. T. & T. Co.



Herbert

The Nerve Centers of the Trans-Atlantic Radiophone System

From this gigantic antenna system at Rocky Point, New York, 7,250 feet long, the radio impulses that carry your voice from the telephone in your home, when you put in a call for London, are sent out across the Atlantic ocean to sensitive radio receivers and finally to telephones in homes and offices on the other side. At the left is one of the elaborate control boards at the radio station at Rugby, England, where radio messages on that side of the water are received and retransmitted by wire. Land wires carry the messages from the central telephone exchange in New York to the transmitting station at Rocky Point. The radio receiving station at this end is at Belfast, Maine. The opening of this service to the public on January 10, 1927, was attended by great success.



From a photograph made for POPULAR RADIO

TESTING A LOW-FREQUENCY AMPLIFIER IN THE LABORATORY

At the right of the picture may be seen a set-up for a four-stage low-frequency amplifier that Professor Bowles is investigating to determine its characteristics.

WHAT EVERY FAN SHOULD KNOW ABOUT

AUDIO AMPLIFIERS

The first article in a new series on the principles underlying truthful amplification and reproduction at low-frequencies—written by an authority in terms that everyone may understand.

By PROFESSOR E. L. BOWLES

WHEN a note on a violin is sounded, that note produces a certain effect on one's ears.

The note is made up of vibrations of audible frequencies; or, in general, it may be said to be made up of a fundamental tone and several "overtones," which are harmonics of the fundamental frequency. Sound frequencies are designated as low frequencies or audio frequencies.

If the fundamental frequency alone were present, the note would sound colorless. In fact, it is this composite nature of the note of a musical instrument that not only gives the note quality and character, but that distinguishes it from the same note on some other musical instrument.

So, in speech, it is the relative mag-

nitudes of the harmonics or overtones that give quality and character to one's voice.

In broadcasting a program of any sort, the sound waves must first impinge upon what is called a microphone. This device transforms sound energy into electric energy, much as a generator in a power plant transforms mechanical energy into electrical energy. The microphone may be in the studio at the broadcasting station, or it may be at the point where a concert is being given, or where some interesting or important event is taking place.

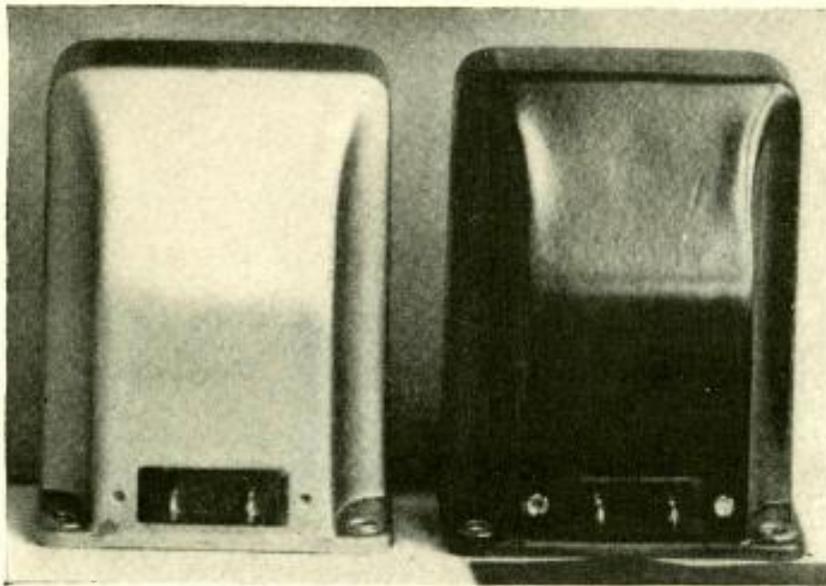
The electric energy produced by the transformer action of the microphone is too small to properly impress itself upon the high-frequency wave which is to transport it through space; therefore the

feeble electric currents that represent the low, audible frequencies of the sound must be amplified by what may be called a speech or voice amplifier.

The microphone and speech amplifier of a broadcast station are illustrated schematically in Figure 2.

After the speech amplifier has magnified or amplified the voice currents to the proper degree, they are caused to effect what is called a modulator; this serves to properly impress them on the radio wave which is to carry them through space. This radio wave is known as a "carrier wave."

The carrier wave may be of a frequency of from about 540,000 to 1,500,000 cycles (or complete vibrations) per second. These frequencies are designated as "high-frequencies" or "radio-fre-



TWO TYPES OF COUPLING UNITS

FIGURE 1: At the left is shown a high quality transformer, and, at the right, a double-impedance unit; both of these units are used to couple low-frequency amplifier tubes.

quencies." Such frequencies are *inaudible*, as the normal ear responds only to frequencies lying between about 16 and 16,000 cycles per second. (The frequency of middle "C" on the piano is approximately 259 cycles per second). A high-frequency electric carrier wave is used because, among other qualities, it is capable of being sent through space more readily than electric waves of lower frequencies.

The radio wave is generated by an electric oscillator; it is radiated into space by means of an antenna. When there are no sound waves to actuate the microphone, the carrier wave goes out into space without the power to actuate the ordinary receiving set in an audible fashion. However, when a sound wave encounters the microphone, an imprint of this wave is made upon the carrier wave so that, at a properly tuned receiving set, the response will be a *facsimile* of the original low-frequency disturbance at the transmitting microphone.

In the receiving set, the first problem usually is to amplify the feeble electric waves intercepted by the receiving antenna. To do this, it is first necessary to tune the receiver so that it is in a receptive condition for the carrier-frequency wave of the broadcast station whose program is to be received.

The high-frequency amplifier magnifies the currents produced in the antenna by these passing waves. These currents then actuate a detector or demodulator. The detector *undoes* what the modulator at the transmitting station did; that is, the detector extracts the low-frequency imprints from the high-frequency carrier wave.

The electric currents which the detector passes on to the succeeding ap-

paratus represent feeble low-frequency electric waves which should be facsimiles of those produced by the microphone at the transmitting station. These currents in the detector circuit of the receiver may be of sufficient magnitude to operate a pair of telephone receivers or other sensitive reproducer placed in the detector circuit. In almost all practical cases a low-frequency amplifier is necessary at the receiver to give a receiving set sufficient power output to operate a cone or horn type reproducer.

It is remarkable that, in spite of the distortion introduced by every ailment of the transmitter and receiver, it is possible to obtain good reproduction with good apparatus. On the other hand, it is astonishing that with the possibility of obtaining good reproduction so few have taken advantage of the better low-frequency equipment. In

most cases it will be found that the best is the cheapest, and in particular the most economical. In order to outline what is meant by the "best," let us consider first the electrical recording and reproduction of sound.

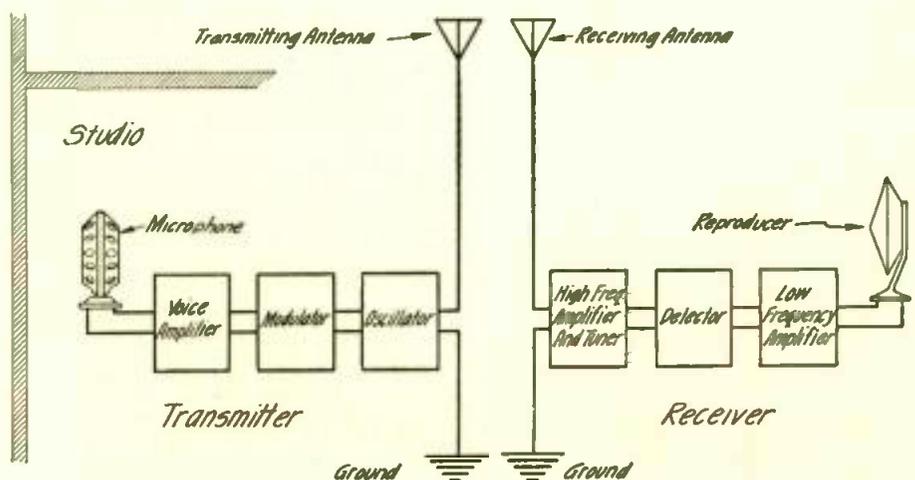
The microphone is a vicarious ear in which one has (but should not necessarily have), implicit faith. It "picks up" the audible or low-frequency disturbances about it and causes them to be converted into electric currents.

Before the "mike" can give you the best, it must have the best given to it. Therefore we must assume *a priori* that the speaker or artist has a good voice or is a good performer on his chosen musical instrument.

Further, the program must be rendered in the proper surroundings. The studio must be acoustically correct, so that there are no echoes, no objectionable reverberations, no objects or cavities to resonate to certain notes and, above all, no extraneous noises.

Distortion of the sound, then, may take place in the studio or wherever the program is "miked," and may not be entirely attributable to the transmitter or receiver. Assuming the proper kind of studio, the microphone will introduce some slight distortion, although in a properly designed and adjusted instrument it will not be noticeable except by delicate laboratory tests. Even though the "mike" has been properly adjusted, some distortion of the program is sure to occur in the voice amplifier at the transmitting station. In a good voice amplifier, this will not be noticeable, but there are many broadcasting stations with poor amplifiers or with good ones poorly adjusted.

With a good "mike" and a good voice amplifier, both properly adjusted, there is still a further possibility of distortion in the modulator. Too many broad-



WHERE GOOD QUALITY MUST BE PRESERVED

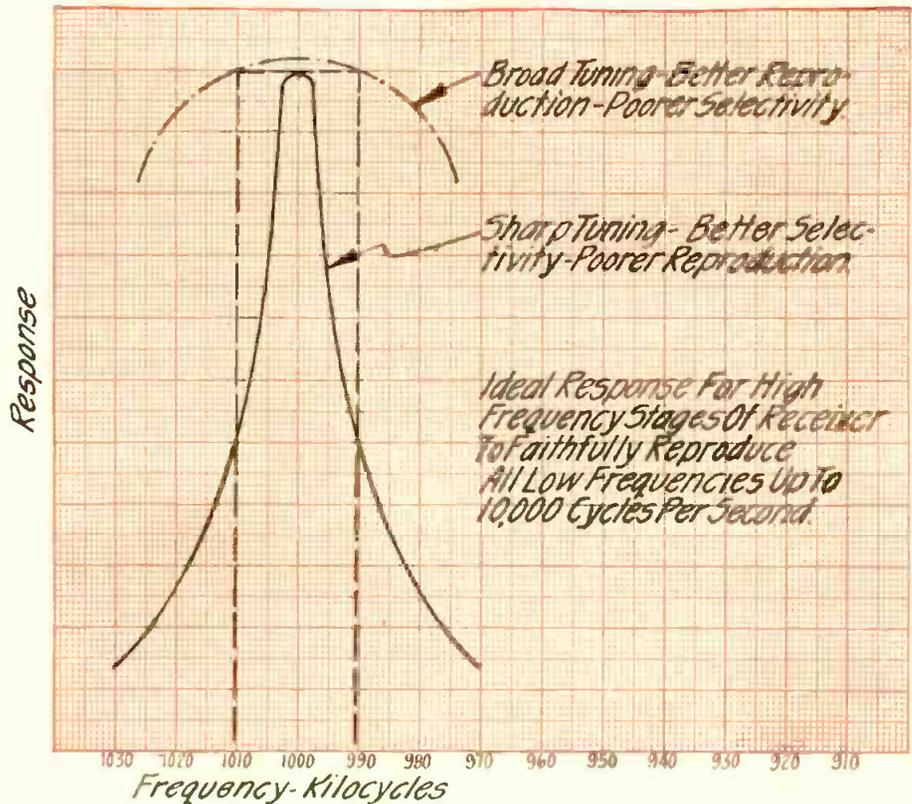
FIGURE 2: To obtain undistorted reproduction at the loudspeaker of the sounds which enter the microphone, each unit of apparatus must pass along the current without distorting it in the slightest degree. This drawing shows, in a general way, the many different points at which distortion may occur.

casting stations attempt to impress the low-frequency voice-current effects on the carrier wave too intensely, or to "over-modulate." This causes bad distortion of the louder sounds. The possibility of such distortion may be realized when it is stated that the average variation of power in speech is 1,000 to 1, and in music as great as 100,000 to 1. Even though the modulator is adjusted to give the best results, it may do poorly unless it has been carefully designed. There are consequently many broadcast stations which are not able to send out a well-modulated wave.

It must be realized that the thermionic valve (or as it is better known, the vacuum tube) which is used in the amplifier or modulator is not a perfect device, and that it will always introduce some distortion wherever used. In properly designed devices this distortion is so small that it is not discernible by the ear.

To sum up, then, the low-frequency waves must be faithfully transformed to low-frequency electric waves; and these, in turn, must be carried into space. The transmitter as a whole must be capable of responding to a whisper or a *pianissimo* passage, or to a shout such as a *fortissimo* passage. Not only this, but it must be impartial in its reproduction of different instruments. It must not introduce frequencies which are not present in the sound waves it has undertaken to translate into an appropriate form of electrical energy for broadcast transportation through space.

The transmitter, taken as a whole, may introduce "frequency distortion;" that is, it may not properly represent different frequencies of sound waves as to relative intensity, and it may introduce "harmonic distortion." That is, it may introduce frequencies which were not present in the sound waves actuating the microphone. Thus, before examining the receiving set, it is necessary to admit that the broadcasting station may be a flagrant offender. If it is not, and a good program is at hand, let



A STUDY OF RESONANCE CURVES

FIGURE 3: The broadcasting curve gives a wide channel so that the side bands are included and no musical tones in the reproduction are lost. With extremely sharp tuning, the resonance curve shown in solid lines in the diagram cuts the side bands and the higher tones are lost, giving drummy or muffled reproduction. Ideal tuning is broad enough to cover the band from 1010 to 990 KC.

us now examine the receiving set to find out how this good program may be reproduced with fidelity in all fairness to the creditable and deserving broadcasting station.

The broadcast receiving set must first be tuned to the frequency of the wave of the station it is desired to receive.

This operation is not always properly performed. Some times the receiving set is so made that it never can be properly performed. A set which is exceedingly selective, or that gives a very high amplification with relatively few high-frequency stages, is almost certain to distort the currents which must actuate

the detector and, thus, the reproduction.

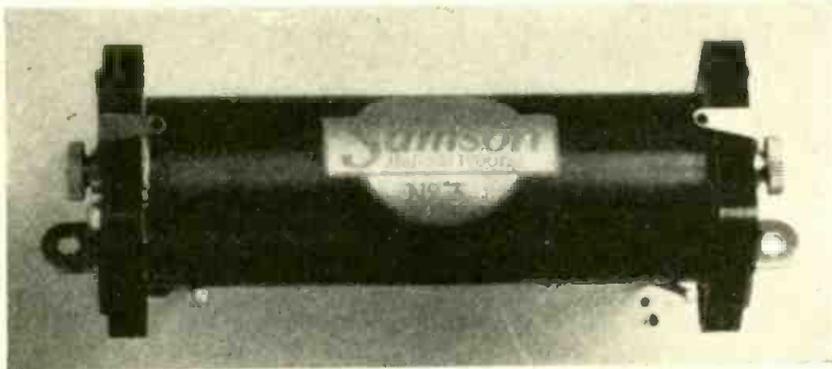
Selectivity, if too high, although often necessary to separate broadcast stations that are close together on adjacent wavelengths, introduces distortion by unduly attenuating or reducing the magnitude of the so-called "side bands" of the incoming radio wave. That is, the incoming radio wave consists of a spectrum of frequencies which range equally above and below the carrier frequency.

For instance:

If a broadcast station is said to have a frequency of 1,000 kilocycles (usually abbreviated "kc") or a wavelength of 300 meters (usually abbreviated by the greek letter λ) and if a receiving set is tuned to receive a wave of this frequency, this carrier wave will be present in the high-frequency amplifier of the set.

As the microphone is not being actuated, there will be nothing for the detector to strain out of the radio wave; no sound will be heard in the reproducer of the receiving set.

If, now, a pure tone of 1,000 cycles per second is allowed to affect the microphone, three frequencies will be radiated into space by the transmitting antenna. One will be 999,000, one 1,000,000 and one 1,001,000 cycles per second. The first and the last frequencies given are known as the "side bands";



ANOTHER TYPE OF COUPLING UNIT

FIGURE 4: This photograph shows an impedance coil that may be used for coupling between two vacuum tubes that are amplifying at low frequencies. This type of unit is usually used with a coupling condenser.

the second frequency is the carrier. In the event that a higher tone (let us say of 4,000 cycles per second), were to effect the microphone, the two side bands would be 996,000 and 1,004,000 cycles per second, and the carrier would be 1,000,000 cycles per second as before.

In order that a set may receive a broadcast program consisting in part of musical notes having tones or overtones of 10,000 cycles per second, it must not tune so sharply that it does not respond to frequencies as much as 10,000 cycles (10 kc.) higher or lower than the carrier frequency.

Figure 3 illustrates the point made here; it brings out the fact that a broadly-tuned set will give better quality than a sharply-tuned one, and also that the broadly-tuned set is attended by poorer selectivity. With present day practice in the United States, where stations are supposed to be spaced 10 kc. apart, a selective set is a necessity. It is of advantage from the viewpoint of quality to be able to vary the selectivity so as to have a set most selective only when absolutely necessary. Such flexibility is possible, for example, in the "T-C." type of circuit using variable primary-coupling in a high-frequency transformer.

The detector, which translates the composite high-frequency wave into a composite low-frequency wave by finally eliminating the carrier wave, may introduce harmonic distortion or new frequencies not present in the original sounds. At best a detector tube distorts. If properly adjusted, the distortion which it introduces will not be detectable by ordinary means. It may, for example, introduce new frequencies if overloaded by the louder signals; in this case the louder sounds will be falsely represented.

It is wiser not to overload the detector with the idea of reducing the number of stages of low-frequency amplification in the receiver, as the detector tube will operate with a minimum of distortion only when it is not overloaded.

In order to obtain sufficient volume from a loudspeaker or reproducer, it is practically always necessary to have some form of low-frequency amplification in the receiver itself. Such an amplifier must faithfully magnify or amplify those electric impulses which are given to it by the detector unit.

In order that the low-frequency amplifier shall be able to do justice to the broadcast program, it must receive the proper undistorted impulses from the preceding units. The studio must be correct, the microphone faithful, the modulator good, the receiver tuning proper, and the detector functioning properly in order that an undistorted message may be passed on. Assuming

that the low-frequency amplifier in the receiving set has been fairly treated, it is only proper to analyze it in order to give the last transforming device in the chain of units, the reproducer, a fair chance to do itself justice.

For the audible or low-frequency amplification, there are three general types of amplifiers: (1) transformer-coupled, (2) impedance or choke-coupled, and (3) resistance-coupled.

Each of these amplifiers possesses certain advantages and certain disadvantages. One person will vow that one is the best; another will declare that another of the three types is better. Usually this declaration is based upon fancy.

Many low-frequency amplifiers, no matter of what type, are operated under a handicap so that enthusiastic comparisons are often meaningless!

One of the uses of the ordinary three-electrode vacuum valve in receiving sets is that of an amplifier of electric energy. The amplification obtained by one valve may be too little, so that often several valves are used in tandem or cascade. A multi-stage or cascade amplifier is one of several valves arranged to that each one amplifies the energy given to it by the preceding valve. Thus the usual two-stage amplifier has two valves used as amplifiers, the three-stage amplifier three, and so on.

Some type of electric coupling must be used to connect the successive vacuum valves in an amplifier; it is the particular method of coupling and the quality of the coupling device which

have much to do with the success of the amplifier and the quality of its output, or rather the quality of the sound given by the reproducer.

Figures 5, 6 and 7 represent the three methods of coupling two vacuum valves, and, therefore, the three general types of audio-amplifiers.

In the case of the low-frequency transformer coupling of Figure 3, there are two windings on an iron core. These two windings are insulated from each other; and they are connected to the vacuum valves as shown. When an electric disturbance of a changing nature (which may be designated as a changing voltage) is applied between the grid and filament terminals (marked G and F—) of valve number 1, a changing electric current results in the winding of the transformer known as the primary. The passage of a changing current through the primary winding of the transformer causes a changing voltage to appear between the terminals marked G and F— of valve number 2. If the transformer were perfect, the voltage would be the image of that voltage applied to G and F— of valve number 1.

In a well-designed low-frequency transformer it is possible to multiply voltages simply by constructing the device in such a way that there are more turns of wire in the secondary winding than in the primary winding in somewhat the same way that a lever may be used to multiply forces. It is this characteristic of a transformer which makes it very suitable as applied to a low-frequency amplifier. It is not only possible to obtain the (voltage) amplification of the valve itself in this way, but it is also possible to obtain even more (voltage) amplification by having a "turns-ratio" on the transformer greater than one (unity). For example, a transformer designated as a "turns ratio of 2 to 1" is one with twice as many turns on the secondary as on the primary.

The two devices of Figures 4 and 5 for coupling two vacuum valves do not have the same property of multiplying voltages possessed by the transformers of Figure 5. With the same valves it is impossible, then, to obtain as much amplification per stage in the cases of Figures 6 and 7, as it is in the case of Figure 5.

By the use of the so-called high "mu" tubes, however, this comparison is much more optimistic. Resistance-coupled and in some cases, choke-coil amplification is most effectively accomplished by the use of tubes having a high amplification factor ("mu"). With such tubes the amplification per stage approaches the value obtainable in transformer-coupled amplification.

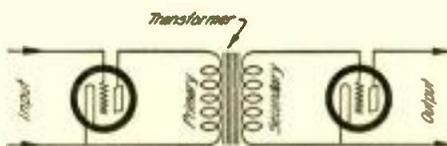


FIGURE 5: This drawing shows the electrical connections for a single stage of transformer-coupled amplification.

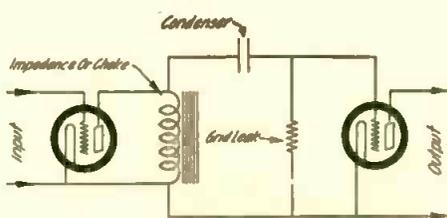


FIGURE 6: The connections for a single stage of impedance-coupled low-frequency amplification are shown here.

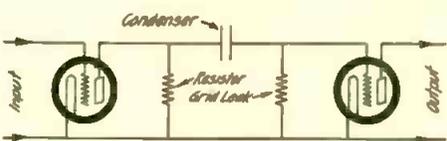


FIGURE 7: One stage of resistance-coupled amplification should be connected up as this hook-up shows.

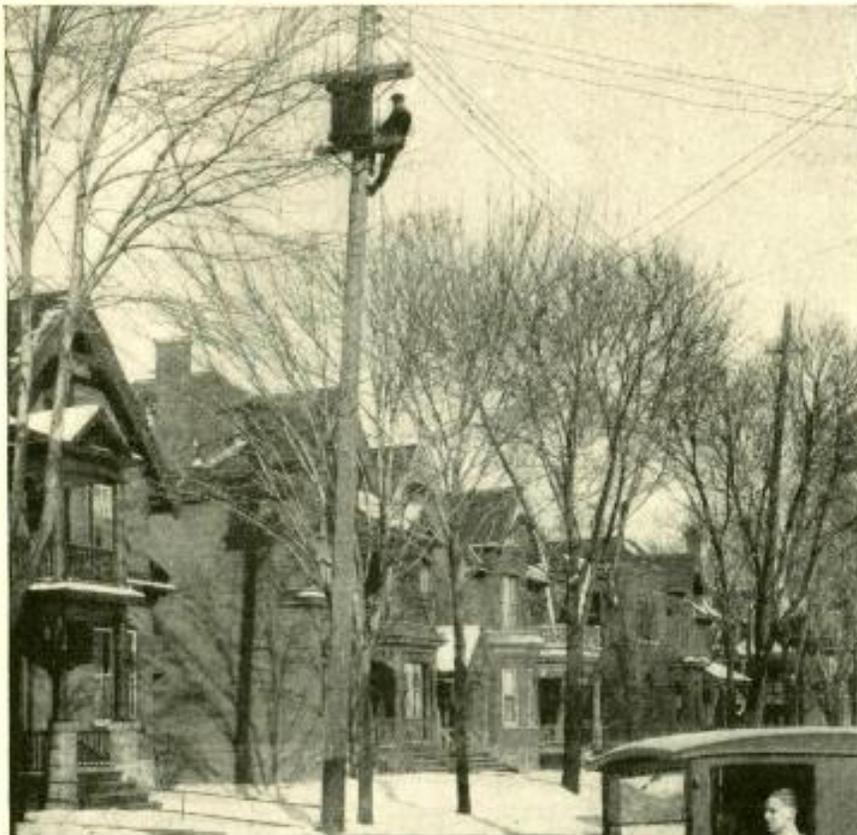
A REAL RADIO

“Interference Patrol”

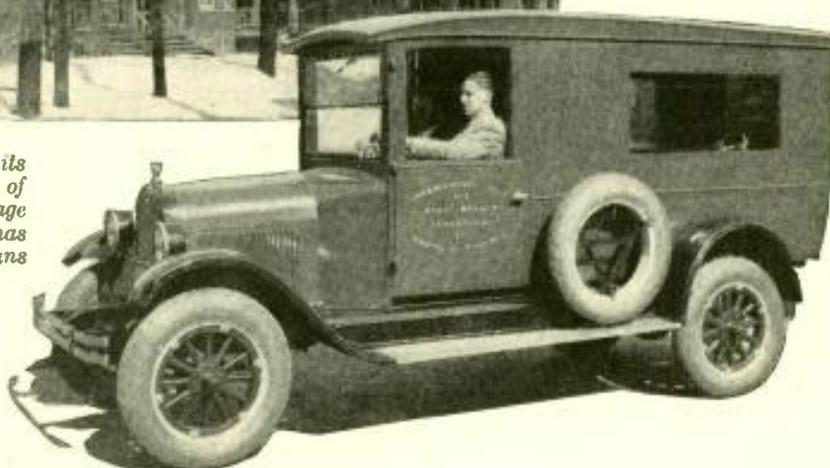
How an emergency fleet of eight radio-equipped motor cars are employed for running down and suppressing unnecessary disturbances to radio reception.

By

JAMES MONTAGNES



Checking interference at its source—this time at the top of a telephone pole, where leakage from a power transformer has led to complaints from the fans in the neighborhood.



INTERFERENCE CAR NO. 3 Radio Branch, Department of Marine and Fisheries

SUCH is the legend on the doors of one of a fleet of eight automobiles equipped to run down radio inductive interference. These eight cars patrol the eastern part of Canada—and constitute a part of Canada's answer to the query raised by radio fans, "What can the Government do to check interference?"

Each car is specially built and furnished with the most sensitive radio receivers and two radio electricians.

Nearly two years ago, after a number of preliminary tests had proven successful, a staff of one engineer and three electricians were appointed to deal with radio interference from power line and electrical apparatus. An automobile was equipped with special instruments and sent on tour in Ontario and Quebec. In three months the two radio electricians with this car carried out investigations of interference in one hundred towns and villages. Two hundred and three cases of interference were handled, of which 124 were immediately elimi-

nated; the majority of the others ceased to annoy broadcast listeners as a result of follow-up correspondence between the broadcast listeners, the owners of the electrical apparatus causing the interference and the Radio Branch at Ottawa.

Such has been the success of this section of the Radio Branch from the very first that the following year five cars were on continuous duty throughout Eastern Canada, with headquarters at Halifax, Montreal, Ottawa and Toronto. Three more cars have now been added to the fleet, one for Vancouver, another for Winnipeg and the third for London, Ontario.

An example of the work accomplished by one of these cars is the tour of car number 3 from June 3rd to August 13th, 1926.

Sixty-five municipalities in Ontario, from Ottawa to Galt, were visited; 286 cases of interference were investigated, out of which number 254 were due to faults on distributing systems. These may be summarized as follows:

Faulty transformer cut-outs num-

bered 234; other faulty series connections (including faults in disconnecting switches and terminals of transformers) were 8 in number; a similar number of cases were due to contact with ungrounded metal; 4 cases were due to lines being in contact with some high-resistance ground, such as wet poles and trees.

Each automobile is equipped with a superheterodyne receiver with direction-finding loop and volume control. Six and seven-tube superheterodynes are used, mounted in a special portable cabinet, which is connected by means of a multi-wire cable plug to a second cabinet that contains batteries and accessories; this receiver is sufficiently sensitive to record a noise due to a fault on a distributing system many miles away. In fact, it was used recently in two Ontario towns to locate faults on power lines situated in the one case fifteen miles and in the other four miles distant.

These receivers may be used while the automobile is traveling at a moderate rate of speed. The interference from the ignition system of the car usually pro-

duces a sound in the receiver which is characteristically different from that produced by the power line, so that this type of interference, if not too great, is not objectionable.

In addition, a portable superheterodyne receiver is carried and used in special tests where two receivers are required. A portable three-tube regenerative receiver, complete with batteries and especially designed to be carried by one man, is also part of the equipment of the car. The latter set is used with a loop or various types of exploring coils for special investigation in power houses and places inaccessible to a car.

The tubes used in all these sets are the tiny "peanut" tubes, manufactured

in Canada, which operate on dry cells.

Many cases of urban interference are also handled; such, for example, as that originating in oil furnaces, electric signs, electrical heating pads, violet rays, and other electrical apparatus. In order to eliminate the interference after it has been located, a number of surge traps, made up of various sized choke coils and condensers, are to be found stored away in the upright cupboards of the cars.

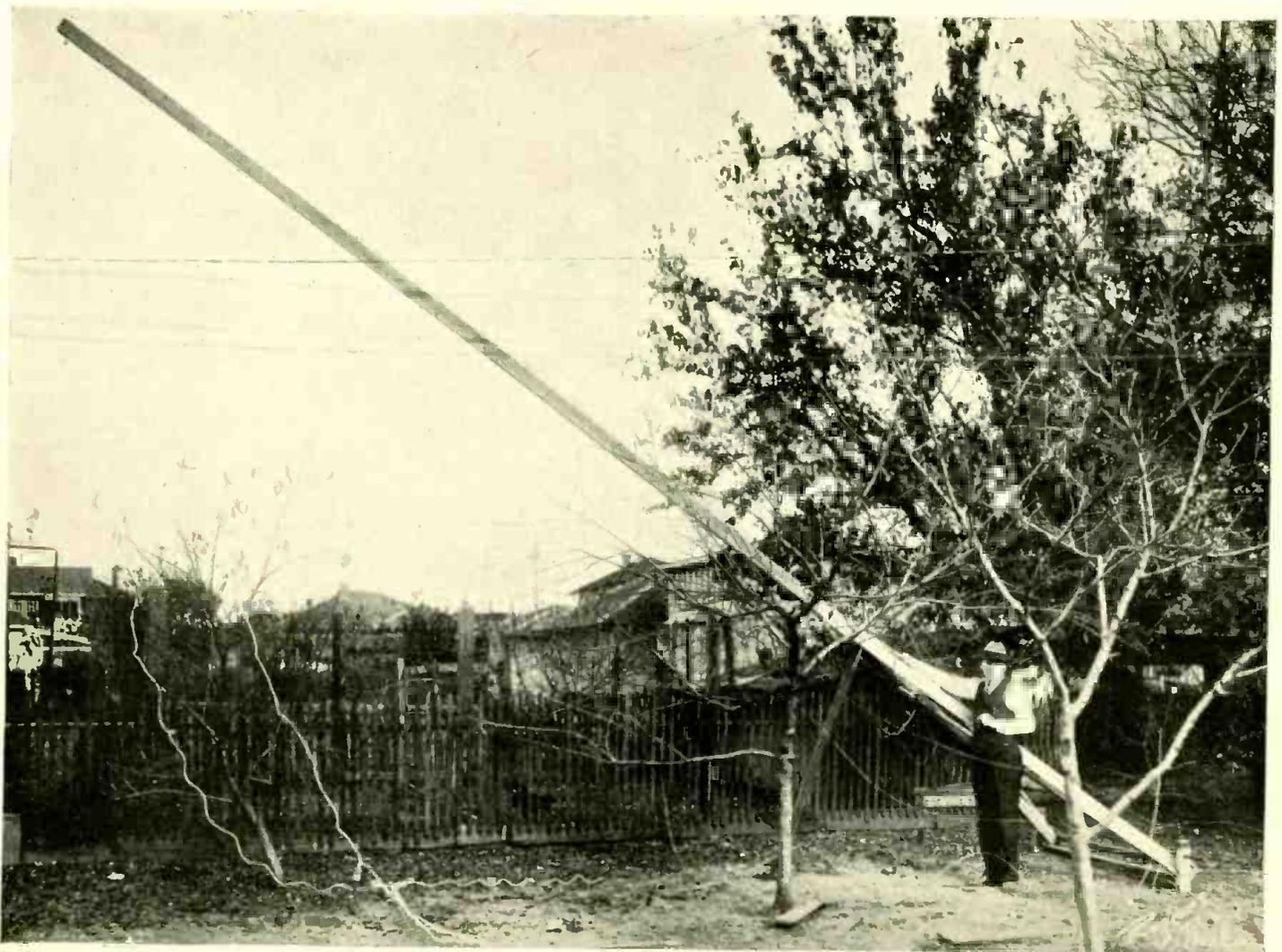
Inside, each radio interference car resembles a cosy little room. There is a small bench at one side and a table across the back, under which is placed the superheterodyne receiver. Below this and surrounding it are a number of drawers and shelves that house other

receivers, tools, measuring instruments, coils and many other items. On top of the table is the loop direction finding antenna, while a cupboard takes up some space behind the driver's seat.

That this service is provided in the Dominion may seem strange, but the listener in Canada is entitled to help in his reception of broadcast music. An annual license is required by every owner of a radio receiver; the charge is \$1.00 for each fan. Out of this sum, amounting to over \$125,000 during the year from April 1, 1925, to March 31, 1926, the radio interference cars with their trained staffs of two radio electricians are paid, and a number of other means of improving radio reception for the listener are made possible.

How to Build the *New* Browning-Drake Receiver— Told by Browning and Drake Themselves

Q In the next issue of POPULAR RADIO—for April—will appear an article on the new Browning-Drake standard receiver, in which the originators of this circuit will describe the improvements of the last year and will give complete constructional details for the new receiver, which will operate direct from the 110-volt, 60-cycle, alternating current lines.



A. E. Burgess

AN ANTENNA MAST THAT CAN BE RAISED AND LOWERED BY ONE MAN

This thirty-foot mast was built by C. P. Burgess of Dallas, Texas of 2 by 4-inch timbers bolted together down to twelve feet from the lower end, where they are spread in a "Y" shape. The base consists of two substantial stakes that are driven into the ground, five feet apart. A one-inch iron pipe is then run through the stakes and the mast ends so that the mast may be easily raised or lowered by one person. Only a few guy wires are needed to finish off a rigid and efficient construction.



From a photograph made for POPULAR RADIO

A CORNER OF THE LABORATORY WHERE THE TESTS ARE MADE

All of the apparatus that is listed in this Department has been tested and checked in the POPULAR RADIO electrical testing laboratory, where the outstanding features and usages of new devices are determined and entered in the testing log book. From these records this Department is made up for the benefit of POPULAR RADIO readers. (The engineer, shown above, is obtaining the amplification factor of a vacuum tube.)

What's New in Radio

Conducted by
THE TECHNICAL STAFF

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



A Device to Test the Voltage Your Power-pack Delivers

Name of instrument: "B" power tester.

Description: This instrument contains a milliammeter and a voltmeter which, when properly connected to the output of a power-pack, show the voltage the power-pack will deliver at

any specified current drain. A rheostat is provided in the instrument to permit the current drain to be regulated as desired. Thus, if a power-pack is intended for use with a receiver which draws 25 milliamperes, the rheostat in the power tester is adjusted until the milliammeter shows a reading of 25 milliamperes. The voltage then shown by the voltmeter on the face of the tester is the voltage which will actually be delivered to the receiver. Terminals for connecting the instrument to the power-pack are provided at the top of the instrument. Also terminals by means of which the voltmeter and ammeter may be used separately for the measurement of any DC voltages or currents not exceeding 300 volts or 100 milliamperes. The voltmeter is of

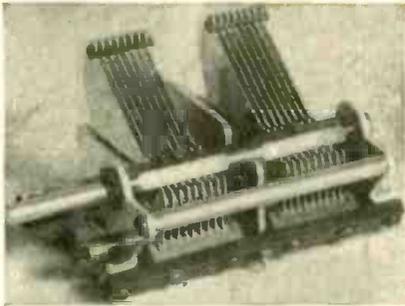
the high-resistance type (approximately 200 ohms per volt). The instrument is housed in a metal container with a crystalline finish. All terminals are clearly marked.

This instrument fills a long felt need inasmuch as the ordinary voltmeter will not provide reliable readings for this use because of the relatively low internal resistance of these measuring instruments.

Usage: To measure the output voltage of a "B" power-pack, at any desired rate of current drain.

Outstanding features: Enables the owner to tell just what voltage his power-pack is delivering to the receiver. Well made. Simple to use. Absolutely safe. Either meter may be used separately if desired.

Maker: Sterling Mfg. Co.



A Double Condenser that May be Used in the LC-27 Receiver

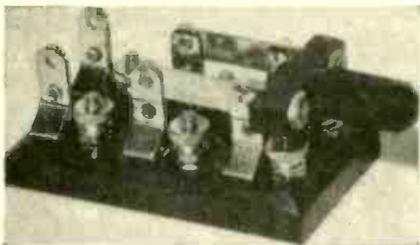
Name of instrument: Dual condenser.

Description: This double capacity unit, which is made especially for the LC-27 receiver, contains a grounded rotor section with a metallic shield between the two sets of stator plates. The shaft is made in one part with the two rotors fastened thereto by means of two set screws. The rotors are carried on a well insulated strip that is fastened at each end of the frame. The type of condenser plates used gives good separation of broadcast frequencies throughout the entire dial range.

Usage: As a tuning unit in radio-frequency circuits.

Outstanding features: Neat appearance. Efficient. Eliminates crowding on the dials. Easy to install.

Maker: Gardiner & Hepburn, Inc.



A Handy Double-pole Double-Throw Switch for the Radio Experimenter

Name of instrument: DPDT switch.

Description: This switch, which is exceptionally neatly made should be invaluable to the radio set-builder who

builds his own testing equipment. It is well made of bakelite with nickel-plated brass switch blades and accessories. The switches are also made in SPDT, DPST and SPST styles.

Usage: In connection with changing circuit hook-ups in radio apparatus.

Outstanding features: Well insulated. Neatly made. Takes up small space. Positive connection.

Maker: Leslie F. Muter Co.



A High-Voltage Filter Condenser

Name of instrument: Filter condenser.

Description: This capacity unit, which is enclosed in an aluminum can, is made in 2 and 4 mfd. sizes, and is rated at 500 volts on continuous direct current. It is equipped with a bakelite connection block with soldering lugs for connecting in the electrical circuit. It also contains two mounting legs that may be used for fastening the block to the base.

Usage: In a "B" power-pack as a filter condenser.

Outstanding features: Neat appearance. Takes up small panel space. Easy to connect. High-voltage operation.

Maker: Tobe Deutschmann Co.



A New Style Condenser that Helps in Tuning

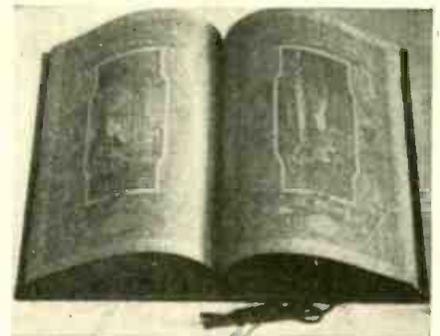
Name of instrument: Variable condenser.

Description: The new Metralign variable condenser incorporates a type of plate that gives improved tuning characteristics to any receiver in which it is used. It combines the best features of straight-line-capacity tuning, straight-line-wavelength tuning and straight-line-frequency tuning and eliminates the shortcomings of each. The workmanship is exceptionally accurate and the condenser is constructed of such sturdy material and with such great care that it should last a lifetime.

Usage: In a radio-frequency circuit for tuning.

Outstanding features: Improved tuning characteristics. Easy adjustment. Noiseless operation. High efficiency.

Maker: General Instrument Corp.



A Loudspeaker That Looks Like a Book

Name of instrument: Cone-type reproducer.

Description: This loudspeaker which has the appearance of a beautiful book contains the Utah reproducing unit, the moving element of which is attached to the two top inscribed parchment pages of the book as it lies open and causes them to vibrate in much the same manner as the parchment cone of a cone loudspeaker. The unit is capable of great volume with very pleasing reception, reproducing both the high and low tones of music and speech; it is equipped with a long cord.

Usage: In connection with a broadcast receiver as a reproducer for home use.

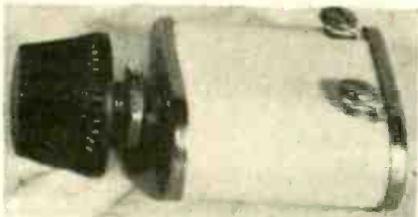
Outstanding features: Novel idea. Beautiful appearance. Good volume and tone quality.

Maker: Utah Radio Products Co.



A RECEIVER HALF AS LARGE AS AN ENGLISH PENNY

This tiny crystal receiver is said to work as well as sets many times its size. A fine tuning coil of fine wire is concealed in the base; the crystal is placed in the small wire cage at the right. The four tiny wire loops are for the antenna and ground connections and for the phone tips.



A High Current Variable Resistance for Regulating Power-pack Voltages

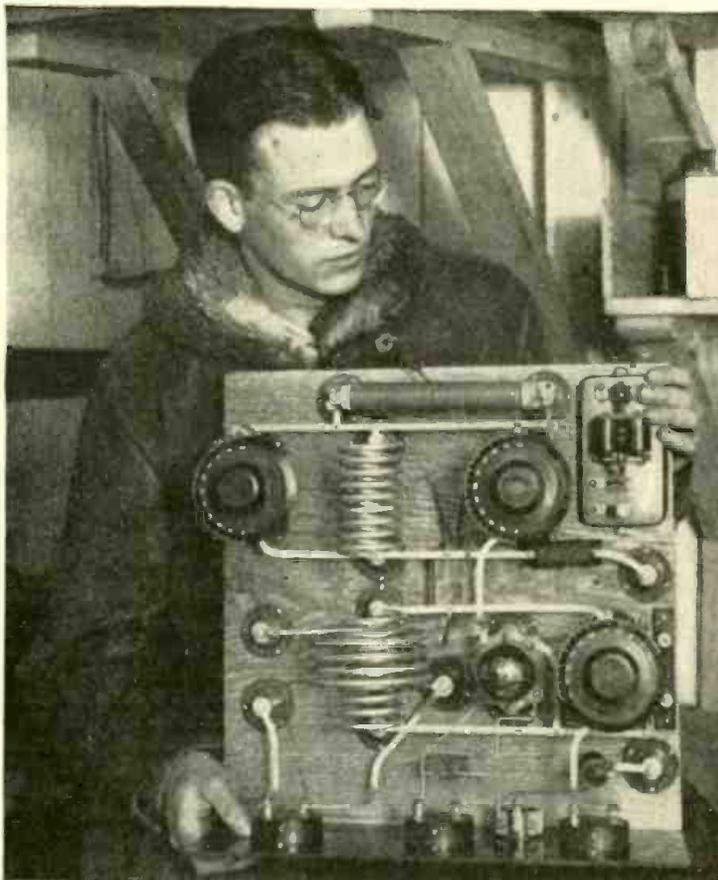
Name of instrument: Variable resistance.

Description: This new resistor, which is especially made for high-current work is exceptionally satisfactory for use as a voltage regulator in "B" power-packs. It contains much larger units than the standard Bradleyohm and will dissipate much greater power than the standard unit. It is built in strict accordance with good engineering practice and is equipped with two terminals which will accommodate the connecting wire either by a screw clip or by soldering. It may be attached to the panel by means of the single-hole mounting.

Usage: In radio circuits and especially in "B" power-packs for voltage regulation.

Outstanding features: High current carrying capacity. Rugged construction. Smooth variation. Neat appearance.

Maker: Allen-Bradley Co.



Herbert

A TRANSMITTING SET THAT IS "WIRED" WITH COPPER STRIPS

Wires have been almost completely eliminated in this neatly built seven-wall, short-wave transmitter by the use of copper tubing for the coils and copper strip for the connections between instruments. The set was constructed by two amateurs, Philip and H. A. Goetz (ZCTF), for the schooner "Morrisey" for use during the Greenland expedition of the American Museum of Natural History. Note how the apparatus has been mounted upon insulators to reduce losses.

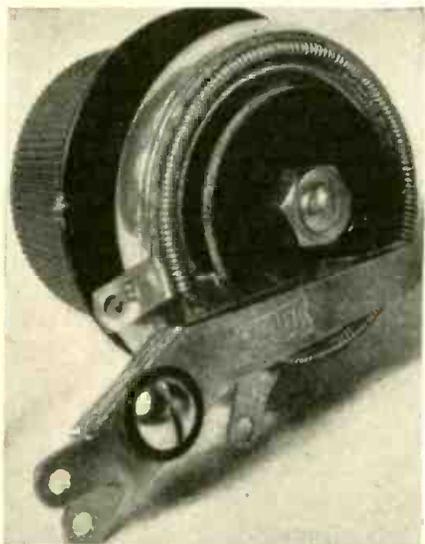
Usage: As a filament control switch and rheostat.

Outstanding features: Compact. Efficient. Smooth operation. Saves cost of one instrument.

Maker: Carter Radio Co.

Outstanding features: Good quality of reproduction. Great volume. Neatly made. Easily installed in a receiving set.

Maker: Ford Radio & Mica Corp.



A Rheostat that Is Also a Battery Switch

Name of instrument: Combination switch and rheostat.

Description: This unit is similar to the regular Carter rheostat except that it has an additional part that functions as a switch as the rheostat is turned down. Upon revolving the rheostat in one direction, the resistance will be lowered in value and upon revolving the rheostat in the opposite direction, the resistance increases in value and finally a switch is operated that turns off all the tubes in the set. The rheostat, however, may be used on one or more tubes but it does not have to be used in series with the total number of tubes that are controlled by the switch.

A Double-Impedance Coupler that Improves Audio Amplification

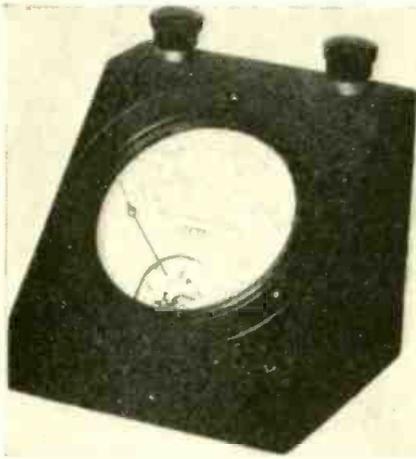
Name of instrument: Double impedance unit.

Description: This new unit, which is used for low-frequency amplification, contains a plate and grid impedance of the proper values and a suitable coupling capacity enclosed in a metal case with four binding posts mounted on insulating strips for connecting in the circuit. The two impedances have no magnetic coupling between them and the energy is supplied from the plate to the grid circuits of the two tubes used through the electrical connection afforded by the coupling capacity of the unit.

The unit gives exceptionally good amplification of both high and low notes and will handle large volumes without any noticeable effect from distortion due to overloading.

Usage: In a low-frequency amplifier as an interstage coupling unit.





A Double Scale Galvanometer

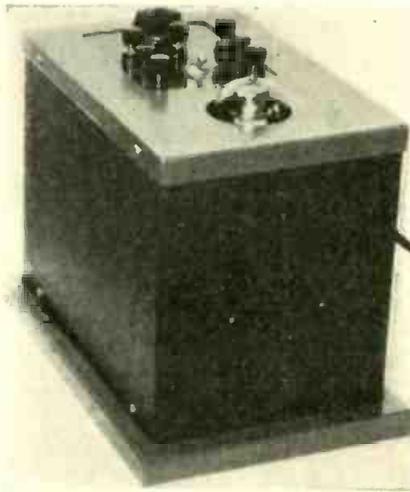
Name of Instrument: Radio-frequency milliammeter.

Description: This new measuring unit is equipped with a symmetrical scale for use as a galvanometer and with a calibrated scale for measuring milliamperes at radio frequencies. It is equipped for panel mounting or it may be used, as shown in the illustration, with the slanting metal base, for use in the laboratory. Two binding posts are furnished with the unit for connections to the external circuit. The case is finished in a neat crystalline black that is attractive and serviceable.

Usage: For use as a galvanometer or for measuring radio-frequency milliamperes.

Outstanding features: A compact laboratory instrument. Good accuracy. Good dial visibility. Large range.

Maker: Jewell Electrical Instrument Co.



A Well-made "B" Power-pack That Operates Efficiently and Quietly

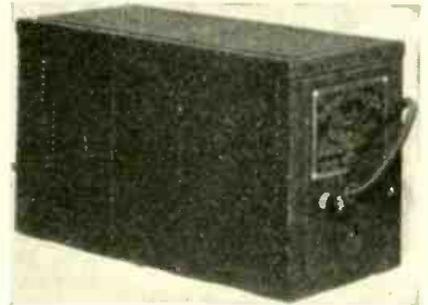
Name of instrument: "B" power-pack.

Description: This unit, which accommodates either the type B or type BH Raytheon, is a rectifier that furnishes direct current for use on the "B" circuits of sets and operates off the 110-volt, alternating current, lighting line. It is equipped with a number of taps for furnishing "B" voltages for the radio-frequency detector and audio-frequency amplifier circuits as well as a variable voltage where it is necessary. It is mounted and shielded in a neatly finished metal case with the terminals and switch located on an insulating panel at the top of the case. The case is easily removed for inspection. The unit is equipped with an extension cord and plug for

connecting to the 110-volt, 60-cycle alternating current lines.
Usage: In connection with a broadcast receiver for supplying plate current to the vacuum tubes.

Outstanding features: Neat appearance. Silent operation. Suitable for use with any receiver. Efficient.

Maker: Chamberlain Electric Co.



A Device to Operate the Tube Filaments from the House Lighting Lines

Name of instrument: "A" battery eliminator.

Description: This device does away with the storage "A" battery completely and enables the owner to light the tube filaments of his receiver from the alternating current lines. It consists fundamentally of a 2-ampere charger which operates the filaments direct through a suitable filter. The device includes a relay switch which automatically turns on the alternating current power when the battery switch on the receiver is turned on. A receptacle is also provided in the case of this instrument to accommodate a plug from the "B" battery eliminator, thus permitting both to be controlled by the battery switch on the receiver.

Usage: To supply the filament operating current for any receiver up to eight 201-a tubes or the equivalent.

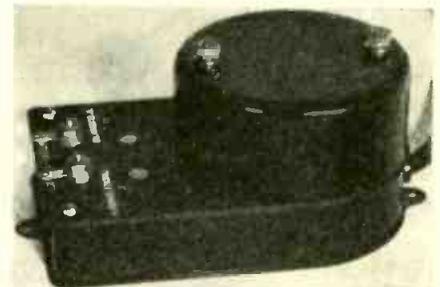
Outstanding features: Well constructed. Good appearance. Automatically controlled. Supplies ample current to operate eight 1/4-ampere tubes. No hum.

Maker: Briggs & Stratton Corp.



A CLOCK THAT TURNS YOUR SET ON AND OFF AUTOMATICALLY

To turn your receiver on or off at a specified moment. All you need to do is set the clock to the proper time by means of the knob just below the clock face; the clock alarm then makes or breaks the filament circuit at the set time. This apparatus is made by the Time-Lite Appliance Corp.



This Device Makes It Easy to Control an AC-Operated Set

Name of instrument: Automatic relay switch.

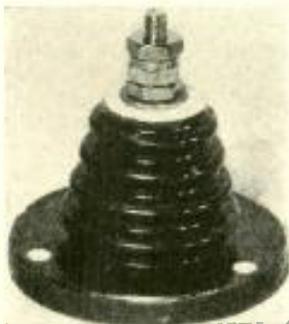
Description: This device is equipped with an extension cord and plug to connect it to the alternating current lines. The device also contains two receptacles to accommodate the plugs from the "B" power-pack and the trickle charger, which would ordinarily be plugged into the alternating current line direct. The instrument includes a relay which operates a

double-pole, double-throw switch and is controlled by the filament switch on the panel of the receiver. When the filament switch is turned on, this instrument automatically connects the "B" power-pack to the alternating current line and disconnects the trickle charger. When the filament switch is thrown off, the "B" power-pack is disconnected and the trickle charger is connected.

Usage: To automatically control power-packs and battery chargers by means of the filament switch on the receiver panel.

Outstanding features: Completely enclosed to guard against accidental contact with the alternating current supply line. Sturdy construction. Eliminates the necessity of plugging the "B" power-pack and trickle charger in and out of the alternating current line and thus permits control of the "A" battery, the "B" eliminator and the trickle charger by means of the filament switch on the panel of the receiver.

Maker: Yaxley Mfg. Co.



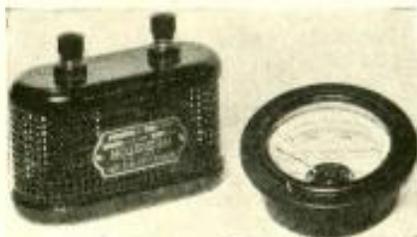
A Handy Insulator

Name of instrument: Stand-off insulator.
Description: This is a glazed porcelain, pedestal insulator approximately 1½ inches high equipped with a binding post. The porcelain base is flanged and is equipped with screw holes for mounting the insulator.

Usage: This device serves the double purpose of insulating any wire which is attached to its binding post and at the same time keeping this wire at least 1½ inches away from the wall or other object upon which the insulator is mounted. It is especially useful in insulating long battery leads, antenna leads, etc.

Outstanding features: Extremely rugged construction. Provides practically perfect insulation. The binding post at the top provides an easy way of attaching the wire or instrument which is to be insulated.

Maker: General Radio Co.



An Instrument for Measuring the Voltage Output of Battery Eliminators

Name of instrument: Voltmeter and high resistance multiplier.
Description: This meter is of standard



Herbert

A RADIO SYSTEM THAT BROADCASTS BABY'S "S.O.S."

An unusual application of radio is this microphone attached to the side of the baby's crib; it brings his cries to an amplifier and loudspeaker placed in a distant part of the house. This ingenious system was designed for its tiny broadcaster by Frank Lester (2AMJ), a Richmond Hill, N. Y. "ham."

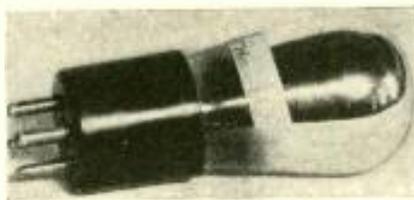


size, workmanship and material. It is supplied with an external resistor which results in a meter resistance of approximately 1000 ohms per volt and is therefore capable of accurately measuring voltages of high-resistance circuits, such as those of "B" power-packs.

Usage: For measuring the direct-current voltage of any high-resistance circuit. Especially useful in measuring the output voltages of "B" power-packs up to 600 volts.

Outstanding features: Convenient size and shape for mounting on a panel. Reliable construction. Accurate. Useful in conjunction with high resistance circuits which cannot be accurately measured by standard voltmeters.

Maker: Weston Electrical Instrument Corporation.



A Tube That Gives Higher Audio Amplification Per Stage

Name of instrument: High- μ vacuum tube.

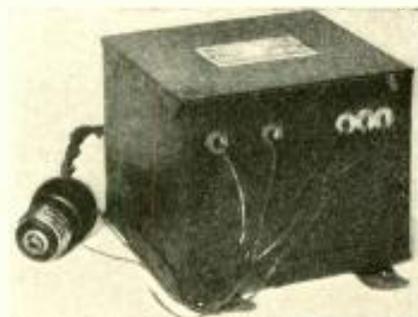
Description: This is a tube especially designed for use in the intermediate stages of an audio-frequency amplifier. The amplification factor (μ) of this tube is approximately 20 as compared with an amplification factor of 8 for the average 201-a type tube. This tube, when used in the first audio stage, will provide increased volume on weak signals.

Usage: May be used as an amplifier tube in the intermediate low-frequency stages of a receiver and will sometimes

find use as a radio-frequency amplifier tube or detector.

Outstanding features: Standard construction and equipped with standard base. Provides high amplification which increases volume.

Maker: C. E. Mfg. Co.



A New Unit that Simplifies Power-pack Construction

Name of instrument: Combination transformer and filter choke unit.

Description: This new device contains in a single metal can a power transformer for the Raytheon tube with a split secondary winding for full-wave rectification and two chokes that may be connected in the standard Raytheon filter circuit. The leads are brought out in suitable lengths on standard insulated wire that may be connected to the other instruments that will be incorporated in the power-pack. The unit is also furnished with an extension cord and a plug for connecting to the 110-volt, 60-cycle lighting lines.

Usage: In a "B" power-pack.

Outstanding features: Simplicity of design. Accommodates the new BH type Raytheon tube. Furnishes the proper values of inductance for the filter circuit. Easy to install. Compact.

Maker: Dongan Electric Mfg. Co.



An Automatic "A" Battery Charger for Your Set

Name of instrument: Storage "A" battery with automatic trickle charger.

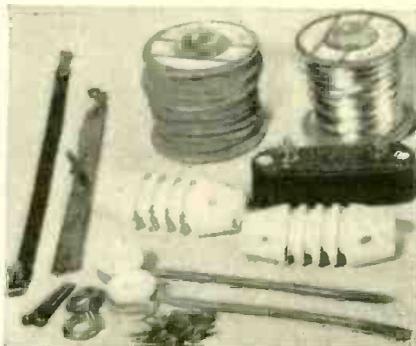
Description: This combination instrument is completely inclosed in a brown, crystalline finished, metal case which is perforated for ventilation, and which measures only 11 inches by 6 inches by 8½ inches. The unit consists of a 6-volt storage "A" battery, an automatic relay switch and a trickle charger. The device is so arranged that when the filament switch on the panel of the receiver is turned "on" the battery is connected to the filaments of the vacuum valves. When the switch in the receiver is thrown "off" the automatic relay in the battery unit connects the trickle charger to the battery and the battery is thus continuously charged at a slow rate while the receiver is not in use. The charger consists of a step-down transformer and a dry, electrolytic rectifier and also a regulating resistance by means of which the charging rate can be adjusted to any one of four rates of approximately .15, .25, .50 or .75 ampere per hour. A fuse is provided in the circuit to prevent damage in case the output

terminals are accidentally short-circuited. The efficiency of the charging unit is extremely high and the operating cost of the charging device, even at the highest charging rate, is somewhat below 1/10 of a cent per hour.

Usage: As a continuous and dependable source for the filament-current supply for a radio receiver which uses standard 5-volt vacuum valves.

Outstanding features: Compact in size. Self-contained battery and charger. Automatic charging control. The charger uses a dry electrolytic rectifier and therefore requires absolutely no attention on the part of the user.

Maker: The Prest-O-Lite Co., Inc.



Complete Parts for That New Antenna

Name of instrument: Antenna kit.

Description: This kit includes everything needed for the installation of a first-class antenna. It includes stranded antenna wire, rubber covered wire for the lead-in and the ground connections, a lightning arrester, porcelain insulators for the antenna and porcelain stand-off insulators for the lead-in wire, a ground clamp for making the ground connection to a pipe or radiator, an insulated strip which is used to bring the lead-in wire through a window and the necessary screws and tacks.

Usage: For the erection of a complete outdoor antenna.

Outstanding features: Complete kit. All parts used are high grade.

Maker: Packard Electric Co.



A Double Cone-type Loudspeaker that Is Also a Ceiling Lamp

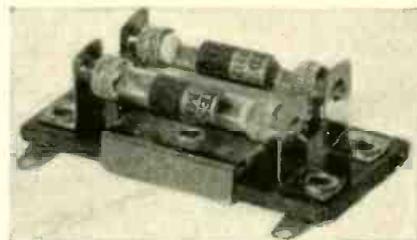
Name of instrument: Cone-type reproducer.

Description: This reproducer, which contains both a large and small cone made of translucent material, contains a reproducer unit that operates both of the cones or only the large one, as the user desires. It also contains a lamp fixture which may be connected to the lighting circuit. The light of the lamp shines through the colored cone and is reflected to the ceiling, giving a pleasant indirect light. The tone quality is exceptionally good.

Usage: In connection with a radio receiver as a reproducer of broadcasting.

Outstanding features: Novel design. Serves as a lamp and reproducer. Good quality. Capable of great volume.

Maker: Electravox Studios.



A Convenient Unit for the Resistance-Coupled Amplifier

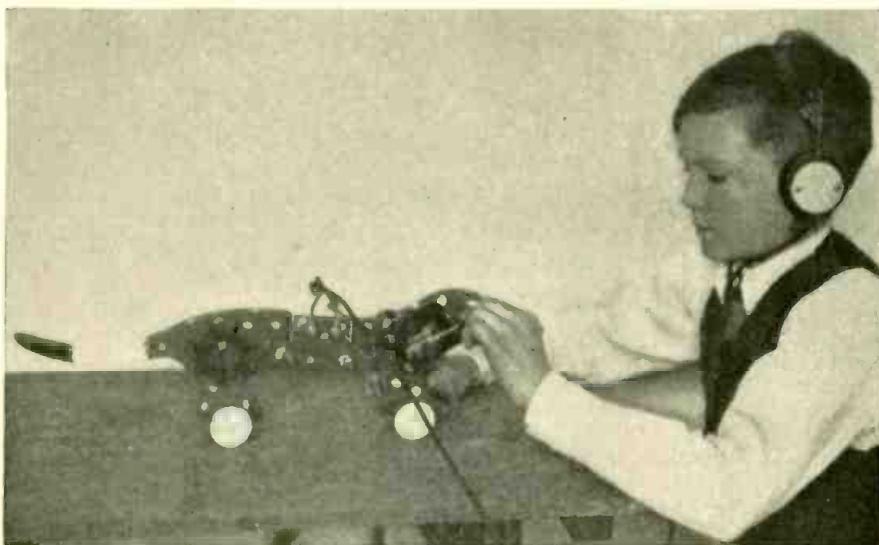
Name of instrument: Resistance coupling unit.

Description: This is a compact and simple unit which consists of a fixed, blocking condenser and two resistance units. The latter are mounted between spring clips and can easily be removed by simply slipping them out of their clips. The entire assembly is mounted on a base of composition material and convenient terminals are provided in the form of soldering lugs at the four corners of the base.

Usage: As a coupling device between vacuum valves in a resistance-coupled amplifier.

Outstanding features: Compact size. Easy to install. Easy to remove and replace resistances while experimenting to determine the proper resistance values for any particular part of a circuit.

Maker: Aerovox Wireless Corp.



Pacific & Atlantic

A "TALKING" DOG BUILT BY A TWELVE-YEAR-OLD FAN
A complete crystal radio receiving set is mounted along the backbone of this toy dog; it was built by George Frazee, a Los Angeles boy, from about \$1.50 worth of apparatus.



A Device That Prevents Waste of Battery Current

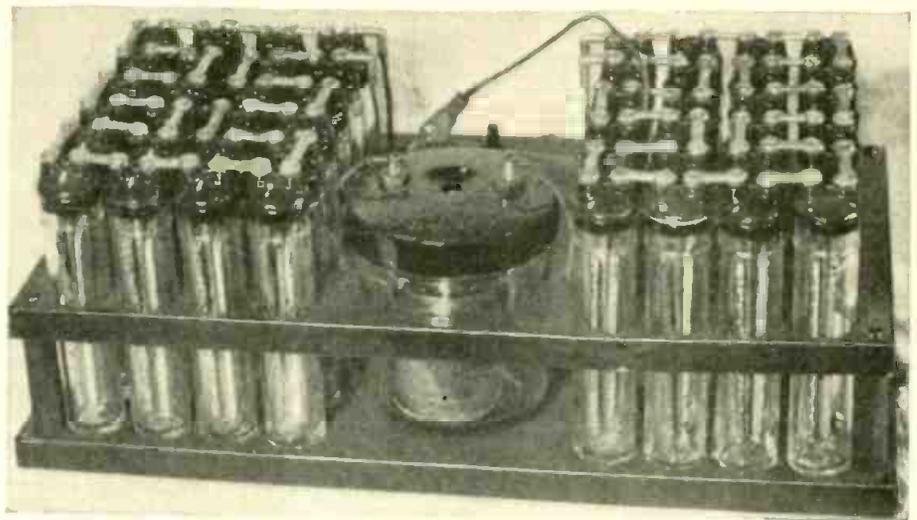
Name of instrument: Combined battery switch and pilot light for radio receivers.

Description: This device is a compact battery switch which, in addition to turning a receiver "on" and "off," also operates a pilot light which is mounted directly on the frame of the switch. It is mounted directly on the panel of the receiver by means of a single hole mounting and it is equipped with a small colored glass window which is intended for mounting on the panel directly in front of the pilot light. Thus, when the switch is turned "on" the pilot lamp lights up and gives visible indication, through the colored glass window, that the receiver is turned "on."

Usage: In a receiver for turning the receiver "on" and "off" and as an indicator as a safeguard against leaving the receiver turned on when it is not actually in use.

Outstanding features: Sturdy construction. Compact size. Easy to install. Positive in operation.

Maker: Yaxley Mfg. Co.



This Unit Eliminates the "B" Battery Replacement Problem

Name of instrument: Storage "B" battery and charger.

Description: The battery consists of two banks of 24 cells each, and has a total average voltage of 96 volts. Each cell is inclosed in a cylindrical glass container with a porcelain top. The container measures approximately 1 1/4 inches by 6 inches. The capacity of the unit is approximately 2000 milliamperes hours.

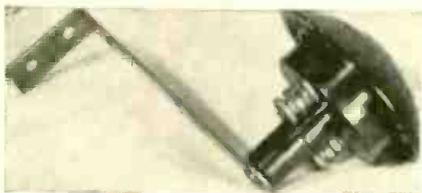
The cells are mounted in a metal rack with one group of cells at each end. In the center is an electrolytic charger, by means of which the entire battery may be charged at one time. A four-pole, double-throw switch is

included in the unit, by means of which the two groups of cells may be connected in parallel for charging or connected in series for use with a receiver.

Usage: As the plate-voltage supply for a radio receiver, or for any other use where the current consumed does not exceed approximately 100 milliamperes.

Outstanding features: Compact arrangement. Well constructed. Easy to charge. Suitable for use with any receiver, especially with receivers which draw a high plate current. Battery and charger contained in a single unit.

Maker: Graynie Corp.



Lightning Protection in a Neat Form

Name of instrument: Lightning arrester for radio installations.

Description: This arrester consists of a composition cap within which is located the protective device, and beneath which are the terminals for connecting the antenna and ground wires. The whole is mounted on a metal bracket for mounting the device outside of the window. This bracket also serves to keep the instrument well away from the wall of the house, in accordance with the requirements of the Board of Fire Underwriters. The projecting cap helps to protect the terminals from the weather, and the protective device itself is completely inclosed, and therefore fully protected.

Usage: To protect any radio receiver installation and its surroundings from possible damage due to heavy charges of static, or lightning.

Outstanding features: Nice appearance. Solidly constructed. Mounting bracket provides adequate spacing from building.

Maker: Swan-Haverstick, Inc.

A Set With a Novel "Rejector" to Get Rid of Interfering Stations

Name of instrument: Bremer-Tully "Eight" Counterphase Receiver.

Usage: As a receiver for radio broadcast reception.

Outstanding features: Simplicity of operation. Good design and careful construction. Neat appearance. Specially designed to provide maximum selectivity through the use of a built-in rejector circuit. Good tone quality.

Description: In appearance the "Eight" is rather unusual, in that the panel that carries all of the tuning and adjustment controls occupies only a small portion of the front of the cabinet, and is entirely concealed when not in use. A small lower portion of the front of the cabinet is in the form of a drop door behind which this control panel is concealed.

Above this door, and in the center of the front, is a window, framed in bronze, through which the calibrated tuning scale may be seen. This scale makes use of an especially clever arrangement for indicating the wavelength to which the receiver is tuned.

The cabinet is of excellent material and workmanship and is finished in a deep brown shaded effect, lacquered and hand-rubbed.

The entire top of the cabinet is hinged to allow access to the receiver units. These units are all mounted on a strong, cast aluminum base, or

(Continued on page 286)



From a photograph made for POPULAR RADIO

A SEVEN-TUBE SET THAT IS TUNED BY A SINGLE CONTROL

An unusual feature of this receiver is the panel design; all of the controls are mounted on a strip near the bottom of the panel which is concealed behind a long, low door when the controls are not in use. The calibrated tuning scale may be seen at the center of the cabinet front.

A Popular-Priced Power-Operated Receiver

Name of instrument: Amrad Neutrodyne Type AC-5 and Amrad Power Unit.

Usage: For radio broadcast reception.

Outstanding features: All operating current drawn from AC lighting lines. No batteries used. Good tone quality. Good appearance. Popularly priced. Easy to operate. Equipped with a power amplifier.

Description: This receiver outfit consists of two separate units: the receiver unit which is inclosed in an attractive wooden cabinet and the power-pack or power unit which is inclosed in a perforated metal case. A connecting cable is supplied to provide the connections between the two units.

The receiver, which is of the table-mounting type, presents an attractive appearance. The cabinet is a massive affair, not in size but in the construction and in the heavy material used. It is all of wood, including the front panel, and is finished in a two-tone mahogany, paneled effect. The top is hinged to provide access to the interior.

The front panel of the receiver carries all of the operating controls except the switch which turns the power "on and off." This switch is in the form of a pendant and is attached to the power unit by a five-foot cable.

The panel control consists of the three tuning knobs and a fourth knob which controls the amount of current to the vacuum valve (or tube) filaments. Immediately above each of

the tuning controls is a small window through which is visible the calibrated scale that is operated by the corresponding tuning control. The fact that there are three tuning controls does not make the process of tuning difficult because the settings of the three controls, for a given wavelength, are approximately alike. Then, too, a given broadcasting station will always come in at the same setting of each of the tuning controls.

Just above the filament control on the panel is a milliammeter which shows the amount of current being fed to the filaments of the UX-199 type valves. The power control knob is adjusted until the hand of this meter points to a section of the meter scale which is marked in red to indicate the proper operating point for the receiver. Once this adjustment has been made this control requires no further attention unless to make up for some variation in the line voltage itself.

There are no controls in the power-pack. All of its output voltages are permanently regulated to meet the requirements of the receiver before the unit leaves the factory. No attention to this factor is necessary on the part of the purchaser of the receiver, except one adjustment that must be made when the unit is first installed. The purpose of this is to accommodate the unit to the line voltage in the particular location where the receiver is put into operation.

Inside of the power-pack, on the case of the transformer, are two terminals

marked "H" and "L." Between these two terminals a short length of wire is found, projecting from the transformer case. This wire terminates in a metal tip which fits either of these two terminals. When the outfit is first installed, this wire is connected to the terminal marked "L." If, when the receiver is put into operation, the meter hand cannot be brought up to the required point (60 milliamperes) on the scale, then the wire in the power unit should be disconnected from the "L" terminal and reconnected to the "H" terminal. It will then be found possible to obtain the proper reading on the meter scale, and the receiver will be ready for operation. Thereafter, this connection in the power-pack need never be changed.

The power-pack consists of a power transformer, rectifier and filter, all of which are completely inclosed in a metal case. The device is made fool-proof by the inclusion of a cut-off switch which is automatically opened when the cover of the metal case is removed. Thus the power unit will operate only when the cover is on.

The design of the power-pack and the material used make this unit admirably suited to its purpose. There is no hum when the receiver is in operation and there is an extremely small chance for anything to go wrong in the power-pack. The filter condensers, which are usually the weakest link in a power-supply device, are of the electrolytic type and are designed with a considerable factor of safety.

The power transformer used in this unit supplies the high voltage, which then passes through the full-wave rectifier, which consists of two rectifier valves of the UX-216-B type and thence through the filter. The DC output from the filter then goes to the receiver through the controlling resistances which are incorporated in the power-pack. This direct current not only supplies the high-voltage requirements of the plate circuits of the receiver, but also provides the filament supply for the four UX-199 type valves. This arrangement is made possible by the fact that the filaments of these tubes are connected in series, and therefore require a total current of only 60 milliamperes. Alternating current is suitable for the filament supply for the UX-112 type power valve and this is supplied direct from a low-voltage winding on the power transformer.

The antenna should be erected outdoors if such an arrangement is at all possible. It should be between 50 and 75 feet in length, except in locations that are well isolated from broadcasting stations, where the antenna may be up to 100 feet in length. In city locations an antenna not exceeding 50 feet in length will provide the best selectivity.

The reproducer recommended by the manufacturer of this receiver is the Amrad "Cone Table" or the Crosley "Super Musicone." The audio amplifier of this receiver is especially designed for use with either of these reproducers and therefore gives better results with them than with most other kinds. In any case it is certain that the tone quality of this combination is very good.

Maker: The Amrad Corporation.



From a photograph made for POPULAR RADIO

A "NO BATTERY" RECEIVER AT A POPULAR PRICE

This receiver, which is of the table-mounting type, operates directly from the AC house lighting lines. The cabinet and the front panel are both of wood and are finished in a two-tone mahogany. Three tuning controls are used, but as the settings of all three are always approximately the same, tuning is not at all difficult; the fourth control regulates the filament current supply.



IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

The Possibilities of Television

THE past winter has served to introduce one more technical term into the American mind, where now such erstwhile mysteries as atom and electron and wavelength possess, thanks to radio, their familiar chairs. The newcomer is television.

On December 15, Dr. E. F. W. Alexanderson, of the General Electric Company, presented before the St. Louis Section of the American Institute of Electrical Engineers, an address in which he summarized the state of the problem of television at that time.* Few scientific events of recent years have attracted so much popular attention or have been noted so widely.

Just two weeks after the Alexanderson address, Mr. J. L. Baird, of London, announced that he had perfected a new television device by which it was possible, not merely to see by radio or over a wire, but to see in the dark; the apparatus being operable by a so-called invisible ray which Mr. Baird had perfected.†

Virtually all processes of television or radio vision depend on the same fundamental principles. A thin pencil of light is caused to cross back and forth over the picture to be sent, as though each tiniest spot of the scene were made luminous in turn, all the rest of the scene being dark. Perhaps a better illustration is the beam of a searchlight picking out a landscape at night or the light-ray of a pocket flash light going over, bit by bit, the walls and contents of a darkened room. The television light pencil does not "see" the view all at once, as our eyes do; but in succession, one bit at a time.

This light ray, carrying successive bits of the view, is then converted, by a photoelectric cell or some similar device, into an electric signal. Like the light ray itself, this signal carries the scene to be transmitted; not all at once but bit by bit. It is as though the letters of this printed page were not visible all at the same time on the paper, but came along one after the other on a printed tape. At the receiving end the successive bits of the view which the electric message brings, whether by radio or over a wire, must be put together again on the flat, so that the

view can be seen all at once in the manner which our eye requires.

There is no difficulty about this process except the difficulty of time. Many variants are already in use for transmitting photographs, diagrams or similar matter; where the light-pencil at the transmitting end can have plenty of time to trace out each element of the picture, transmit it and procure its equivalent tracing on the blank sheet of the receiver. But that is not television. In order that we should be able to see at the receiving end of the apparatus what looks like a natural view or like a moving picture, at least ten complete pictures must be traced each second. The standard motion picture presents sixteen successive pictures in each second. To decrease this number below ten or twelve a second produces an annoying flicker.

In his St. Louis address Dr. Alexanderson reviewed these facts and added one method in which the limitation of speed might be partially overcome. It was possible to use, he said, not merely one moving pencil of light but a number of them, each moving independently and simultaneously. In a model built by himself seven such light pencils are used. Thus each pencil needs to cover only one-seventh of the entire area of the



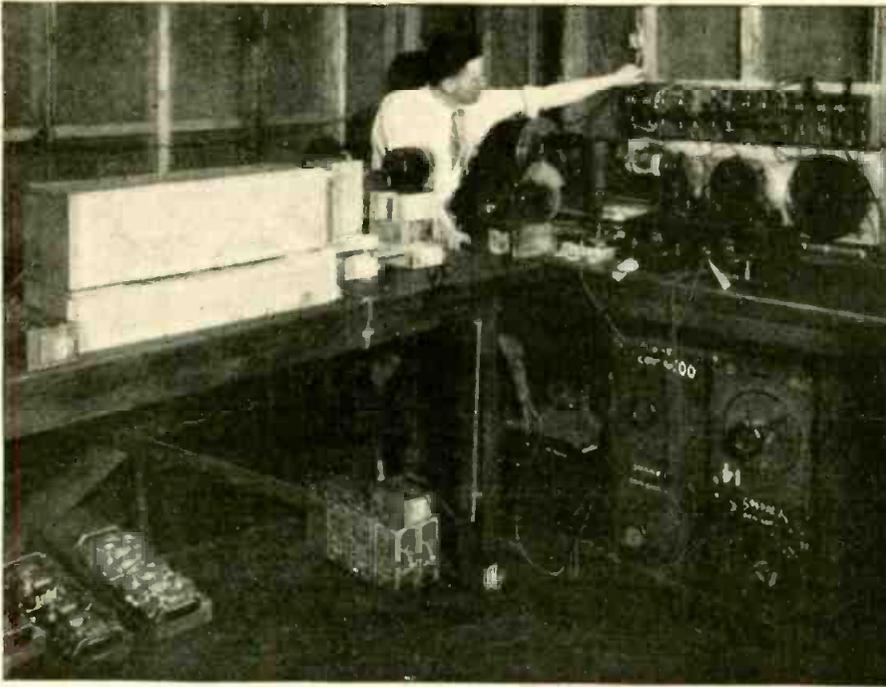
General Electric

HOW DISTORTION MAY AFFECT TELEVISION

Just as distortion in the receiver may make our ordinary broadcasts sound annoyingly untrue, so a similar distortion in Dr. Alexanderson's receiver for radio pictures produced this badly altered copy of an original drawing; released by Dr. Alexanderson, not as an example of success, but to show "how not to do it."

*Dr. Alexanderson's address was circulated in mimeograph form by the Publicity Department of the General Electric Company and was printed widely in newspapers on December 16, 1926.

†Mr. Baird's announcements were reported in cable dispatches from London on December 30, 1926. For an account of the Baird "televisor" see the article by Orrin E. Dunlap, Jr., in *POPULAR RADIO* for November, 1926, pages 649-650, 663, 670.



General Electric

WHERE THE PICTURES ARE SENT BY RADIO

This is the photo-radio transmitter used by Dr. Alexanderson to transmit pictures at speeds as great as one complete picture in two minutes. To attain real television, more than 600 complete pictures a minute would need to be sent and received.

picture. In use each light pencil of the receiver must be controlled separately by a similar light-perceiving apparatus at the transmitter; thus requiring seven ether-channels instead of one, radio being the medium of transmission. Even with the seven light pencils, the speed attained is far below that necessary for real television. Dr. Alexanderson has sent a picture in two minutes, whereas one in a tenth of a second is the goal which must be reached.

In the concluding paragraph of his address Dr. Alexanderson makes this statement: "Our work has already proven that the expectation of television is not unreasonable and that it may be accomplished with means that are in our possession at the present day."

Much as he hesitates to disagree with an engineer of the competence of Dr. Alexanderson, the Editor of this Department cannot bring himself to be quite so optimistic. It is true enough that television is not unreasonable. It is less certain that means at present known will be sufficient to bring it about. The seven light pencils of Dr. Alexanderson's apparatus are still far from fast enough and they have already introduced an enormous electrical and mechanical complexity, as well as an undue absorption of ether channels. Would it not be better to break new ground; to hunt for some totally new idea of how television might be accomplished, instead of attempting the enormous task of speeding up sufficiently the methods that are now in use for transmitting photographs.

The announcements of Mr. Baird, in London, are of much less interest and importance than the suggestions of Dr. Alexanderson. The essentials of the Baird method are like those of every other method. A mediocre result can be attained but there is no sign that improvements in speed will ever be suf-

ficient to solve the practical problem of seeing over the ether or through a wire. The much-heralded "invisible ray" turns out to be nothing more than the well-known rays of infra-red light, used by Dr. Coblentz and General Ferrié, for signalling and already familiar to all physicists. † Any television apparatus that will operate at all can be adjusted for the use of this ray instead of for ordinary visible light, but to talk of seeing in the dark with such a device is pure moonshine, and not visible moonshine either. The famous "secrets" which Mr. Baird is supposed to have imparted to the British Government arent this ray are probably common knowledge already in every physical laboratory.

†See: "The 'Black Light' Radio," by S. R. Winters. POPULAR RADIO for December, 1924, pages 592-596.

The "Opaqueness" Theory of Radio

An example of how a perfectly correct piece of observation may be misinterpreted to prove an impossible theory is furnished by the "shadow" or "opaqueness" theory of radio promulgated recently by Mr. A. J. Musselman of Chicago, Illinois, and which received considerable attention in the newspapers.

Just what the fundamentals of the theory are it is difficult to determine
(Continued on page 270)



International

A LIGHT BEAM THAT "CONFIRMED" A WRONG THEORY OF RADIO

When this powerful searchlight beam, at the Air Mail Field at Maywood, Illinois, was turned on between a radio transmitter and the receiver to which the waves were passing, the effect of the light in ionizing the air decreased the perfection of reception. This was mistakenly thought to prove the correctness of the "opaqueness" theory of radio.

FEATURING THE NEW GENERAL RADIO DOUBLE IMPEDANCE

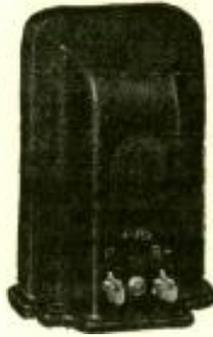
A NEW Amplifier Unit

which provides for **FAITHFUL REPRODUCTION** of

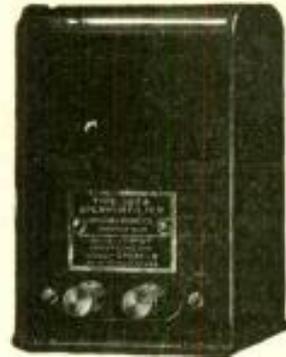
FULL ORCHESTRATION



Type 373
Double
Impedance
Coupler
Price \$6.50
(2 required)



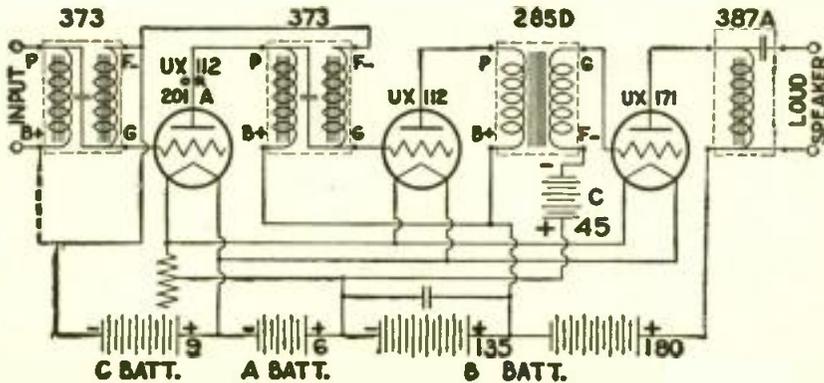
Type 285-D
Audio
Transformer
Price \$6.00
(1 required)



Type 387-A
Speaker
Filter
Price \$6.00
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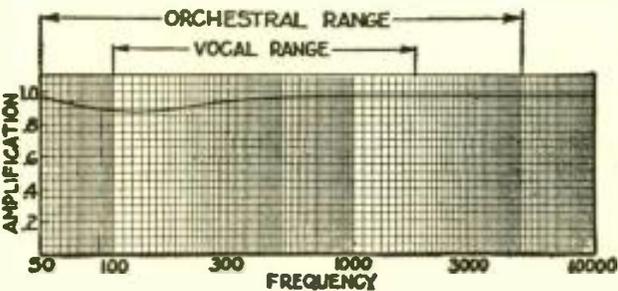


Type 349
Ux-Tube Socket
Price 50c
(3 required)



Type 410
Rheostat
6 ohms
Price \$1.25
(1 required)

A Graphic representation of Vocal and Instrumental Tones as they are amplified by the Type 373 Double Impedance Coupler



The extent of its range of even amplification is from appreciably below 60 cycles to over 10,000 cycles, with a gradual downward deviation of slightly less than 7% between 100 and 400 cycles. This deviation in an otherwise perfect amplification curve is slight as to be practically negligible, because the ear of the average individual cannot detect a variation of intensity of much less than 25%.
The amplification curve, in fact, compares favorably with that generally obtained with resistance coupled systems which have the disadvantage of large sacrifices of plate voltages.

The above circuit diagram shows a combination of two stages of double impedance coupling and one stage of transformer coupling with speaker filter.

While the use of double impedance is not new in principle, the General Radio Type 373 Double Impedance Coupler is unique in design and performance. To facilitate installation, the complete unit, consisting of two impedances and a fixed condenser, is contained within a metal shell. It is connected in an audio amplifier circuit in precisely the same manner as a transformer. The amplifier combination shown above may be readily adapted to any standard manufactured or home constructed receiver and will produce a very noticeable improvement in tone quality.

Its high and even amplification extends over the range of FULL ORCHESTRATION. The deep bass tones of the tuba are brought out in full timbre as are the shrill notes of the piccolo. The range of the human voice is covered with pleasing clarity.

The above amplifier combination has the further advantage that it may be used with the General Radio Type 405 Raytheon Plate Supply Unit. By substituting two Type 373 Units for the transformers of a two stage transformer coupled amplifier the above combination may be completed and proper plate voltages provided by using the General Radio Type 400 Power Amplifier and Plate Supply.

Ask your dealer or write for Folder 373-P.
GENERAL RADIO CO. :: Cambridge, Mass.

GENERAL RADIO

PARTS and ACCESSORIES

The General Radio Company has endeavored to make it possible for the experimenter to obtain its products with minimum of effort. A careful selection of distributors and dealers has been made. They are best suited to serve you. If, however, you are unable to obtain our products in your particular locality, they will be delivered to you, post paid, direct from the factory upon receipt of list price.

YAXLEY

APPROVED RADIO PRODUCTS

Automatic Power Control



The Yaxley Automatic Power Control does all the extra switching for you. It takes care of your B eliminator or trickle charger or both. When you turn your set on, the trickle charger is off, the B eliminator is on. When you turn the set off, the Power Control is standing guard for you. It works automatically and without fail to turn off the B eliminator and turn on the trickle charger.

No. 444, Series Type—for use with sets with tubes having a current draw equal to or greater than 6 U.V.-199 type tubes. Each, \$5.00

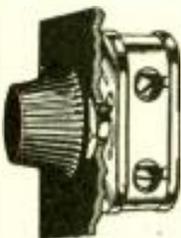
No. 445, Multiple Type—for use with any set and especially for sets having tubes with a current draw lower than that of 6 U.V.-199 type tubes. Each, \$6.00

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Bradleystat

PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Avenue Milwaukee, Wis.

Bradleyometer

THE PERFECT POTENTIOMETER

Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 200 and 400 ohm ratings.



Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Avenue Milwaukee, Wis.

In the World's Laboratories

(Continued from page 268)

but the proof offered for it is simple. At the Air Mail Field of the United States Government, at Maywood, Illinois, Radio Operator Arthur Frietag made tests of radio reception between a near-by transmitter and a receiving set. In the dark, reception was good. Then the beam of a powerful searchlight was turned on so that it traversed the space between the transmitter and the receiver. Reception was immediately less good. This was taken by Mr. Musselman, who was present, to prove that "opaqueness" (really merely darkness) is essential to good radio transmission.

The secret is, of course, simple. The beam of light from the searchlight had some effect, as all light has, in ionizing the air. The cloud of electrified air particles thus created in the space which the radio waves were traversing had disturbing effects on these waves; perhaps absorption effects so that the waves were weakened, possibly still other effects like bending or refraction. All this is quite well-known but seems to have escaped Mr. Musselman's attention. The beam of the searchlight merely did on a small scale what the light of the sun striking the earth does on a large scale. The experiment, however, is interesting and opens the way for further determinations.

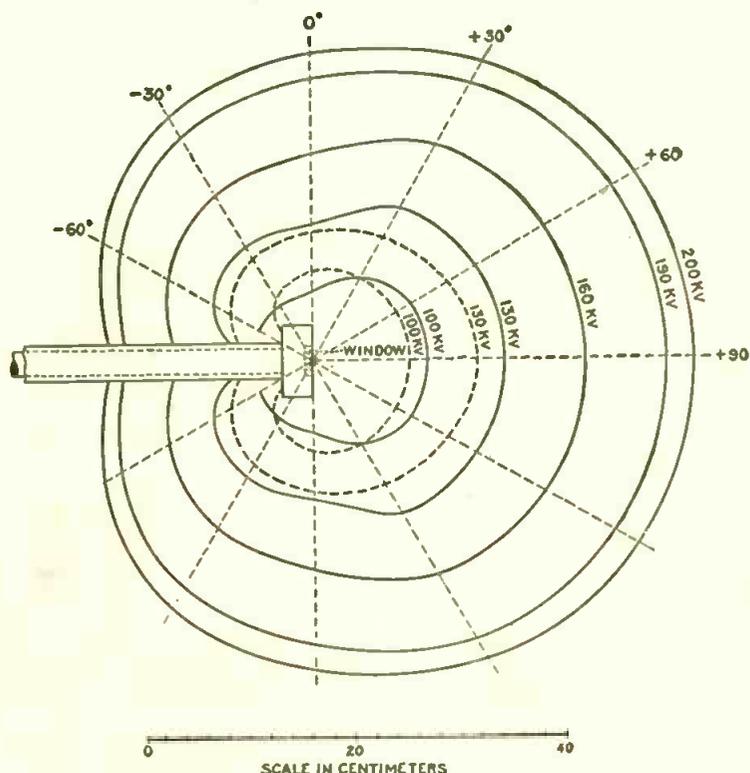
"Death Rays" and the Coolidge Tube

THE famous electron tube devised by Dr. W. D. Coolidge of the General Electric Company two years ago and much noted in the newspapers last fall when it was exhibited to the Franklin Institute, in Philadelphia, has now been described in detail and with some improvements in a paper by Dr. Coolidge in the *Journal* of that Institute.* Essentially, the tube is a device for getting electrons out into the air in a stream of what are really the so-called "cathode rays" well-known from the classic investigations of Crookes, Sir Joseph J. Thomson and others on such rays inside vacuum tubes.

When the filament of a radio vacuum tube is heated, electrons escape from it. They escape also from the filament of a hot electric lamp or from any other hot body in a vacuum. Dr. Coolidge invented, some years ago, the Coolidge X-ray tube in which the X rays are produced by a stream of electrons driven at enormous speed against a "target" of metal inside the tube. The electrons are

*"The Production of High-Voltage Cathode Rays Outside of the Generating Tube," by W. D. Coolidge. *Journal of the Franklin Institute* (Philadelphia, Pa.), volume 202, pages 693-721 (December, 1926). Also, "Some Experiments with High-Voltage Cathode Rays Outside of the Generating Tube," by W. D. Coolidge and C. N. Moore, the same, pages 722-735.

FIG. 12.



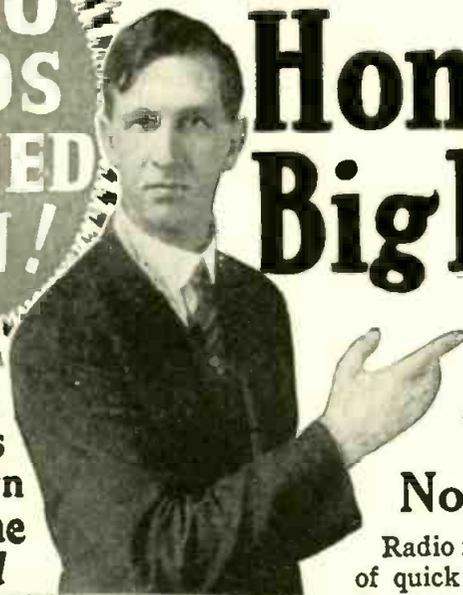
From the *Journal of the Franklin Institute*

A RANGE MAP FOR THE COOLIDGE TUBE

The electron tube perfected by Dr. W. D. Coolidge emits a stream of electrons through a window made of thin metal. Once out in the air, these electrons forsake their straight-line paths, being diverted by collisions with air atoms. The successive lines of this chart show the areas over which the emitted electrons spread at the tube voltages indicated.



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You Get All of This

All instruments shown here and others sent to all my students free of extra cost under special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.



\$70 in One Day For T. M. Wilcox

"I am in business for myself and RECENTLY MADE \$70 in ONE DAY. I was an electrician of rich experience, occupying a splendid position as telephone superintendent when I enrolled with you believing it would open up greater opportunities—have not been disappointed. Estimate Radio will be worth tens of thousands of dollars to me in next few years." T. M. Wilcox, Belle Island, Newfoundland.

World Famous Training That "Pays for Itself"

My Radio course World-Famous as the training that "pays for itself." Make more money QUICK when you take up this practical course. Work on millions of antennae, receiving sets, offers you big chance to make spare time cash while you're learning. I'll show you how—teach you the latest "dope," furnish you with business cards, show you how to get the business and make it pay. My students don't wait a year to increase their income—they report QUICK INCREASES as a result of this course—often two or three weeks after starting.

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So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods make it possible for you to start RIGHT AWAY toward one of the bigger Radio jobs. Many men in Radio now earning \$50 to \$250 a week. No delay, no losing time from work—no scrippling or scamping to get your training.



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"Accepted a position with the Chicago Daily News Station WMAQ. MY INCOME PRACTICALLY DOUBLED, thanks to you. I handle all consultation, also do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAQ, Chicago, Ill.

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CLAROSTAT alone covers the entire range — from practically zero to 5,000,000 ohms. . . . and a current carrying capacity of 20 watts without the slightest trace of packing, arcing or frying noises.

Going fast! The first edition of "The GATEWAY TO BETTER RADIO" is almost exhausted. Send for your copy at once. 32 pages covering everything in radio. Send 25c to Dept. P. R.

American Mechanical Labs., Inc.
285 North 6th St. Brooklyn, N. Y.



produced from a hot filament in the usual way and are formed into a speedy stream by the electrostatic attraction of a high-voltage electrode inside the tube. This is much the same as the action of the "B" battery voltage in drawing the electrons of a radio vacuum tube over to the plate.

This Coolidge X-ray tube was already a device for producing a stream of electrons, but this stream was in a vacuum. The new tube gets it out into the air. This was first accomplished over thirty years ago, before much was known about electrons, by the French physicist Lenard, to whom Dr. Coolidge makes due acknowledgment. A window of thin metal was inserted in one end of the glass tube. Against this a stream of electrons was directed. Some of them got through into the air but the attachment of the metal window to the glass leaked and the tube was otherwise unsatisfactory. Since that time the procedure of sealing metal to glass has been perfected, mainly by Dr. William G. Housekeeper of the Bell Telephone Laboratories. Making use of this newer knowledge and using a window of thin nickel or copper foil supported by a gridwork of heavier metallic molybdenum, Dr. Coolidge was able to produce a form of Lenard tube which would not leak air and which did discharge electrons.

The electrons escape through the metal window in the form of a conical beam of fast-moving electric particles. Some of these particles hit against the atoms of the metal foil through which they must pass and are deflected sideways. Others hit against atoms of air and are similarly scattered. Accordingly, the thin beam of electrons which exists

inside the tube becomes, when it escapes, a more or less diffuse cloud of these particles, more concentrated in the direction of the inner beam but spreading out to some extent in all directions.

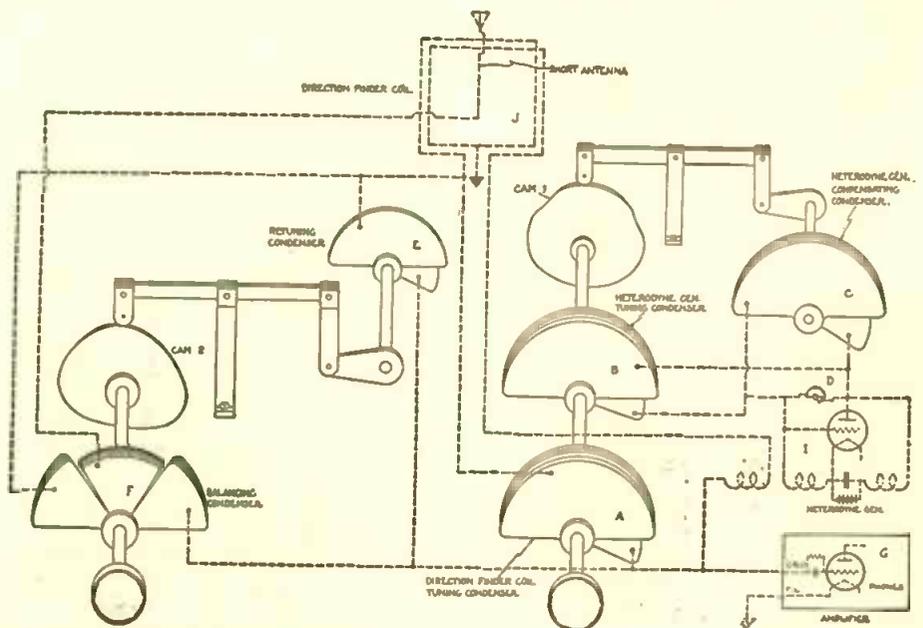
Many striking experiments have been demonstrated by Dr. Coolidge with this electron beam in air. It will act powerfully on chemical compounds, produce light in many minerals, destroy living matter, and so on. It has been compared to a more concentrated kind of radium but the comparison is not quite accurate, at least in so far as the curative action of radium is concerned.

A Small Portable Radio Compass

AN interesting development in radio direction finding is the small and portable radio compass recently perfected by Mr. F. W. Dunmore of the United States Bureau of Standards.* The entire apparatus is contained in a small aluminum box, which also serves as a shield against undesired radio energy. A vertical loop antenna may be turned around its vertical axis to obtain the directional readings.

The receiving circuit is a superheterodyne, as used in the standard receivers of the United States Signal Corps except that arrangements have been made to reduce the controls to two, one for tuning and one for balancing. A set of interchangeable antenna coils is provided, together with a compensating coil for the heterodyne generator for each.

*"A Portable Direction Finder for 90 to 7700 Kilocycles," by F. W. Dunmore. United States Bureau of Standards, Scientific Paper Number 536 (part of volume 21), pages 409-430 (dated July 1, 1926; title page dated October 21, 1926, distributed December, 1926.)



U. S. Bureau of Standards

HOW THE PORTABLE RADIO COMPASS IS CONSTRUCTED

The components of the new portable radio compass recently designed by Mr. F. W. Dunmore of the United States Bureau of Standards, are shown in this diagram. A superheterodyne circuit is used. Tuning is extended to a wide range of wavelengths by the use of plug-in loop antenna coils, together with cams to operate the auxiliary condensers.

The Big Fellows Use Faradons, Bill



Complete block assemblies for usual eliminator requirements.



Model T. The high efficiency, all metal mica receiving set type unit in desired capacities with convenient terminals. Very compact.



Convenient units for assembly or replacement in special filter hook-ups.



In 1/2, 1 and 2 Mfds.

"Believe me, I'm using 'em wherever I need a condenser.

"We can't do better than follow the lead of the Navy, R.C.A., General Radio Corp., General Electric, Westinghouse, Bell Telephone and many other quality equipment manufacturers when it comes to condensers. They all use Faradons!"

Dependability, convenience, and long life are built into Faradon condensers with the accuracy that comes only from years of experience, finest

materials and rigid inspection of the finished product.

Since 1907 Faradon experts have met condenser needs. There is a Faradon specially designed for each particular purpose. Get the Faradon unit or block having the capacitance desired in the operating voltage class to meet your requirements.

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Radio Measures the Earth's Waistline

THE world-wide tests of longitude by radio measurements planned in 1922 by an international committee of which the distinguished French radio engineer, General Gustav Ferrié, is chairman, were carried out successfully during October and November of last year. More than thirty nations participated in the tests. Practically all the astronomical observatories of the world made arrangements to tie their positions on the earth's surface into the remainder of the network. Reports indicating the successful receipt of the signals almost everywhere were made recently to the French Academy of Sciences* and to the American Astronomical Society, as well as to other participating scientific organizations.

The basic idea of the tests was the distribution of exact time, by radio, to each of the observing stations. By comparing this true time with the local time, as indicated by the sun, the exact longitude of each station can be determined. Ordinarily astronomers and surveyors use a chronometer for this time determination, adjusting the chronometer carefully at some standard meridian of longitude, like that of Washington or of Greenwich, and then carrying the chronometer to the station which is to be occupied. The difficulty is that the chronometer may change.

The method adopted for the recent tests was not the dependence on any one signal sent at a prearranged time, but the daily sending and reception of a series of signals transmitted at different hours and on different wavelengths. This was repeated for two months.

*"On a Great World-wide Operation for the Measurement of Longitudes" (In French), by M. Ch. Lallemand. *Comptes Rendus de l'Académie des Sciences* (Paris), volume 183, pages 765-768 (November 8, 1926).

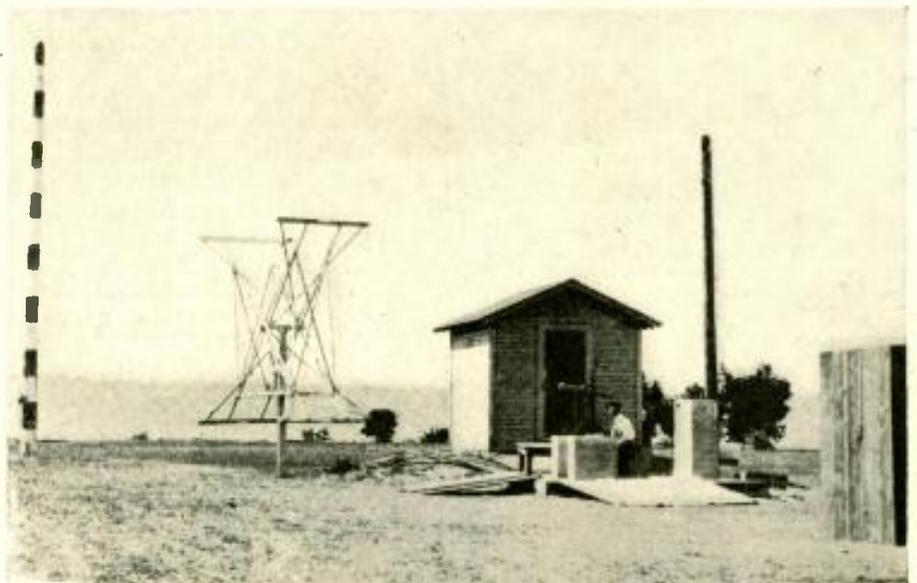
Another Human "Aura" Claimed

Two Swiss investigators, Professor L. Farny and Dr. E. K. Müller, both of Zürich, have published recently some remarkable experiments which they claim prove the existence of some kind of emanation which escapes continually from the human body and which they call the "anthropoflux."*

A simple experiment is typical of all. A tiny condenser, made of two small plates of silver separated by a small air gap, is connected with an electrometer and a forty-volt battery and is placed near the skin, so that the supposed anthropoflux can pass between the plates of the condenser. This mysterious flux evidently decreases the insulating power of the air, for the charge gradually leaks across the condenser and is registered on the electrometer.

Assuming that the observations are correct, which is probable enough, one seeks for an explanation less startling than the assumption of some human emanation hitherto unknown; anything that would ionize the air in the condenser would serve. Possibly heat rays from the body would do this, but that is uncertain. It is conceivable, also, that activated atoms of one gas or another are escaping from the human skin continually, as a result of perspiration or of the small amount of respiration which the skin itself is known to carry on. Still other guesses are possible, none of them quite so unlikely as the one which the Swiss investigators appear to prefer. It is to be hoped that more experiments will be done and the matter cleared up.

*"A Flux Emanating from the Human Body which Renders the Air More Conducting and Increases the Dangers of High-Voltage Electricity" (In French), by L. Farny. *Bulletin no. 10 de l'Association Suisse des Electriciens*, Reviewed by "F. L. L." in *L'Industrie Electrique* (Paris), volume 35, pages 550-552 (December 10, 1926).



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WHERE THE EARTH'S GIRTH WAS MEASURED

At this station, near San Diego, California, Captain F. B. Littell of the United States Naval Observatory took part in the world-wide plan of determining longitudes by radio, organized by General Ferrié of the French Army and recently completed.

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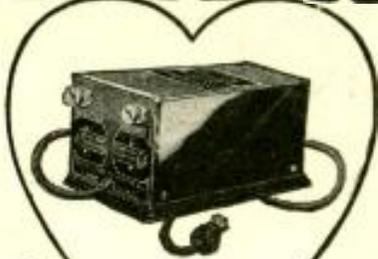
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Static "Messages" from the Sun and Their Mythical Effect on Human Wars

ONE of the successes of the recent meetings of the American Association for the Advancement of Science, so far as publicity is concerned, was an incidental remark by Professor Michael I. Pupin, made at the end of his address as retiring President of the Association on the evening of December 27, 1926, in Philadelphia. Dr. Pupin had been discussing the history of the art of communication, as exemplified by the telephone and the radio telephone; he concluded by stating that he had discussed communications between persons on earth; he wished now to say a word about another kind of communication—that between the sun and the earth. Static and radio fading and other things which we now regard as annoyances were better regarded, he believed, as messages from the sun, messages which we might be able, one day, to read.*

This idea that terrestrial radio is affected by electric, magnetic or other disturbances in our familiar luminary is not a new one; indeed, the Editor of this Department had the honor to express a similar opinion in the very first issue of POPULAR RADIO, nearly five years ago.† Dr. Pupin's statement took hold, however, of the public fancy. Widely telegraphed by the press, it seems to have been interpreted by many editorial writers and others as indicating that Dr. Pupin had gone over to the side of the mystics and believed the sun to be inhabited by living creatures like ourselves, whose supposed "messages" to us were what he (Pupin) had in mind.

There can be no argument against the Doctor's real meaning, that sunspots and solar eruptions and other similar events are reflected on earth by radio disturbances which we ought to be able to read. That static is one of these disturbances due to direct action from the sun is unlikely; too much evidence now points to thunderstorms as the cause of most of the static, if not of all of it. Fading is more probably a direct solar phenomenon and there can be no doubt at all that the occasional periods of very low transmission—periods which the fans sometimes refer to as "blanketing"—are related to the magnetic disturbances created on earth by sunspots. All of this has been explained several times in the columns of POPULAR RADIO.

Modern astronomical discoveries make it certain that the sun is a great ball of white-hot gases; its surface temperature being in the neighborhood of ten thousand degrees Fahrenheit, and its central temperatures far higher, possibly as high as forty million degrees Fahrenheit. The upper layers of the sun, corresponding to the outer atmosphere of the earth, are composed of very thin gas, thinner even than the gas left inside the "vacuum" of a vacuum tube.

This dilute gas is highly luminous because of the radiation which it receives from the lower layers, farther inside the sun. A part of this radiation is heat and light, other parts are composed of ultraviolet rays and of the still shorter X rays. The power house is deep within the sun's mass. There occur the atomic transformations which are now believed to provide the sun's energy. This energy, radiated layer by layer out to the solar surface, finally escapes into space in the form of the heat and light of which we receive our share.

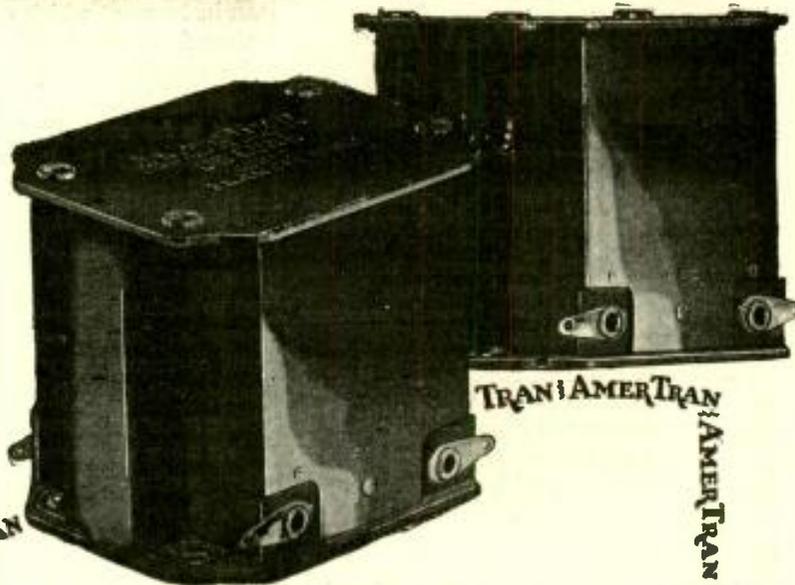
So long as this process goes on in a perfectly orderly manner, the internal energy flowing uniformly to the surface and escaping uniformly into space, it probably would have no effect on the variations of terrestrial radio from hour to hour or day to day. But the solar machine does not work with perfect smoothness. We can see occasional great storms in the visible surface layers of the sun; these manifest themselves as what we call sunspots. Scientific study has shown them to be great whirling vortices, like terrestrial tornadoes but incomparably vaster, for some of them are large enough to swallow a dozen earths at one bite. We know that these sunspot vortices are the site of enormous magnetic forces. There is reason to believe that powerful streams of electrons shoot out from these vortices and that sometimes these electron streams strike the earth, producing the Northern Lights and other electric effects.

Sunspots wax and wane in frequency according to a cycle of about eleven years. The next maximum of the cycle is due during the coming winter. The increase of the spots began over a year ago, as has already been noted in this Department. At present we are in a period of high sunspot activity; which will continue, it is expected, for two years or more in the future. It is notorious that we have experienced during the past two years worse radio conditions than for the three years previous to 1925. Most radio engineers and astronomers join with Dr. Pupin in ascribing this misfortune to the disturbing effect of the sunspots.

There is no doubt, then, that the sun and radio are related. The question is, what can we learn about the sun by radio studies? It is doubtful whether we can learn as much as Dr. Pupin expects. The great problems of the solar students are chemical and physical problems. Whence comes the energy of the sun? Why do the sunspots occur in cycles of eleven years? Is matter being made or unmade in the sun's interior? What happens to the sunlight that streams away so bounteously from the sun as it does from billions of other stars in space? Radio studies on earth are not likely to contribute much to the solutions of these problems. More help may be expected from the spectroscope,

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The manufacturer of AmerTran Products has a reputation for making *only* fine quality units, which, when subject to fair comparison, have proved their merit always.

This manufacturer has never misrepresented his products, their uses, or state of perfection. Solely on the basis of accomplishment has been earned the endorsement of the radio trade and the radio public.

This manufacturer will continue to offer dependable, well-designed and well-made products. Never will it be claimed that they are faultless or the ultimate. That would ridicule the efforts of those who are always turning the good article of today into the better article of tomorrow.

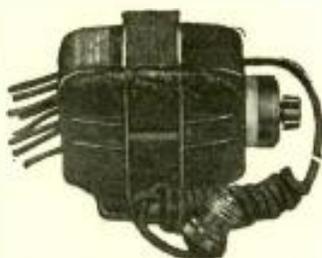
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Type PF-52 is intended for use in the better type of power supply developments. It will convert the standard 110 volt, 60 cycle alternating house lighting current to a higher voltage for the plate and lower voltage for filament supply. Price \$18.00 Each.



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This is a scientifically designed impedance or choke coil of general utility, designed primarily for use in filter circuits. As an output impedance for bypassing direct current from the loud speaker it is both efficient and economical. Price \$6.00 Each.



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GLENN H. BROWNING, Laurence M. Cockaday, Gerald M. Best and many other eminent radio designers use the Lynch Metallized Resistor in their experimental circuits and receivers. These men know radio; they have laboratory and testing equipment with which quickly to make accurate comparisons. There could be no better proof of the true merit of the Lynch Metallized Resistor than the endorsement of these experts.

Comprising a concentrated metallized deposit one-thousandth of an inch thick upon a rigid core, sealed forever within a glass tube, the Lynch Metallized Resistor gives conductive, non-arcing resistance that remains silent, accurate!

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Because the fixed resistor is small in size, do not underestimate its vital importance.

Precision in Manufacture
The utmost care, the best of materials, the most skilled craftsmen make each Lynch Metallized Resistor the precision-built, yet rugged little instrument that it is.
Frequent rigid inspections, and sufficient aging before final test make possible our guarantee—
Absolutely Noiseless Permanently Accurate Dependable!
Our warranted accuracy is 10% but through precision in manufacture, Lynch Metallized Resistors average within 5% in actual production.
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PRICES:—

.25 to 10 Megohms	.50	Single Mounting	.35
above .01 to .24 "	.75	Double "	.50
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Lynch Metallized Resistors cost no more than the ordinary kind. If your dealer cannot supply you it will be well worth your while to wait for the mail—we ship post-paid, at once.

LYNCH METALLIZED

FIXED RESISTORS

an instrument which can determine the atom from which a light ray comes and the condition of that atom when the light ray left.

It is far more likely that the studies suggested by Dr. Pupin will prove valuable in reverse direction than that which he suggested. Anything that astronomers can learn about the forces and changes in the sun will be sure to help us to understand and to overcome such pests as fading and blanketing. It is not so sure that what we learn about radio will help the astronomers with their solar problems.

Another communication presented to the meetings of the Association which Dr. Pupin addressed was by Professor A. Tchijovsky, of the University of Moscow. It proposed the oft-repeated thesis that sunspots cause wars, an idea that is as old as the first recorded discovery of the sunspots by the ancient Chinese. Adopting the eleven-year cycle now generally accepted, Professor Tchijovsky attempts to show that the greater disturbances of humanity tend to cluster around the years when sunspots are visible in maximum number. The idea is by no means impossible, for recent researches at Mount Wilson Observatory, also recounted at the Association meetings by Dr. Seth J. Nicholson, prove that for the present period at least the percentage of ultraviolet rays in sunlight increases with the increase of sunspots. It is these ultraviolet rays which have the most pronounced effect in electrifying the upper levels of the earth's atmosphere and probably in causing the weakening of radio propagation which we are now experiencing. More important for Professor Tchijovsky's idea is the fact that ultraviolet rays have powerful effects on the human body, causing sunburn, stimulating the circulation, curing such diseases as rickets and even growing hair on bald heads. It is by no means impossible that the increase of ultraviolet rays in sunspot years might do something wide-spread to humanity and have some really noticeable effect on human affairs.

But the proof of any theory is the way in which it fits the facts and by this test Professor Tchijovsky's sunspot theory of wars is found wanting. Only the most cursory examination of the data of history is necessary to show that wars or other disturbances do not follow any clear eleven-year cycle, which they would have to do if sunspots were their cause. To say, as some of the newspaper headlines did, that war will come in 1928 because sunspots will be plentiful in that year, is still farther from the actual truth.

*Dr. Pupin's address is published in full, but not quite as he spoke it, as "Fifty Years' Progress in Electrical Communications" by M. I. Pupin. *Science* (Lancaster, Pa.), volume 64, pages 631-638 (December 31, 1926).
†"Are We Getting Radio Signals from Another Planet?" by E. E. Free. *POPULAR RADIO*, volume 1, pages 8-13 (May, 1922).



A Message to Manufacturers

Today, buyers of radio receivers, battery eliminators and power amplifiers—insist upon the latest of approved designs and finest quality of performance. To you, the manufacturer, much depends upon your source of supply on parts.

For audio amplification, power amplification and battery elimination the very latest designs are found in Dongan Transformers. Exclusively a manufacturer of high-grade parts Dongan offers the newest improvements in engineering ideas and the extreme quality in construction — at a price within your purchasing requirements.

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Radio in 1950 A. D.

(Continued from page 230)

The Federal government may at some time be obliged to take over or directly supervise all broadcasting of general public character—and we may then have three or four great stations blanketing the country with a national program on a high wavelength, while local stations keep to lower wavelengths, or vice-versa.

Meanwhile the mission of the radio Moses is to lead us out to a really high-standard of broadcast reception. The loudspeaker or reproducer cannot make up for deficiencies in receiving sets.

Indispensable as radio has come to be in our daily lives, the radio art is still in its infancy. (I will risk that bromide because it is so very true.) It is a lusty infant, to be sure, but infant diseases linger—especially the whooping cough. We have yet to subdue the whoops of the receiving set. The task of the radio technician is to really cure the infant of pulmonary disabilities. Modelled on the telephone receiver, the radio reproducer has from its beginning been built on the piston principle of operation by moving a diaphragm or cone in the direction perpendicular to its surface. There may be discovered better ways to do this in the near future.

One advance in the art of reception we are on the verge of attaining; indeed, it may possibly be an accomplished fact by the time this is printed—the use of one large audion or valve as equivalent to a group of smaller ones, with several steps of high frequency amplification in the same valve or tube. This will get us away from the growing multiplicity of valves which has resulted from our straining after better broadcast reception.

So many improvements are going forward that one hesitates to hazard a guess as to what receiving sets may be like a generation ahead; certainly there will be a still closer tie-up between wire-telephony and radio long before that.

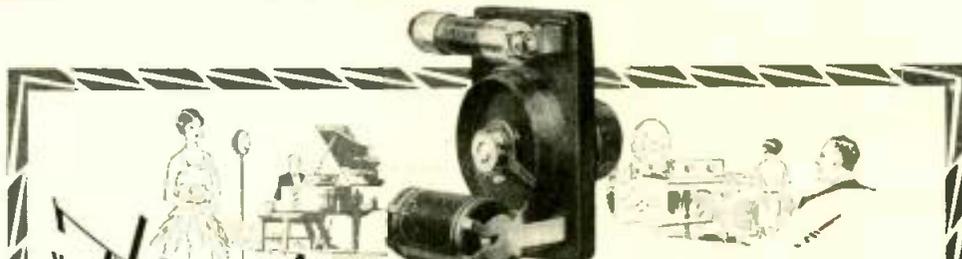
When Mars was nearest the earth a few months ago an English doctor filed a radio message for that planet. His faith in radio was too great. But who shall say that some higher frequency may not make it possible to communicate with Martians—if there are any—when next their planet swings our way?

Attributed to radio competition, cable rates have been reduced for the first time in forty years.

A music publisher alleges that broadcasting has the effect of shortening the life of a popular song.

We have all along been ready to believe that broadcasting would be found to serve some useful purpose.

—Punch



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HUNDREDS of letters from delighted listeners-in are telling us of their experiences of "the other night on the radio."

Owners of the Carborundum Crystal Set Hook-up who are reaching out to stations 50, 70, even 200 miles away and getting perfect reception.

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But above all they are telling us of the clear, true quality of tone—undistorted, crystal clear tones that come to them because of the installation of

The Carborundum Stabilizing Detector Unit

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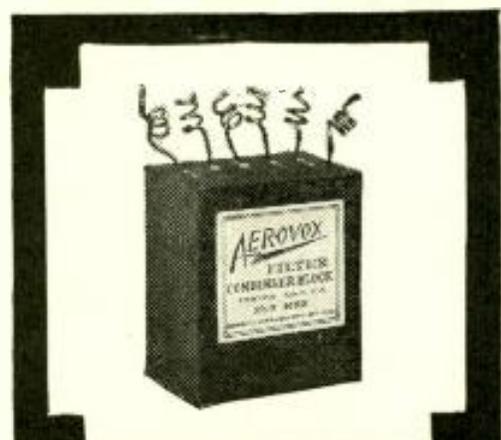
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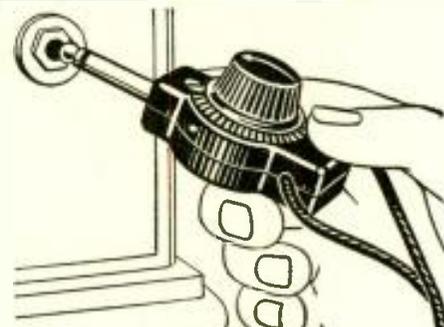
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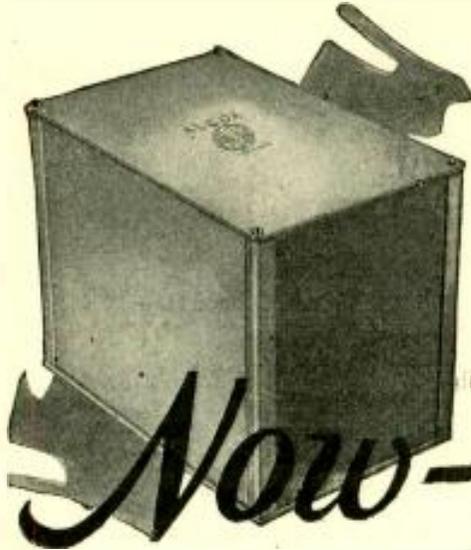
HERE is a simple radio control—the Centralab Modu-Plug—that is unique even in a field where phenomenal developments are common.

Provides smooth, noiseless control of tone and volume direct at the plug with the set operating at full efficiency. Without adjusting tuning dials or other controls, you can regulate volume from a whisper to maximum simply by turning the little knob on this plug. Reduces static interference—clarifies tone. Replaces the ordinary loud-speaker plug.

\$2.50 at your dealer's, or mailed direct on receipt of price.

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17 Keefe Ave., Milwaukee, Wisconsin
Manufacturers of variable resistances
for all radio circuits

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To meet the growing demands of new radio design, which insist upon shielding, the Aluminum Company of America now provides a Box Type Shield.

Aluminum, used with success in the Alcoa Wing Type Shield (for interstage shielding) gives the set builder and the manufacturer an adaptable, easily-worked material of great durability and shielding performance combined with extreme lightness. Its uniformly high quality, judged from both metallurgical and radio standards, is established.

The New Alcoa Box Shield is especially designed to be of the greatest use to the greatest number of set builders. If it does not suit your size requirements exactly you will find that a few moments' easy work will adapt it most satisfactorily to your needs—being easily cut, easily worked and permanent when assembled.

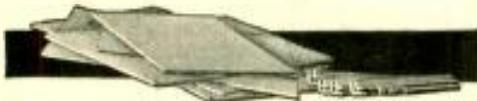
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Consists of: Top, Bottom, Sides
4 Extruded Corner-Posts
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Assembles 5" x 9" x 6".
Easily modified.

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ALUMINUM COMPANY of AMERICA

2321 Oliver Building, Pittsburgh, Pa.



Popular Delusions About Radio

(Continued from page 245)

that height seems to be much less important than is commonly supposed.

The same observation applies to the widely-advertised theory that "the longer the antenna the better the reception."

Acting on this, many listeners have erected antennas as long as 150 or 200 feet, only to find that the result was broad tuning and excessive static. Most manufacturers now recommend an antenna of not more than 100 feet, and for all-around efficiency, in particular as regards sharp tuning and minimum static, as short as 50 to 75 feet.

Perhaps the most common and unfortunate delusion leads to the burning of the filaments of vacuum valves to their limit or higher. Thousands of listeners indulge in this practice; they are told that better results can be thus secured. But the only actual results are materially shortened filament life and inferior tone quality.

Valves are designed for maximum efficiency at a prescribed voltage, which can be determined by setting rheostats at the point recommended by manufacturers, or failing this by a few moments of experimenting. It will be found that considerably improved results on the score of tone quality, and practically the same volume can be secured by turning the rheostat slightly below the full position; at the same time securing much longer filament life, which is eminently desirable in itself.

Many manufacturers are now equipping their sets with automatic filament controls which make it impossible to burn the filaments too high. But with intelligent operation, this should not be necessary.

The most absurd though fortunately harmless delusion in connection with set operation, however, is that distant programs are somehow inherently better than local programs. Everyone has witnessed, if he has not been the principal in the spectacle of a listener clinging stoutly to a program from a station a thousand miles away, through static and fading, while one just as good, and probably much better, from another station a few miles away, capable of reception at full volume and without interference, goes to waste.

The explanation is, of course, the "distance" craze, plus lack of appreciation for the home town. Fortunately the first is passing, and rightly. And the delusion that distant programs are inherently better than home-town offerings is being slowly dispelled.

In fact, all of the delusions that encumber broadcasting in the popular mind are being replaced, one by one by something nearer the truth.

Flux a factor in Satisfactory Reception

THE importance of the proper flux for radio soldering, has become so significant, that manufacturers of better radio sets have, after extensive laboratory tests, adopted Kester Rosin Core Solder—alert set builders, too, use nothing but Kester Radio Solder, the handy size package of Kester Rosin Core Solder.

Pure rosin, as in Kester Radio Solder, is absolutely non-corrosive and is the only safe flux for radio. Being a hard, dense substance, rosin will not attract and collect dust (carbon particles) which forms a path for leakages. Chloride fluxes in either paste, liquid or compound form are highly corrosive. They absorb moisture from the air, and when heat is applied, a spattering, fuming and spreading action is caused. The areas over which flux is thus spread attract and collect dust (carbon particles) which forms an excellent path for leakages and soon impairs the receptive quality of any set.

Insist upon knowing that the set you buy has been soldered with Kester Rosin Core Solder and be equally sure that you use only Kester Radio Solder on the set you hook up yourself.



A free sample—write for it now

KESTER Radio SOLDER

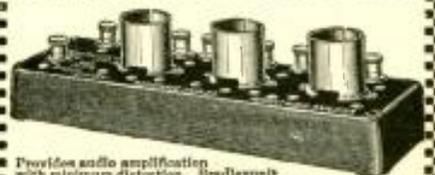
The safe solder and flux for radio

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Bradley Amplifier

Resistance-Coupled
PERFECT AUDIO AMPLIFIER



Provides audio amplification with minimum distortion. Bradleynit milled resistors used in the Bradley Amplifier do not vary with age and are not affected by atmospheric conditions. Can be used to replace transformer amplifiers in standard radio sets with decided increase in tone quality.

Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Avenue Milwaukee, Wis.

Bradleyleak

THE PERFECT GRID LEAK



Provides a noiseless range of grid leak resistance from 1/4 to 10 megohms. Assures most effective grid leak resistance value for all tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

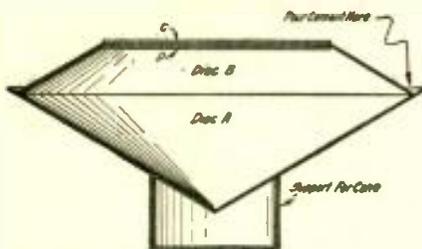
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Electric Controlling Apparatus

276 Greenfield Avenue Milwaukee, Wis.

How to Build Your Own 36-Inch Cone Loudspeaker

(Continued from page 250)



HOW DISCS A AND B ARE JOINED

FIGURE 4: Disc A should be inserted, front down, in a hollow cylinder such as a halboz. Disc B should then be placed upon disc A and adjusted until the edges of the latter protrude an equal distance beyond disc B all the way around. Then pour the cement all around the edge of disc B where it touches the larger disc, A.

Next, fasten the two small rubber washers onto the back rings as a bumper for the cone when hanging on the wall. A small eyelet should also be fastened in a proper position to hold the loudspeaker on the wall itself.

How to Adjust Unit E

Attach the cord to your radio receiver in the regular manner and loosen up the set screw in the side of the nose-piece and tune in a signal on the receiver. The signals at first will be either very weak or the reproducer will rattle. Adjust the unit, E, by turning the regulating screw at the tip either to the right or to the left until the proper volume is obtained without rattling.

Then, tighten the set screw and the reproducer is ready for continuous operation. When the cone is completed, the music and reproduction will be of a high order, giving the high and low tones that make for natural broadcast reception.

It should be remembered that the amplifier in the set should be a quality amplifier, if quality reproduction is to be expected. If the amplifier distorts, the signals from the cone reproducer will be distorted also, but if they are natural and lifelike, the resultant reproduction should be well-nigh perfect.

A Stolen Receiver "Squeals" on Its Robbers

A SQUEALING radio set that interfered with a Berlin policeman's enjoyment of his radio, recently led to the arrest of a band of robbers that had eluded the police for months. When the policeman found from a technical friend that his trouble in getting clear reception was probably due to an unlicensed and radiating set, he scoured the neighborhood to track the offender down. The result of his search was the discovery that a near-by apartment was being used as the storehouse of a gang of robbers and that among the loot was the radio that had been spoiling his programs.

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The "SELF-ADJUSTING" Rheostat

The Watch Dog of your Tube

ONLY Amperite can insure utmost clarity, volume and tone quality from your tubes. Only Amperite can safeguard them against damage and premature burn-outs through improper current regulation. There is only one Amperite—the patented, automatic, variable filament resistance. Don't be confused or misled into buying spurious imitations or substitutes represented to be just as good. All popular construction sets specify Amperite. Simplifies wiring. Eliminates hand rheostats. Price \$1.10 complete.

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Right now, there is an opportunity in your locality to profitably devote your spare time or all your time to a pleasant, easy and profitable business—one that does not require any training or capital.

The publishers of POPULAR RADIO offer you an opportunity to become their local representative to take care of expiring subscriptions and new subscriptions for POPULAR RADIO and two other popular magazines that they publish.

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All material will be furnished you free of charge and you will be paid an attractive commission and salary.

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Send me full particulars regarding your salary and commission offer to local representatives.

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CARTER

"Midget" Rheostat with Filament Switch

Game trails and road builders

In the early days, most roads followed the old game trails, the early settlers used the easiest way. But the road builders made surveys — built bridges, cut tunnels, filled valleys. They built roads.

Half Size

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So in Radio, Carter has built parts — not just followed beaten paths, the way of least resistance — but built parts unknown in the early days of make-shifts. The result is there is no substitute for a Carter part.

Any dealer can show you why

In Canada: Carter Radio Co., Limited, Toronto

CARTER RADIO CO. CHICAGO

Copper Shielding

Gives better reception—closer selectivity and finer tone quality.

Sheet copper combines higher conductivity with easy working qualities.

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DEALERS — send for large and profusely illustrated catalog on the products of scores of nationally advertised radio manufacturers.

Wholesale Exclusively

**"Pioneers in the
Distribution of Radio"**

The Unique "Retrosomic" Receiver

(Continued from page 248)

rents find their way into the tuned loop circuit, 9 and 10, and are thus amplified at these frequencies across the plate and grid of the second tube. Finally, the low-frequency currents flowing through coil 9 are transferred over to the coil, 11, and thus to the grid of the third tube, through the low-frequency transformer, 15. It would appear, therefore, as if some form of reflex action does occur in the Retrosomic circuit, but it is not a reflex circuit of the usual type by any means.

The Importance of the Loop Circuit

The inventor of this new circuit attaches the greatest importance to the design and dimensions of the tuned loop circuit, 9 and 10, and to the coupling coil, 11. For the reception of broadcast signals on wavelengths lying between 100 and 600 meters he expressly states that the primary coil, 9, must have 64 turns of No. 24 wire and the secondary coil, 11, 89 turns of No. 28 wire, giving an inductance value of 389 microhenries.

These coils may be wound as plain solenoids, on formers $3\frac{1}{2}$ inches in diameter, or, for convenience in coupling, may be plug-in coils mounted in a double-coil mounting. The same applies to the arrangement of the antenna inductance and its associated tickler coil. The tuning condenser, 10, in the tuned loop circuit should have a maximum capacity of not more than .0005 mfd.

It has already been remarked that the plate of the second tube has no "B" power connection. Another function of the hard-worked tuned loop circuit is, apparently, to take care of this anomaly, for the inventor states that, although there is no direct, high-voltage connection to the plate of the second tube, it is found in practice that a difference of potential will be set up between the plate and grid which is approximately equal to the voltage of the "B" battery.

This potential difference can actually be detected (when the set is in operation and receiving signals) by means of a suitable high-resistance voltmeter connected across the plate and grid of the second tube. There is therefore ample evidence of the building up of oscillatory currents of considerable magnitude in the tuned loop circuit.

To summarize the operation of the receiver in the inventor's own words:

"The incoming signals are applied at high frequencies directly on to the grid of the first tube, and simultaneously (in part) on to the grid of the second tube through the branch lead to the loop circuit, 9 and 10.

"From here they are transferred to the grid of the third tube and so back to the coil, 12.

"Partial rectification takes place in the first tube owing to the action of the grid battery, 8; and a similar operation takes place at the second tube owing to the presence of the grid cell, 8.

"Finally, any high-frequency energy reaching the grid of the third tube will be rectified by the action of the blocking condenser, 17."

Operation of the Receiver

It is, of course, somewhat difficult to convey to American readers an adequate idea of the capabilities of a British receiver, tested in England, but the following particulars may serve to give some idea of the performance of the Retrosomic receiver.

During a recent test, made in London within a short distance of station 2LO, the receiver proved itself capable of extremely gratifying results. Using an outdoor antenna, for which it is apparently best suited, the set brought in all the British stations, including relays, on a loudspeaker at will.

Even Cardiff, notoriously the most difficult station in England to receive, came in at good loudspeaker strength. No interference whatsoever was experienced from 2LO, which was broadcasting throughout the test. A large number of Continental stations were also tuned in, also free from interference from London, although the wavelengths of some of the Continentals were very close to London.

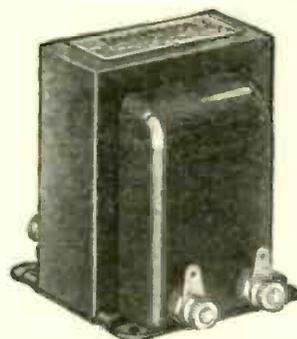
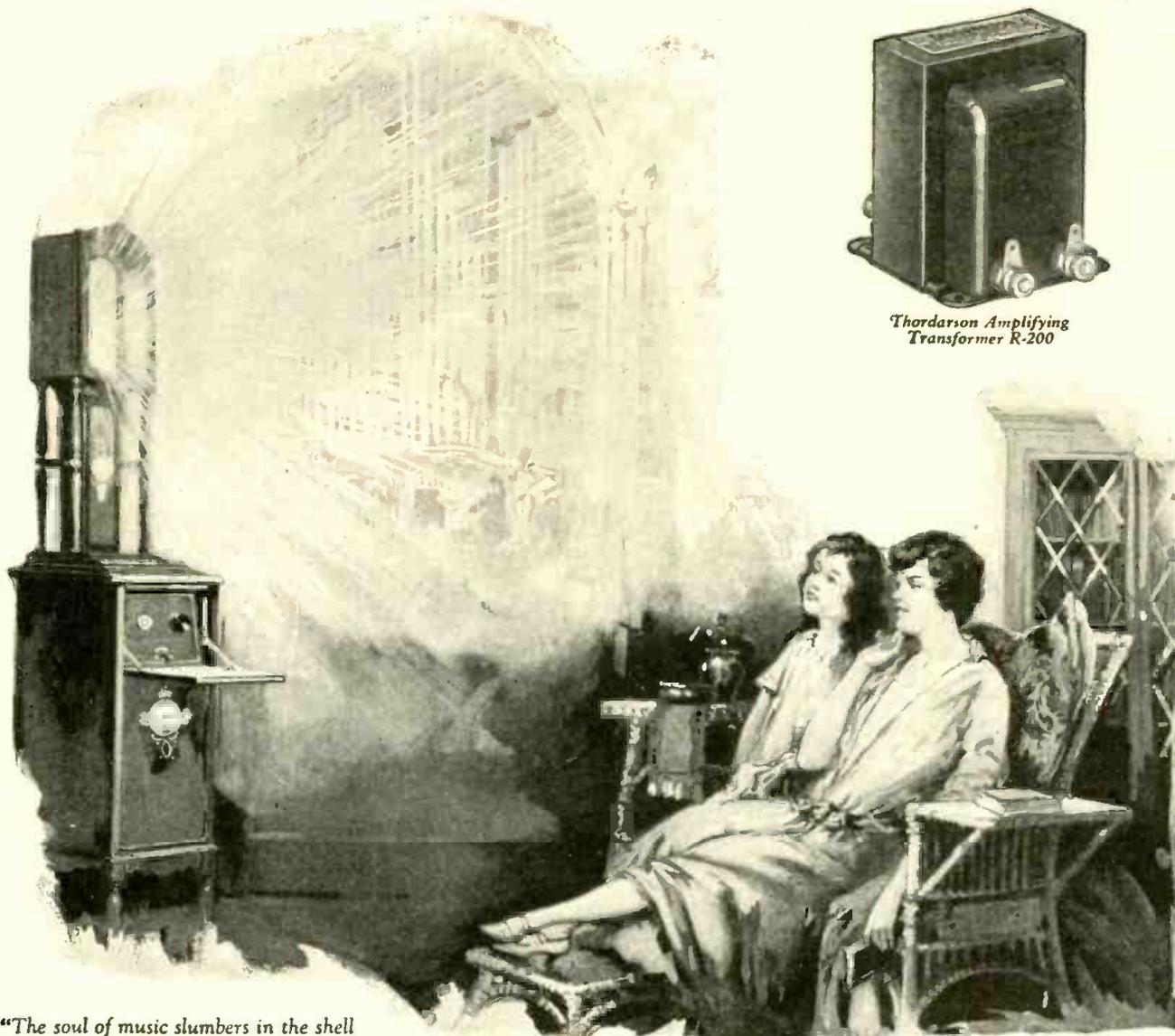
The test proved conclusively that, when working properly the Retrosomic receiver is capable of equalling the performance of a superheterodyne, and even bettering the performance of such a receiver as regards selectivity. Its range appears to be limited only by considerations of static and interference.

On the whole, this receiver is quite one of the most interesting developments in circuit novelties that has appeared for some time, and commends itself as being worthy of the serious attention of the amateur.

How to Build the New SC-II Receiver

So much interest was shown in the SC receiver, described in POPULAR RADIO for March, 1926, that the designers have brought out a new and improved receiver on the same lines—the SC-II. This set is even more simple to build than the original SC although it is much improved in operation and quality and combines the newest developments in shielding and simplified control without increasing the over-all price.

Watch for it—in POPULAR RADIO for April.



Thordarson Amplifying Transformer R-200

"The soul of music slumbers in the shell
Till waked and kindled by the master's spell."
(Samuel Rogers — "Human Life").

WITHIN your set slumbers a world of music which you can charm to a living fullness and richness of tone by installing Thordarson Amplification.

The manufacturers of leading quality receivers have recognized in Thordarson Amplifying Transformers a fidelity of musical reproduction which removes the ordinary artificial tones of radio and replaces them with living harmonies.

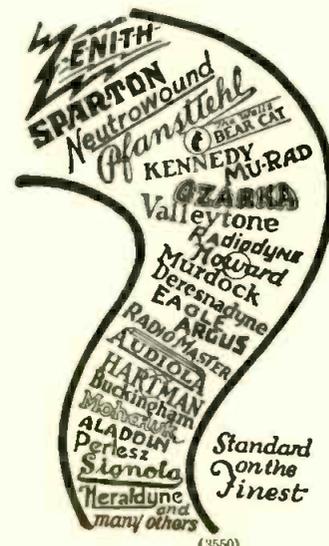
Whether you are buying a complete receiver, or whether you are building your own — if you enjoy music — be sure that your transformers are Thordarsons.

THORDARSON

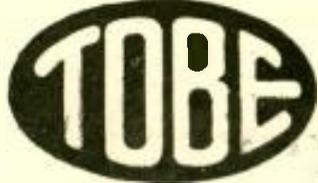
RADIO TRANSFORMERS

Supreme in Musical Performance!

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
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(3550)



RADIO INTERFERENCE FILTER No. 1

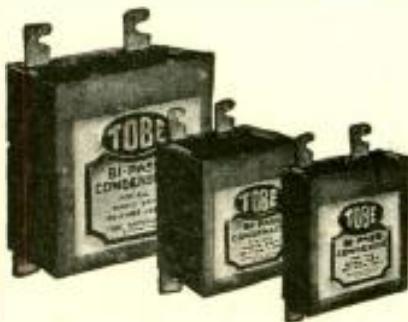


is made for attachment to household motors and appliances, up to 1/4 H.P., such as oil burners, refrigerators, sewing machines, vibrators, etc. Its design incorporates means for prevention of damage to commutators, which may occur when condensers only are used.

Provided with five leads so that no extra wiring is required for attachment. A simple wiring diagram is printed on the label.

Price—\$15.00

Write for special descriptive pamphlet L-3



TOBE FILTER and BI-PASS CONDENSERS

Standard wherever Radio is found. They are specified by Arthur H. Lynch and James Millen in the National Lynch Power Amplifier, Radio Listeners Own Set—Shielded Highboy Super, Bruno Set, Samson De Luxe Set, Alden Somerbridge Circuit, Hi-Q-B-Eliminator, R. B. Lab. Set, Lincoln Super, Ultra-5. Used as standard equipment by National Company, General Radio Company, Philco, Modern, Stora, King Radio, and many other leading manufacturers.

Ask your dealer to show you the new TINYTOBE. A new process little condenser,—capacities .0001 to .02.

Tobe Deutschmann Co.
Engineers and Manufacturers
Cambridge :: :: Mass.

The "Radio Detective"

(Continued from page 238)

the skin-resistance test which is another part of the procedure.

But one of the characteristics of radio is that it will work invisibly and at a distance. Why not modify the standard electrical third degree of Dr. Link's demonstration so that it becomes an invisible and unconscious process, a "radio third degree"?

For the recording of the heart-beat, for example, it would be possible to place some kind of sensitive microphone, safely concealed, inside the structure of the imagined witness chair which I have already mentioned. Communication between this microphone and some recorder or loudspeaker in another room would be a problem simple enough for any experienced radio engineer. The only apparent difficulty in such a device is the fact that the microphone concealed inside the furniture would probably pick up a great deal of accidental noise in addition to the sounds of the heart-beat. If the witness moved in his chair, rubbing a woolen overcoat against the wood above the microphone, the recorder might indicate that the heart had exploded. There exist, however, so many modern methods of introducing audio-frequency filters to select certain sounds and to exclude others that a practical solution of listening thus to the heart-beat of an unsuspecting witness seems by no means an improbability.

Another point upon which the psychologists lay great stress in giving the electrical third degree is the exact timing of the interval which elapses between the asking of a question and the instant when the witness begins his reply. Hesitation is interpreted as suggesting, if not proving, some attempt to conceal the true answer to the question.

Since the timing of these hesitations must be so accurate that small fractions of a second are important, it cannot be done by ear alone or even by the use of ordinary stop-watch timers. In Dr. Link's demonstration the apparatus used was a special electric chronograph, so arranged that the timing mechanism was started by the breath of the examiner speaking the question word and was stopped by the breath of the witness speaking his reply. To pick up the necessary pulses of the breath thin metal diaphragms were placed close in front of the faces of the examiner and the witness. These diaphragms, pressed back by the breath pulses, made electric contacts and operated the chronograph. Here, obviously, is a job which radio could do better. A concealed microphone, placed conveniently anywhere, would operate a time-recording chronograph much more accurately and conveniently than any other known device. Perhaps the best of all the electro-



RESULTS in easier tuning, more distance, volume and clarity—greater stability. Indorsed by leading authorities.

Indorsed by leading radio authorities

Model "N" A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube Browning-Drake, McMurdo Silver's Knockout, etc., capacity range 1/4 to 20-micro-micro farads. Price \$1.00

Model "G" with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets. Capacity ranges:

Model G-1—.00002 to .0001 MFD
Model G-5—.0001 to .0005 MFD
Model G-10—.0003 to .001 MFD
Price \$1.50

X-L PUSH POST

Push it down with your thumb, insert wire, remove pressure and wire is firmly held. Releases instantly.

Price 15c.

Push Post Panel permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. Price \$1.50



X-L Radio Laboratories 2427 Lincoln Ave. CHICAGO, ILL.

Build the "Town and Country" Portable Receiver with Simplified Blue Prints

The "Town and Country" Portable Receiver, developed by the POPULAR RADIO LABORATORY and described in the July, 1928 issue, marks a decided advance in portable receiver design. While not a "vest pocket" receiver, the new "Town and Country" is small enough to be taken along on a motor boat or train trip. Efficiency has not been sacrificed for the sake of compactness.

The receiver uses six UX-199 tubes and one UX-120 power tube. Operating on a loop, tone quality is guaranteed by the use of a fundamentally correct circuit, high-class transformers and cone-type speaker. The "Town and Country" Portable Receiver is mounted in a special mahogany cabinet with a drop front and is equipped with a carrying handle. All equipment, including the folding loop, cone loud-speaker, batteries and connecting cable, is installed in a suitcase. Connections from the equipment to the set are made by means of jacks and plugs.

By using POPULAR RADIO Blue Prints in building your "Town and Country" receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model.

If your local dealer cannot supply you with Blue Prints of this set, they will be sent postpaid upon receipt of \$1.00 per set.

POPULAR RADIO

Service Bureau 34-D

627 W. 43rd St., New York City

psychological tests is the one called the psychogalvanic reflex. The method of conducting this test, devised by Dr. David Wechsler, of New York City, has already been described in POPULAR RADIO and is quite simple. Electrodes are attached to the skin of the witness. A small electric current is passed through the skin and through the witness's body, being measured by a delicate galvanometer. Any excitement felt by the witness is reflected within a few seconds by a decrease in the electrical resistance of the skin. As used by Dr. Link, this test was made visible through the movement of a spot of light on a screen. A decrease of skin resistance, indicating guilty knowledge on the part of the "criminal," was marked immediately by a violent motion of the light spot across the wall.

To give this test without the knowledge of the person who is receiving it seems difficult. The test is said not to work when alternating currents are used. To introduce the necessary direct currents into the skin requires large electrodes, tied firmly in place. No one could be fooled about the fact that these were being used.

However, I suspect that the possible applications of radio technique to this test have by no means been exhausted. Even if the production of a direct current through the skin of the subject is conceded to be beyond the present resources of our science, it is probable that the changes in the human skin, whatever they may be, which result from excitement and which make the reflex test a possibility, are accompanied by electrical or chemical disturbances which some radio method would be competent to detect.

If any radio engineer will take the trouble to devise and perfect some method of measuring this psychogalvanic reflex without the knowledge of the person who is receiving the third degree, he will find that his method, as well as the provision of invisible microphones for the heart-beat and for responses, will be heartily welcomed by the modern psychological detectives.

Radio Brings Country Boys Back to the Farm

To radio, more than to any other one thing, should be given the credit for checking the widespread and alarming migration of farm boys to the city according to Harold C. Lewis, a Chicago educator who has just completed a survey of the aims of the 2500 country boys who are in his student body this year. Mr. Lewis's survey shows that 75 percent of these boys plan to return to the farm upon graduation—25 percent more than in the survey of five years ago—and he credits this change largely to the fact that radio has made farm life far more attractive.



*Add
the new*
Balkite Combination
to your radio set now
with your "A" battery it supplies
all radio power automatically from
the light socket

Now you can make your radio set a light socket receiver merely by adding the new Balkite Combination Radio Power Unit. Once connected to your "A" battery and set and plugged into the light socket, it *supplies automatic power to both circuits*. You need not even turn it off and on, for it is controlled by the filament switch already on your set and is entirely automatic in operation. It will give you a constant quality of reception that cannot be secured in any other way.

Balkite Combination can be installed in a few minutes. It has no tubes, nothing to replace or renew and is a permanent piece of equipment. It is noiseless in operation. It will serve any set now using either 4 or 6-volt "A" batteries and requiring up to 30 milliamperes at 135 volts of "B" current—any set of 8 tubes or less, including power tubes.

Add Balkite Combination now and know the pleasure of owning a receiver always ready to operate at full power not only for this season but for years to come. Price \$59.50. [In Canada \$83.] Ask your dealer. *Fansteel Products Company, Inc., North Chicago, Illinois.*

FANSTEEL
Balkite
Radio Power Units

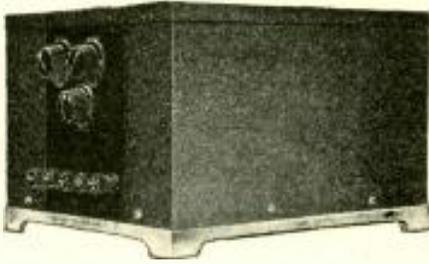
What Built the Reputation of

Mayolian

"B" SUPPLY

The "B" Without a Buzz

?



Type 612
Delivers 40 Mills at 180 volts
All voltages are adjustable
Complete with Raytheon Tube \$42.50

PIONEERING in battery elimination, Mayolian was probably the first manufacturer to adopt the now far-famed Raytheon tube as the heart of its B Supply Units, and to earn the approval of Raytheon. From that day to this, each Mayolian has been rigidly held to the standards of the Raytheon and Mayolian laboratories. Years of exhaustive research, extreme precision in manufacture, skilled supervision—all these have contributed to the pre-eminent position of Mayolian.

Today, no matter what make or type of receiver you have, there is a Mayolian to give it a continuous, uniform, noiseless "B" Supply—direct from the nearest light socket, at half the cost of burning a 25-watt lamp.

The Heavy Duty Types of Mayolian employ the new Raytheon B H tube

The nearest dealer will gladly demonstrate in your own home.
Write us.

MAYOLIAN
RADIO CORPORATION
1668 Webster Ave., New York, N.Y.

Pioneers in Battery Elimination



*The Power of Niagara—
The Quiet of an Arctic Night*

What's New in Radio

(Continued from page 265)

framework. This arrangement makes for great rigidity, an essential feature where a number of tuning units are mechanically coupled together to be operated by a single control. In this receiver five variable condensers are coupled together to operate simultaneously by means of one wave-length tuning control.

Each of the stages of tuned-high-frequency amplification, as well as the detector stage, is completely enclosed in a burnished copper "can" or shield. This shielding together, with the provision of suitable filter devices to help isolate the stages from one another, results in a high-frequency amplifier which is very efficient and, at the same time, stable.

The receiver makes use of seven thermionic vacuum valves (or tubes). UX-201-a type valves are used except for the detector tube and the last low-frequency amplifier stage. For the detector a UX-200-a type valve is recommended and, for the last low-frequency stage, a UX-112 type power tube.

The receiver may be operated with batteries, or with "A" and "B" power-packs which supply the operating voltages after conversion from the house-lighting lines. The filament-current supply, if a battery is used, should be of the six-volt storage type. If an "A" power-pack is used, it should be capable of delivering six volts at 2 amperes continuously. For the high-voltage plate supply the use of the "Bremer-Tully 'B' Power-pack" is recommended by the manufacturer. This "B" power-pack is especially designed for use with the receiver and therefore requires no adjustment modification of any kind when used with the Counterphase. The set may be used with either an outdoor or an indoor antenna. During a test made by a member of the POPULAR RADIO LABORATORY, a short wire about 15 feet in length, stretched across the room on the ground floor of a New York apartment house, brought in a number of stations up to 500 miles distant, with great volume. If the absolute maximum of signal strength and long distance reception are desired, an outdoor antenna about 75 feet long should be

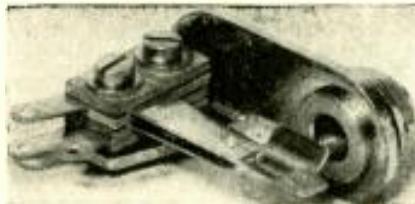
used. Otherwise either a shorter outdoor antenna, or an indoor antenna of any convenient length, will be suitable.

For ordinary reception, the receiver is essentially single-control. That is, the wavelength tuning of the entire receiver is accomplished by means of the single "Selector" knob. A similar knob, marked "Volume," permits the operator of the receiver to vary the volume of reproduction to suit his taste. The other controls provided on the small front panel enable the operator to meet any unusual conditions that may exist. In tuning in extremely weak stations, for instance, a "Fine Tuning" knob is provided. This serves as a balancing auxiliary to the main "Selector" knob; but it is only required where the absolute maximum of efficiency is necessary.

A unique feature is the inclusion of a rejector as a part of the tuning circuits. This rejector or wave-trap consists of a coil and condenser which is ordinarily cut out of the circuit, but which, in cases of extreme interference between the signals of two broadcasting stations, may be cut into use by means of a switch located on the control panel. With this switch thrown to the "In" position, a small knob next to the switch is turned until the interfering station is no longer heard. The usefulness of this feature is apparent, especially in view of the overcrowded condition of the air at the present time.

At the extreme right end of the control panel is a small switch which enables the operator to make use of either two or three stages of low-frequency amplification. For ordinary reception, only two stages are necessary. In that case this "Power" switch is thrown to the "low" side. This action automatically cuts out the second stage of low-frequency amplification but leaves the first and third stages in operation. This is important, as it means that the power amplifier stage is always in the circuit, thus insuring the best quality of output to the reproducer (loudspeaker) regardless of the amount of amplification used.

Maker: The Bremer-Tully Manufacturing Company.



A Jack That Makes It Easier to Get a Well-balanced Panel Layout

Name of instrument: Headphone or reproducer jack.

Description: This jack fills a real need of the home set-builder. Instead of being constructed so that the springs run at right angles to the panel, this jack has the springs arranged parallel with the panel. Thus the terminals to which connections are made do

not project far back into the receiver, as is the case with old-fashioned jacks. Instead, the terminals are close to the panel and off to one side. In installing this instrument on the panel, the arm bearing the terminals may be swung up or down or to either side in any manner which is most convenient and provides the shortest leads behind the panel. At the same time the mounting sleeve which projects through the panel may be installed at a point on the panel that makes for the most symmetrical layout, from the standpoint of appearance. Thus, there need be no compromise between the symmetrical lay out of the panel front and convenience of connections behind the panel.

Usage: In any receiver to provide a convenient method for connecting headphones or a reproducer.

Outstanding features: Strongly built. Compact. Easy to install.

Maker: Yaxley Mfg. Co.

**Windsor Wall or Table
Type Cone Speaker
Amazes Radio World**



Model 210
(Pat. Applied For)

The latest model Windsor Cone Loudspeaker has astonished the world of radio. In convenience, quality of reception, and extremely low price, it far surpasses anything yet offered. The cone is 22 inches in diameter and is supported by an easel back. It can be hung up on the wall, as in the picture above, or stood upon any flat surface as shown in the picture below. It contains the famous Windsor loudspeaker unit noted for its extreme clarity and fidelity of reproduction.



Model 210
22-inch Cone Loudspeaker with easel back

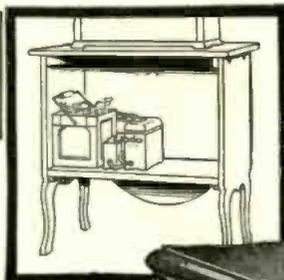
\$15⁰⁰
(West of Rockies \$18)
(Pat. Applied For)

Model 302 (Shown below)
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker.



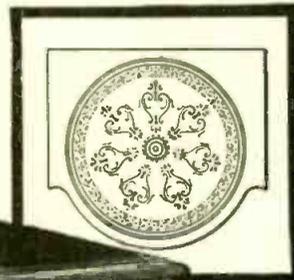
(Pat. Applied For)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-inch Windsor Cone Loudspeaker. The top is 30 in. x 17 in. and stands 29 in. high. Plenty of battery and equipment space is provided by large shelf in rear. Price, finished in Mahogany or Walnut **\$48⁰⁰**
(West of Rockies, \$55)



Rear view at left shows large compartment with ample space for batteries, battery charger, or battery eliminator, which are entirely concealed from view. Back is open for ventilation of batteries.

At right is shown the Cone Loudspeaker, with its panel, which is quickly and easily removable, allowing instant access to all batteries, battery charger, battery eliminator or other equipment and wiring.



(Pat. Applied For)

Model 200—with 22-inch Cone Loudspeaker

This Windsor Cone Loudspeaker Console is equipped with a 22-inch Windsor Cone Loudspeaker. Its top is 30" x 17" and is 29" high. The battery shelf provides ample space for batteries, charger, battery eliminator and other equipment. Beautifully finished in either Mahogany or Walnut.

Model 200

\$29

Console with Cone Loudspeaker Ready for Set and Batteries (West of Rockies, \$35)

This is the Fastest Selling Line of Loudspeakers and Loudspeaker Consoles in the Radio World Today

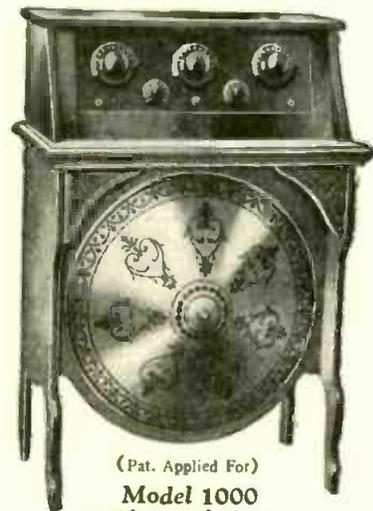
The quality of radio reception made possible by Windsor Cone and Horn Loudspeakers and Loudspeaker Consoles so far surpasses anything heard heretofore that it amazes and delights every radio enthusiast. The Windsor Line is so complete that everyone can find in it a loudspeaker, loudspeaker table, or loudspeaker console exactly to fit their particular needs.



Model 100
with Moulded Composition Horn Loudspeaker or 16-inch Cone Loudspeaker
(Pat. Nov. 18, 1924)

Above is shown a beautiful Windsor Loudspeaker Console, finished in either Walnut or Mahogany, which provides ample space on top for any radio set. The battery shelf beneath will accommodate all necessary equipment. Equipped with either Moulded Composition Horn or 16-inch Cone Loudspeaker. Size: 38 in. x 18 in., and 29 in. high. Price **\$40⁰⁰**
(West of Rockies, \$42.50)

To the right is shown the newest Windsor Loudspeaker Console. It is equipped with a 22-inch Cone Loudspeaker and cabinet suitable for 7-inch radio panels up to 26 inches in length. Battery shelf provides ample space for all equipment. Beautifully finished in either Walnut or Mahogany. Price (without receiving set) **\$44⁰⁰**
(West of Rockies, \$52.00)



(Pat. Applied For)

Model 1000
with 22-inch Cone Loudspeaker

Note to Dealers: Write or wire today for details of the highly profitable Windsor line.

Electrical Department

WINDSOR FURNITURE COMPANY

1414 Carroll Avenue • CHICAGO, ILLINOIS
Los Angeles Branch—917 Maple Avenue



KARAS HARMONIK TRANSFORMERS
Give Maximum Quality Volume with the One Tube UNIVALVE RECEIVER

THE Univalve Receiver, having but one tube, described and illustrated in this issue of POPULAR RADIO, uses a Karas Harmonik Audio Frequency Transformer to deliver full strength QUALITY reception—and DELIVERS IT. All who have heard this new receiver with its multivalve tube which handles one stage of radio frequency, detector, and two stages of audio frequency amplification, using only one vacuum tube, have been mystified and amazed at its tremendous volume and the entire elimination of howls and squeals so common to many circuits. The answer lies in the newly developed circuit and the employment of a Karas Harmonik Amplifying Transformer for audio amplification.

Read the Article—Then Build the Univalve

Read the article describing the construction of this novel receiver in this issue of POPULAR RADIO. Then build the set yourself. Be sure to obtain a Karas Harmonik Transformer from your dealer, for it is used in this circuit, and no other will give such tremendous volume and such distortionless amplification. If your dealer is out of stock and you are in a hurry, you can order your transformer direct from us by filling out and mailing the coupon below. SEND NO MONEY. Just hand the postman the price of the transformer plus a few cents postage upon delivery.

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1023 Association Building, Chicago
Please send me 1 Karas Harmonik Audio Frequency Transformer for which I agree to pay the postman \$7, plus postage, upon delivery. It is understood that if I am not perfectly satisfied with my purchase within 30 days I may return it for full refund of purchase price.

Name.....
Address.....
City..... State.....
(If cash accompanies order we will prepay postage.)



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

The Popular Radio Medal for Conspicuous Service

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

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

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

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

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

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

The Secretary of the Committee of Awards, POPULAR RADIO MEDAL for Conspicuous Service, 627 West 43rd Street, New York.

The Committee of Awards

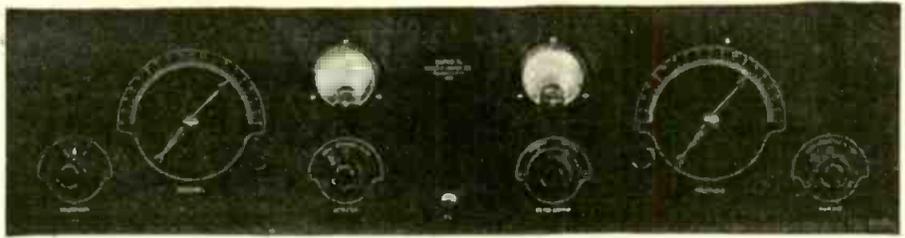
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Panel size, 36"x9"x 1/4"

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Weight: 55 lbs.

A SUPER-10 has been installed on board the "U. S. S. Wright," now sailing for Asiatic waters with the U. S. Aircraft squadrons. This receiver will also be used for entertaining civilian representatives at various ports of call.

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THE NORDEN-HAUCK SUPER-10 is an entirely new and advanced design of Receiver, representing what we believe to be the finest expression of Modern Radio Research Engineering. It is the product of years of experience devoted exclusively to the attainment of an ideal Broadcast Receiver—regardless of cost.

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- Special Power Audio Amplifier, operating any loudspeaker and eliminates necessity of external amplifier.
- Can be operated directly from house current with socket power devices.
- Thoroughly shielded at all necessary points.

Complete Price List for Socket Power Operation

1 Norden-Hauck SUPER-10, completely constructed and laboratory tested.....	\$307.00
*1 Heavy-Duty 200 V. "B" Eliminator and Tube, 50/60 cycle A/C 110 V..	42.50
1 Automatic "A" Power Supply, complete.....	29.50
10 Tested Tubes, including Power Tube.....	22.50
1 Western Electric Cone Speaker, 540AW or Farrand Sr., and Plug.....	32.60
1 Set Antenna Equipment, complete.....	5.00
2 "C" Batteries.....	2.00

TOTAL COST OF ALL ITEMS—NOTHING ELSE REQUIRED..... \$441.10
+ 25/30 cycle A/C current, \$47.50.

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Please send me without cost or obligation on my part, attractive illustrated literature describing the new Norden-Hauck Super-10.

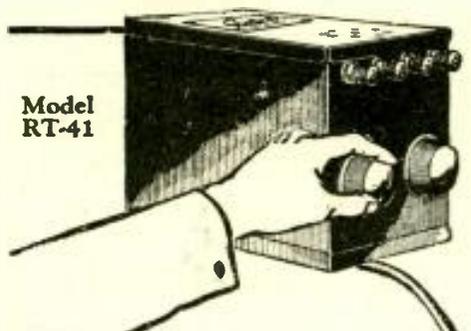
I enclose \$2.00 for which please send me, postpaid, complete full size constructional drawings and all data for building the Super-10.

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Never Before— Such Tone Quality

Model
RT-41



*Sterling perfected
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control gives this
added Advantage*

PERHAPS you regard a "B" Eliminator merely as a means of doing away with the expense and nuisance of forever replacing worn-down "B" Batteries.

But with the Sterling "B" Eliminator, there is a tremendous improvement in tone quality too! The secret of this amazing tone quality lies in the extremely fine control of the "B" voltage.

This definite Sterling advantage in tone quality is possible only by using first quality materials, high standards of manufacture, backed by 20 years of Sterling electrical experience.

This Sterling Dependable Light Socket Power Unit RT-41

is the ideal "B" Power supply for sets using as many as 5 tubes. It takes up no more room than a 45 volt dry battery—yet it gives three times the power—135 volts.

Just right for Radiolas 25 and 28.

Price complete with
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Also Raytheon Tube Types
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Send for booklet "C" telling
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WHAT READERS ASK

CONDUCTED BY DAVID LAY

In justice to our regular subscribers a nominal fee of \$1.00 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.

How to Increase Amplification in a Low- Frequency Amplifier

QUESTION: My receiver includes two stages of transformer-coupled, low-frequency amplification, both transformers being of the 4 to 1 ratio type. I want to add another stage in order to increase the volume; but I have been told that the use of another stage of transformer-coupled amplification is not practical. If this is true can I add a stage of resistance-coupled or impedance-coupled amplification?

—BENJAMIN COHEN

ANSWER: As your transformers are both high-ratio units it is doubtful whether you would get any better results by adding a third stage of amplification, regardless of the type of coupling used in the added stage. If you do add another stage it is likely that you will have to "doctor up" the amplifier with shunt resistances and condensers with the result that your volume will be increased little, if at all.

An easier, and far more practical plan would be to install a power tube of the UX-112 type in the second stage of amplification and increase the "B" battery potential on this tube to 135 or 157 volts, with the proper "C" bias, as recommended by the tube manufacturer. This should give you a considerable increase in volume and would have only a simple change in the connections in the grid and plate circuits of the last tube. The proper connections for this change were given in this department in the November, 1926 issue.

* *

How to Control Oscillation in a Superheterodyne

QUESTION: My superheterodyne receiver gives me some trouble, when I try to tune in weak signals, because I cannot bring the intermediate amplifier gradually up to the point of oscillation. As I turn the potentiometer knob toward the negative side, the circuit "flops" into oscillation suddenly, but not until the arm is almost at the negative end at the resistance winding. In another superheterodyne receiver the control of oscillation was much more gradual and smooth and I could keep the circuit just under the point of oscil-

lation and obtain extreme sensitivity in this way. In the receiver the oscillation took place when the potentiometer arm was just beyond the middle of the winding. The potentiometer I am using now has a resistance of 200 ohms. It is connected across the "A" battery and the grid returns of the three intermediate amplifier tubes are connected to the arm. Would it help me to use a potentiometer of higher resistance? If not, is there anything else you can suggest?

—HARRISON RIDER

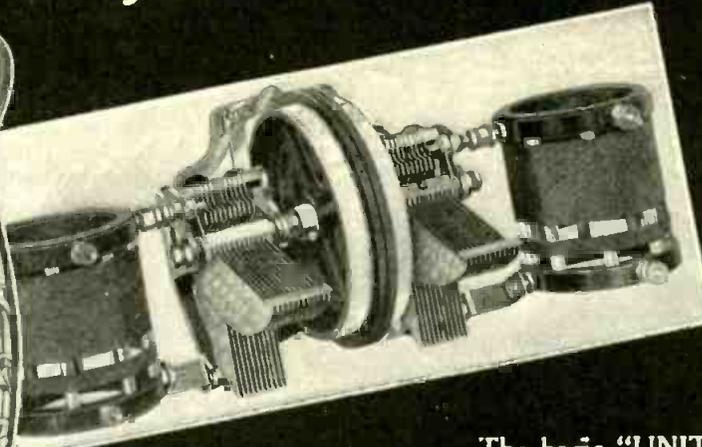
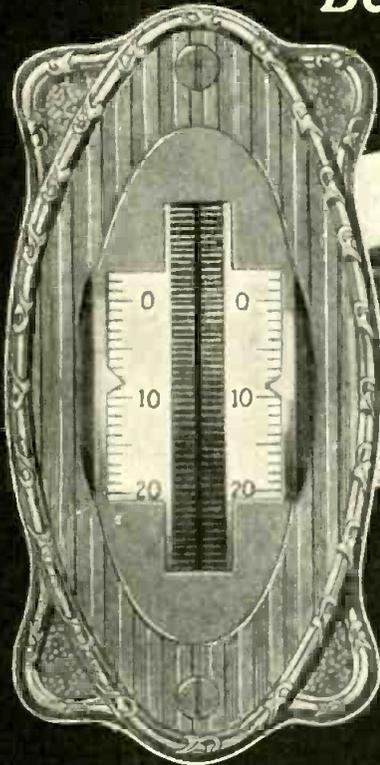
ANSWER: The use of a 400-ohm potentiometer would help you slightly inasmuch as it would give you a little finer adjustment; but the help from this source would hardly be sufficient to warrant the cost of a new potentiometer. If your amplifier does not break into oscillation until your potentiometer arm is almost at the negative side, there is no necessity for having the grid returns of all your intermediate tubes connected to the potentiometer. It is more than likely that the grid return connections of the second and third amplifier-tubes can be made direct to the "A" (—) terminal, leaving the return from the first amplifier tubes connected to the potentiometer. This will remedy the trouble and will give you much better control of oscillation.

* *

How to Build an Antenna Mast Without Puncturing the Metal Roof

QUESTION: I am the "despised landlord" of an apartment house. When I constructed the house I went to considerable expense in installing copper cornices to add to the beauty of the house. Not wishing to have this expensive beauty marred by the erection of numerous unsightly antenna wires on the roof it was necessary for me to prohibit the erection of masts. The demand for radio has increased to such an extent now, however, that I can no longer insist on the strict observance of such a rule. Can you give me specifications for the erection of poles to which antenna wires may be attached, which will be secure, of good appearance, and which will require no puncturing of the roof-

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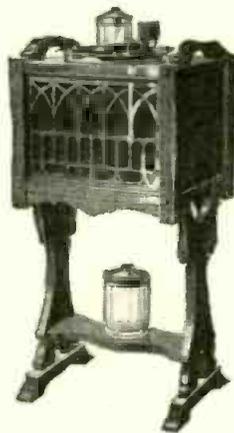
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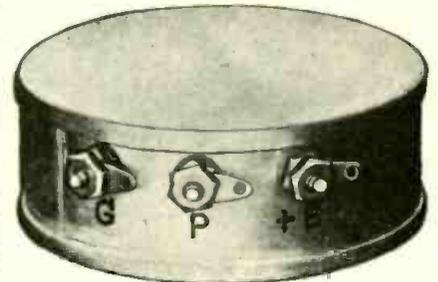
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The new Sickles Shilded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

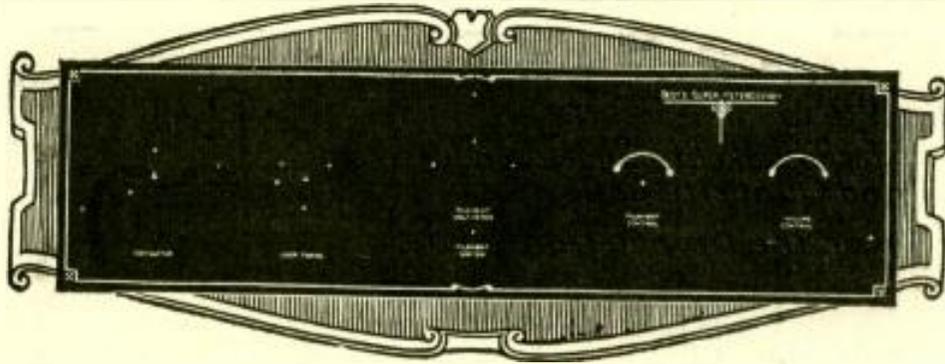
Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

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30	Shilded Transformer	\$2.00 each
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Best's Super, Karas, H. F. L.

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Special panels cut to size and Formica Tubing are also available for amateurs.

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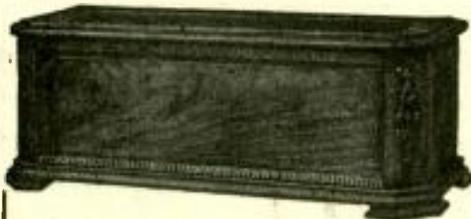
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MODEL "C" CHEST

Cabinets in stock—have piano hinge and are 10" deep—grooved front top rail being removable. Illustration shows gold line wood panel to match.

Sizes	Walnut Only	Panel to Match
7x18-10	\$15.00	\$1.26
7x21-10	17.00	1.47
*7x21-12	17.50	
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*For Hammarlund-Roberts Hi-Q Receiver.
*For Madison-Moore Receiver.
*For Victoreen Receiver.

Special Cabinet (Mahogany or Walnut) for Univalve Receiver 7x15 panel, 8" deep \$8.00

Walnut Infradyne Cabinet

\$26⁰⁰

LC-27 Cabinets

Mahogany or Walnut with Baseboard

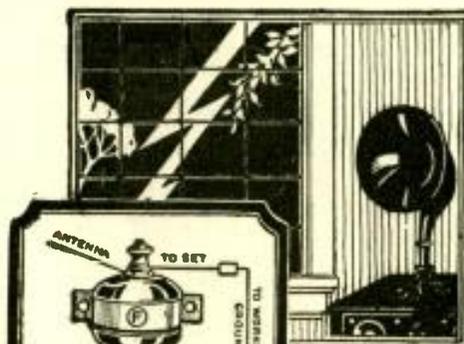
\$18⁰⁰

The LC-27 cabinets have 25° slope and take 8" x 26" panel. They are full 10" deep back of the panel.

WRITE FOR folder showing complete LC-27 Line and other Radio Furniture.

CORBETT CABINET MFG. COMPANY

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"Little Joe" Lightning Arrester

Especially designed for Radio Work. Made of porcelain, small, neat, rugged and serviceable. Can be suspended on antenna or fastened to wall.

Ask Your Dealer

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Trenton, New Jersey

ing? I would prefer to use iron pipes. My idea is to erect three or four poles at my own expense, and insist that all antennas must be attached to these poles. Or perhaps allow tenants to erect their own poles provided they comply with the specifications which I designate.

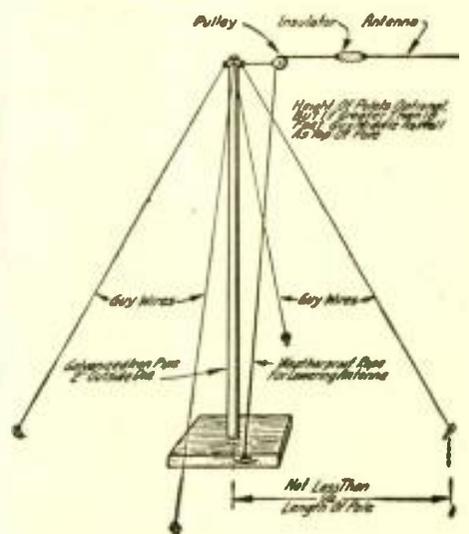
—A. E. M.

ANSWER: Any support used for antenna wires should be either firmly imbedded in the roof, or securely guyed with wires. A practical scheme that does not involve puncturing of the roof surface is shown in Figure 1. The [step or seat for the pole is made of a three-foot piece of 4 by 10-inch planking with a hole, just large enough to accommodate the pole, bored half way through from the center of one side. The planking is placed flat on the roof, with the hole uppermost, at the point where the pole is to be erected. Next, the pole is prepared, with four guy wires attached to, or near, its top end.

A pulley should also be attached to the top end of the pole; more than one pulley if the pole is to support more than one antenna. Each of these pulleys should be equipped with a piece of weatherproof rope at least twice as long as the pole. The ropes are run through the pulleys and the two ends of each rope are then secured to the bottom of the pole.

The guy wires may be No. 12 galvanized iron wire if the pole is to be used for not more than three antennas. If more antennas are attached the guy wires should be heavier, and preferably stranded. The anchorage for the guy wires should be predetermined. These anchorages may be made to the lower end of nearby vent pipes or other superstructures on the roof, or may be attached to the brick wall by means of anchored screw eyes. In any event, the point to which the anchored end of the guy wire is fastened should be distant from the base of the pole by at least 1/4 of the height of the pole.

With the above preparations made, the pole is raised, and seated in the hole in the plank. While it is held in an upright position the four guy wires are made secure to their anchorages. When this has been done, the erection job is complete. The weight of the pole, plus the downward pull of the



HOW TO BUILD A MAST FOR A METAL ROOF

FIGURE 1: This antenna mast has been especially designed for buildings that have a metal roof that might be ruined by nail or screw holes. The iron pipe, that forms the mast, is set into a large, square block of wood; the guy wires may then be attached to the lower end of vent pipes or to any other superstructure on the roof.

guy wires will hold the plank securely in place without the aid of nails or other attachments. In putting up the antenna it is only necessary to attach the wire to one end of the rope which was previously run through the pulley, and then pull the rope taut; the wire should be attached with an insulator.

The lower end of the rope is then tied to a cleat provided either at the lower end of the pole, or on the plank.

The height and diameter of the iron pipe will depend on the requirements. For the support of one or two antenna wires a 2-inch galvanized pipe is suitable if it does not exceed 18 feet in length. Smaller diameter pipe is liable to bend under the strain of the antenna wires.

Shall I Build a Super?

QUESTION: Just what are the advantages of a super-heterodyne receiver as against an average five-tube, tuned-radio-frequency receiver? Which type of receiver, would be the more practical for use under average conditions?

—LESTER DRAKE

ANSWER: A well-designed and well-constructed super-heterodyne receiver has certain advantages over other types of receivers; but there are advantages on the other side. In reaching a decision as to which type of receiver to construct, it will be necessary for the builder to take into consideration all of these advantages as applied to his particular requirements and conditions.

The modern super-heterodyne receiver is simple to operate and uses only two tuning controls. In addition to these two controls there is usually another to regulate the volume of reproduction. These three represent all of the necessary adjustments required in operating the receiver.

The super-heterodyne receiver is extremely selective—much more so than the average tuned-radio-frequency receiver. On the other hand the selectivity of the "super" may be so great as to cut sidebands and thus result in a poor quality of reception. Usually the selectivity will vary with the sensitivity; that is, when the "volume" control is adjusted to provide extreme sensitivity the selectivity will also be high and this aids materially in tuning in distant stations. When the receiver is adjusted for lower sensitivity, as in normal use, the selectivity will be decreased; but even then it is usually greater than that of the average receiver.

The super-heterodyne receiver is so sensitive that the use of an outdoor antenna is not necessary. A loop measuring two feet across supplies sufficient pick-up to bring in stations at great distances. In this respect the super will bring in as great or greater distances, using a loop, as a good five-tube receiver which uses an outdoor antenna.

Finally, an eight-tube super-heterodyne receiver need be no larger in physical dimensions than a five-tube, tuned-high-frequency receiver; and it can be operated successfully with dry-cell tubes.

To sum up; the super-heterodyne receiver has the advantages of simplicity of operation, extreme sensitivity and selectivity, requires only a loop antenna, and may be made extremely compact. It is therefore the ideal receiver for portable use.

The disadvantages of the super, on the other hand, are greater operating cost (for filament supply); usually higher cost to construct, more susceptible to interference from local electrical disturbances and static; stations tune in at two distinct settings of one of the dials (oscillator).

\$75 A WEEK BUILDING RADIO SETS

—in your spare time

Join the Radio Association of America. Learn how to build and repair radio sets. The Association will train you—start you out in business if you wish. Be the radio "doctor" of your community. \$3 an hour upwards easily made. Radio offers you a big money-making opportunity right now.

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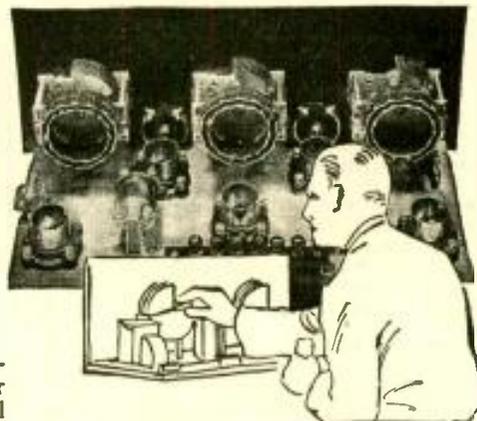
"I have at last found myself," writes Lyle Follick, Lansing, Michigan, "I have already made over \$500 building radio sets after working hours." Werner Eichler, Rochester, N. Y., writes, "I have made over \$50 a week in my spare time."

Our members are starting radio stores, increasing their salaries, securing better positions, passing radio operator examinations, earning big money for the most enjoyable kind of spare-time work.

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A membership in the Radio Association of America gives you the most up-to-date and thorough training in the Science of Radio.

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ing you need in preparing for a Licensed Radio Operator's examination. You receive the privilege of buying parts at wholesale prices.

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If you're interested in Radio for either pleasure or profit, join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write now for details. Write before it's too late.

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ably stands the severest test you can give

—clear reproduction of speech

YOU will enjoy the many speeches and talks that will be broadcast this winter much more if you attach an Amplion Cone to your radio set.

The secret of its fine performance lies in the matchless Amplion unit which is assembled with the Cone in a handsome mahogany cabinet, 14" x 14" x 9".

Model AC12—\$30

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THE AMPLION CORPORATION OF AMERICA

Suite X, 280 Madison Ave., New York

The Amplion Corporation of Canada Ltd.—Toronto



A good name NA-ALD in radio

Use Power tubes for good quality at full volume

Simply adapt to your set with

Connectoralds

(Reg. U. S. Pat. Off.)

The use of a Power Tube in the last audio will very greatly improve your tone quality. No change in set wiring is necessary when Connectoralds are used.

For UX 171 and UX 112 Tubes, Na-Ald 112 Connectoralds are recommended for maximum volume with storage battery sets. These tubes will deliver without distortion several times the volume of the regular 201A. Price \$1.50.

For UX 120 Tubes in UV 201A sockets, the Na-Ald No. 120 Connectorald should be used. To convert a storage battery set to dry batteries with ample loud speaker volume, use a UX 120 tube in the last audio stage with the 120 Connectorald and UX 199 tubes with 419X Adapters in the other sockets. Price \$1.25.

For the UX 120 Tube in UV 199 sockets, ample loud speaker volume without distortion is obtainable from any set equipped for UV 199 tubes by means of the UX 120 or equivalent tube, with the Na-Ald No. 920 Connectorald. The tube is raised slightly, but provides for its use in most sets with limited headroom. Price \$1.25.

For UX 120 tubes in the UV 199 sockets of the Radiola Superheterodyne Semi-Portable and Radiola Super VIII. These excellent Superheterodynes will deliver ample volume for loud speaker operation when equipped with the UX 120 (used with the Na-Ald No. 420 Connectorald). Price \$1.25.

ALDEN MANUFACTURING CO.

Dept. 320-C

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ACME CELATSITE BATTERY CABLE

—a silk-covered cable of vari-colored Flexible Celatsite wires, for connecting batteries to set. Prevents "blowing" of tubes; gives your set an orderly appearance.



Stranded Enameled Antenna

Best outdoor antenna you can buy. 7 strands of enameled copper wire; maximum surface for reception. Prevents corrosion and consequent weak signals.



The Original Celatsite

—a tinned, copper bus bar wire with non-inflammable "spaghetti" covering, for hook-ups. 5 colors; 30-inch lengths.

We also offer the highest grade of "spaghetti" tubing for Nos. 10 to 18 wires. 5 colors; 30-inch lengths.

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Flexible, stranded wire for point-to-point and sub-panel wiring. Non-inflammable "spaghetti" covering. In black, yellow, green, red and brown; a color for each circuit. Put up in 25-foot coils.



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The BEGINNER IN RADIO

CONDUCTED BY ARMSTRONG PERRY

The Use of House Lighting Wires for Antennas

THE difficulty or expense of providing suitable antennas still deters many folks from using radio.

The wire, insulators, lightning arrester, lightning switch and labor for an outside aerial may add a considerable percentage to the cost of a receiver, and in addition there is sometimes difficulty in arranging with property owners or people who have antennas on the same building. The use of a loop antenna means that a sensitive and fairly expensive receiver must be purchased; several more tubes are needed to amplify the small amount of energy that is picked up by a loop—enough to make the broadcasts audible even in a pair of good phones.

Old-time amateurs used to cut in on light and telephone wires when no better substitutes were available. When the broadcasting era arrived, manufacturers placed on the market devices such as the amateurs formerly made for themselves, in order to connect with the wires. Some of these antenna plugs, as they are called, may be purchased for a dollar or less and most of them may be used with entire satisfaction under most conditions in houses where there are electric lights.

To the uninitiated it may seem dangerous to screw a plug into an electric light socket and thus connect wires that are known to carry a current strong enough to kill a man, with fragile and sensitive apparatus that is handled while in operation. The fact is that the antenna plug cannot pass the lighting current into the radio apparatus. It does pass the energy produced in the wire by the radio waves, but it is through a condenser whose metal plates are insulated from each other so effectively that no current such as that employed to light an electric lamp can possibly pass from one to the other. Even though the button is turned on, so that

a lamp would light if screwed into the socket, the wires are "dead" all the way back to the switch, while the antenna plug is in position, unless they are connected by some other means. Current can flow only when there is an unbroken circuit, or when a break in the circuit is so narrow that the current can leap the gap, and the circuit is effectively broken so long as the antenna plug is in position.

The radio energy that the plug passes is entirely different from the lighting current. The condensers in the antenna plug may be compared with a glass window that stops the air currents but freely passes the light and sound waves, because they pass the radio currents but will not pass the lighting current.



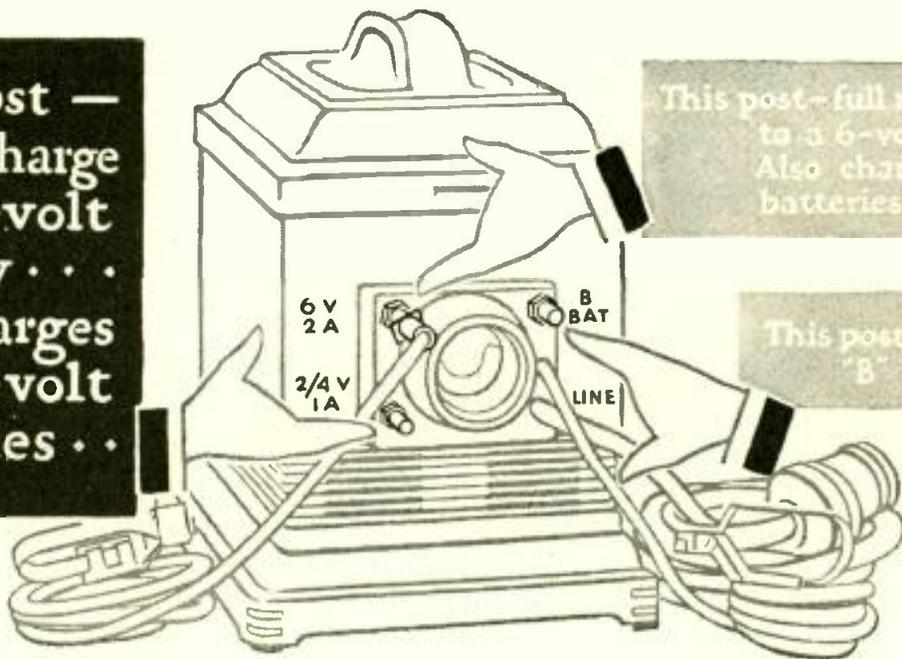
A SIMPLE ANTENNA

The house lighting lines may easily be used as an antenna by the use of the antenna plug described above.

“Trickle Charge” with a 2 ampere Tungar

When you have a Tungar you have a complete battery charging outfit. It will deliver either a full rate or a trickle charge. Clip it on one post and you will get a full 2 ampere boost, on another, a trickle. It is just the kind of device needed to insure perfect reception at all times. In addition to charging all radio “A” and “B” batteries, Tungar charges auto batteries, too.

This post —
trickle charge
to a 6-volt
battery . . .
Also charges
2- or 4-volt
batteries . .



This post—full rate charge
to a 6-volt battery
Also charges auto
batteries

This post—charges all
“B” batteries



Tungar

REG. U.S. PAT. OFF.

BATTERY CHARGER

East of the Rockies:

- 2 ampere Tungar . . . \$18
- 5 ampere Tungar . . . \$28
- Trickle Charger . . . \$12

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

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GENERAL ELECTRIC

**WE SELL
GENUINE
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PANELS**



**This Desk
is made of
Walnut or
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not Gum, Poplar
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A beautiful Table of genuine Walnut or Mahogany veneer, Top 5-ply. High-grade lacquer finish rubbed to piano finish. Has ample leg-room and battery spaces. Size top 17 x 36 in. Height 28 in. Battery spaces 8 in. wide, 9 1/2 in. high, 13 in. deep. Crated 56 lbs.

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GENUINE GRADE M FORMICA PANELS. We guarantee these to be perfect, cut true, edges smooth.

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Postpaid in U. S. Deduct 25c if you order both a cabinet and panel from us. Both by Express collect. Your choice Black, Wal. or Mah. color.

CABINET FOR UNIVALVE RECEIVER \$4.50 Walnut or Mahogany finish. Formica panel 7 x 15 x 3/16 \$2.25 postpaid. Wal., Mahogany or Black color.

We Have a New Cabinet—Send For Complete Catalogue—Free.

THE SOUTHERN TOY COMPANY, Inc.
Hickory, North Carolina

The antenna plug is in two parts. One part is a standard screw plug such as is inserted into a light socket when a floor lamp or other electrical device is to be connected; the other part is larger and has two prongs that fit into slots in the screw plug. Inside this larger piece are two small condensers. Outside is a binding-post terminal for each of these condensers. The condensers may be of different values and connecting the receiver with one of them may give better results than can be obtained through the other. The directions usually show several different connections, sometimes as many as seven, and one or more of these, in all probability, will give satisfactory results in your set.

In some cases better results are obtained with the button turned on and in other cases with it turned off.

It is foolish in this day of entertaining and educational broadcasts to permit anything (and especially any difficulty about an antenna), to prevent the full enjoyment of the benefits of radio.

The lamp-socket antenna may not bring in as many stations as could be heard with an outside wire, but it can be used with real satisfaction by millions who are within easy reach of some of the best broadcasting stations in the country.

In hundreds of communities an antenna plug and a cheap crystal detector outfit, costing less than \$10.00, will give the user most of the advantages enjoyed by many families that have purchased expensive apparatus.



**I. C. A.
PANELS & PARTS
for the New
UNIVALVE RECEIVER
Featured in This Issue**

Add to the appearance as well as the performance of this phenomenal set by giving it an I.C.A. front panel of Insuline or Bakelite. Either of these standard insulating materials will provide highest insulating efficiency, insuring better reception.

Drilled and engraved front Panel for Univalve Receiver, 7 x 15 x 3/16 in., in Insuline \$3.00; Bakelite, \$4.50. Binding Post Strip, 1 x 9 x 3/16 in., Bakelite, 50c.

I. C. A. Panels in hi-gloss Insuline or Bakelite are furnished for over 70 popular circuits, including those sponsored by "Popular Radio." Decoration by the beautiful Etch-C-Gravure Method. All panels drilled ready for mounting. We also furnish Sub-panels for practically all well known circuits. Plain Panels in Insuline or Bakelite, black and wood finishes, in all standard sizes.

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Make your set "Better" and "Better Looking!"**

I. C. A. Insulation Parts give your set that much-desired "professional finish" sought by the home set builder. I. C. A. Products include: Tubing; Spaghetti Tubing; Rods; Sub-Panel Mounting Brackets; Sockets; Binding Post Panels; Vernier Dial; Pointer Knobs; Knife Switches; Three-Stage Resistance Coupled Amplifier, etc.

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To SET BUILDERS**

POPULAR RADIO

Laboratory tested sets are easier to build if you use our **FREE PICTURE WIRING DIAGRAMS** with our

Just Tear this Advt. out

Let us Quote You on—

Gentlemen: Without obligation, send me full information and prices on sets which I have marked X.

Univalve Receiver

Cockaday's LC-27

Improved Browning-Drake

S-C. Single control, All Wave

Hammarlund - Roberts Hi-Q

PORTABLE TEST BOARD

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SHORT WAVE EQUIPMENT

I enclose \$1.00 for Simplified Blueprints

SIMPLIFIED FULL SIZE BLUEPRINTS

A radio set constructed from one of our kits is not only easier for the experimenter to build but its appearance both inside and out, makes it more valuable to you.

Every Stamford Shop Kit includes a set of full size simplified Blueprints. An instrument layout shows every part in exact size and position. A picture-wiring diagram shows where and how to connect each wire. By following the wiring plan of the designer your set cannot fail to perform more efficiently.

Our Kits contain everything needed to complete the set, down to the last piece of bus bar and screw. Every panel is machine-drilled and artistically decorated.

Cheek opposite the sets you are interested in for complete data and prices of kits and parts.

Cockaday's LC-27 Custom Built Write for Prices on Various Models

Diamond-of-the-Air 5-TUBE KIT—Complete Parts \$37.50 Licensed under Armstrong Patent No. 1,113,149



TWO RADIO OPERATORS WHO HAD A GOOD TIME

Last summer the two radio operators under the loudspeaker horn were sent from New York where it was ninety in the shade, to Estes Park, Colorado, where a pair of blankets felt good at night. They set up and operated a broadcasting station at an elevation higher than had been occupied by such a station in the United States. It transmitted the proceedings of a gathering of Boy Scout officials, including speeches by Dan Beard, James E. West and other famous men. Keep working at radio and some day you too may land an interesting job—as these two youngsters did.

**RADIO SHOP OF STAMFORD
20 Worth St. Stamford, Conn.**

A Scout Radio Shack in the Trees

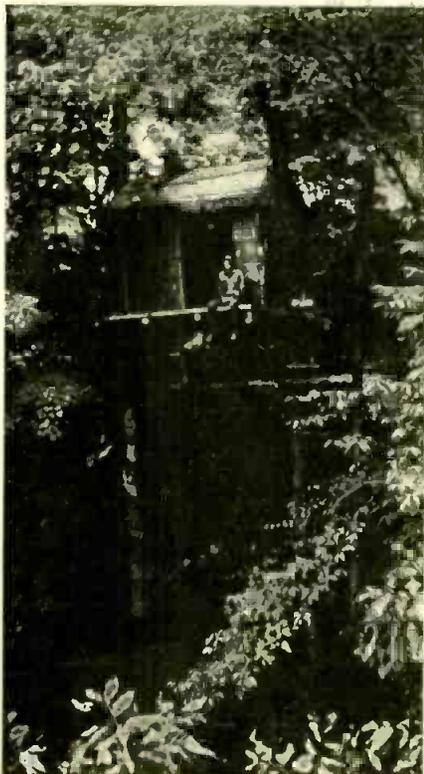
A boy scout in Gowanda, New York, decided a while ago that so long as he had to put his aerial up in the trees, he might as well build his radio shack there also.

The first step was to select three trees near enough together to support the structure. When these were found, he started up one of them, nailing on cleats as he climbed. With the cleats forming a ladder forty feet high, it was easy to hoist poles to bridge the space between the trees and form beams to support the shack. The ends lay in convenient crotches or were lashed and spiked in place and braced underneath by brackets.

The floor was made large enough to extend beyond the cabin and form a porch. The house was framed of two-by-four joists and boarded; the gable roof was covered with a single layer of roofing paper.

On account of the foliage, insulated wire was needed for the antenna. A wire attached to a nail driven into one of the trees might have served, but whether the trick of using a tree as an aerial was known to the scout or not is not reported. A ground connection also could be made through a tree although it would not be excellent.

Radio under such conditions has several advantages. One of them is that only an agile parent can come and get the operator when it is time for him to go to bed.



A RADIO SHACK IN THE TREES

This young boy scout in Gowanda, N. Y. reduced interference from both neighborly buildings as well as from insistent parents by building this comfortable little house forty feet above ground.



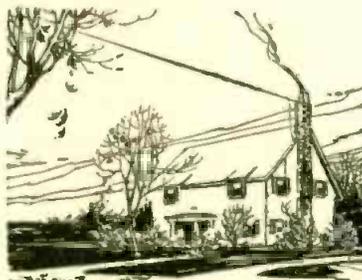
Get Your Money's Worth
of
local and distant
programs

Use a
Beldenamel Aerial
with your new set



DISTANCE! That is the real test of your new set.

But don't forget that you cannot get the finest results unless you have a good aerial. Many good sets are permanently crippled because set owners mistakenly believe that corroded, soot-covered aerials are "good enough."



Ask your nearest radio dealer
for a Beldenamel Aerial

A corroded aerial reduces the volume and distance of even the finest radio set. That is why a Beldenamel Aerial should always be used. Each strand of a Beldenamel Aerial is coated with weather-proof, fume-proof baked enamel. Even after years of service, a Beldenamel Aerial is still as good as new. It cannot corrode. It always assures maximum distance and greatest volume.

Belden
Manufacturing Company
2316A South Western Avenue,
Chicago, Illinois

**MICADON 640A**

Capacities:

.006 to .02 mfd

Price

\$1.00 to \$1.95

METALEAK

15,000 ohms to

200,000 ohms

75¢ each

.25 meg. to 5 meg.

50¢ each

Perfect Tone Quality at low cost

The best tone quality can be enjoyed even with an inexpensive set if resistance coupled amplification is employed. It is the one sure method of getting even amplification of all tones, and it has the added advantage of consuming less "B" battery current than other methods of audio amplification.

Micadon 640 A is the Dubilier Condenser to use for this unit. Designed and patented by Dubilier it provides unvarying capacity with the lowest dielectric loss—so essential for the true reproduction of sound. Used with the silent Dubilier Metaleak, Micadon 640 A will give you the foundation for an amplifier unit with all the tone quality found in the best radio sets.

If you are interested in building a resistance coupled amplifier send ten cents in stamps or coin for our 32-page booklet "Seventeen Ways to Improve Your Set." It gives diagrams and specifications and contains hints for set builders that only experts formerly knew.

Dubilier

CONDENSER AND RADIO CORPORATION

4377 Bronx Blvd., New York, N. Y.

A Radio Receiver in a Scout Hat

THE first prize in one of the contests at a recent radio show was won by a receiver in a Boy Scout hat. This novel and practical idea can be worked out in a number of ways.

The most difficult part to manage is the phones. These should be as light and as thin as possible. A single phone may be used, but the lightest one obtainable is heavy enough to throw the hat off balance unless parts of equal weight are suspended from the opposite side.

A head-band would be in the way inside a hat. The phone cords are attached to the sweat-band so that the phones hang loosely over the ears, where they are pressed into closer contact by the hands. They can be hung slightly above the correct position and then drawn down tightly by an elastic band passing under the chin. This leaves the hands free.

The phones and a crystal detector are all that are necessary for picking up local stations after contact is made with an antenna and a ground. When galena is used it may be necessary to mount the detector with long wires so that it can be taken from the hat and held in the hand for adjustment. Or the phones may be mounted so that they can be removed from the hat and the hat placed on the ground while the receiver

is in use for convenience in operation.

Some crystals requiring heavier contact may be sealed in so that they will function for a long time without readjustment. Cat whiskers have been made with a brush end that made many contacts with the crystal, and it is claimed that these can be used indefinitely without readjustment unless the whole brush loses contact. A small, flat detector that will fit into the crown of the hat and hold its sensitive adjustment might be designed by any ingenious radio amateur. The crystal must be protected so that the sensitive surface will not touch the hair, which contains enough oil to coat the surface and destroy its sensitivity.

A receiver without a tuner will not be selective, of course. A tuner that will fit into the crown of a Scout hat, or any hat of similar type, may be made from a spiderweb coil and a book-type condenser. The latter may be made of two metal plates, fastened together at the ends but insulated from each other, and operated by a screw or other device that will open and close the free ends like pages of a book.

The plates may be cut to fit the crown of the hat; one may be attached to the felt, the other left free to open and close. The screw or other control may project through the crown where it can be reached by the hand without removing the hat.

The plates must be protected so that



A RADIO RECEIVING SET IN A BOY SCOUT HAT

The headphones are hung from the sweat-band; the tuner and crystal detector are mounted in the peak of the hat.

they will not touch anything; a simple method is to enclose them in a piece of a rubber bathing cap, which will stretch enough to permit the maximum separation and also serve to draw the plates together again. The lightest and thinnest, though not the most durable, condenser may be made of sheets of tin foil, wax paper and stiff cardboard. The tin foil may be attached to the cardboard covers of the book and strips of Wax paper fastened in such positions as to prevent the two sheets of tinfoil from touching each other. The spiderweb coil may be attached to the outside of one of the covers, with one end fastened to one sheet of tinfoil and the other end to the other sheet, thus forming a shunt connection.

The tuning range of this tuner will depend upon the inductance of the coil and the capacity of the condenser. The measurement of the inductance in a coil is difficult. It is better to buy one to cover a given range of wavelengths or wind one of similar dimensions. A beginner who has a little knowledge of mathematics may be able to calculate the capacity of a home-made condenser approximately by using this formula:

Capacity, in microfarads, equals the area of the plates in centimeters, squared, multiplied by the dielectric constant, divided by 11,309,760 times the distance in centimeters between the plates.

The dielectric constant of air, which is the dielectric that separates the plates in this type of condenser, is 1, so the above formula as applied to this case is simplified to squaring the area of the plates in centimeters and dividing as stated above.

Some may prefer to use a fixed condenser and a variable inductance coil. A fixed condenser is even easier to construct, the tinfoil being laid between sheets of wax paper, and it can be folded to any convenient size. A tapped coil with a switch involves much more work than one without taps, but many have been made by beginners with satisfactory results.

Wires for the antenna and ground connection may be coiled around the outside of the hat after they are connected with the apparatus inside through the ventilating holes in the crown. Fifty feet of small wire does not add much to the weight of the hat. The free end of the wire may be attached to a stone and thrown over the limb of a tree to raise the antenna to the desired height. The end of the ground wire may be dropped into a stream of water, attached to a nail driven into a tree, or connected with any water pipe or other metal that enters wet soil.

Having phones and tuner installed in his hat, a Scout might construct an adapter that would enable him to place a small detector tube in his flashlight and light the filament with its batteries.

"I have made 6 of your 3 ft. Cone Speakers and have never heard a speaker so wonderful. I have had no trouble in making them."

—K. T., Chicago

"I wish to congratulate you on your loud speaker. The results obtained either on a two peanut tube set, or a 10 tube Super 10 with four stages of audio are simply wonderful."

—R. B. T., Montreal

"I am surprised and gratified in the way it works. It has a beautiful tone and does everything that you claimed for it in your advertisement."

—R. T. K., Pontiac.

Later: "I have been using the

cone every day and it works better than ever. In my last letter I was careful not to brag too much; could have said a lot more."

"Is in every way satisfactory and is all, in fact more, than I hoped for."

—J. N. H., Gary.

"It is the finest speaker that I ever owned or heard."

—W. A. R., Port Huron.

"I cannot help but write to you and express my appreciation of the wonderful tone quality and purity of this most excellent loud speaker."

—G. H., Cleveland

"Properly constructed the unit produces a reproduced tone quality

that is without exception remarkable."—Milo Gurney, Technical Ed., Radio Digest, Chicago.

"Mr. Gurney has recommended it as comparable only with the 3 ft. I would like to build two of these speakers for the use of my parents and myself."

—E. E. P.

"Is the best I have heard; the 3 ft. cone cannot be beat at any price."

—H. M. L., Galesburg

"We put the speakers together and they worked fine. Everyone is enthusiastic about them."

—Volney Hurd, Radio Ed., Christian Science Monitor, Boston.



Build Your Own 3-foot Cone Speaker

—save four-fifths of the retail cost

In one evening you can build as fine a giant 3 ft. Cone Speaker as you can buy if you use genuine PENN parts. You save 4-5 the retail cost of a factory-built 3 ft. Cone Speaker by the simple, easy-to-follow directions.

Radio's greatest technical editors endorse the PENN Unit and other PENN parts—L. C. Cockaday, Milo Gurney, Volney Hurd, Robt. Casey and many others—because the PENN Unit has proved itself the finest, most sensitive, most powerful and sturdiest for the home constructor.

The Penn C. S. Unit, heart of the 3 ft. Cone Speaker, has a super-charged, 16 oz. cyanide hardened steel magnet, udalyted, which adds 50% to magnetic life. Unit is adjustable to output of set with which it is used; so sensitive it operates with any set able to work a loud speaker; so powerful it takes all the volume the tubes will pass; reproduces perfectly all audible frequencies. Guaranteed electrically and mechanically perfect.

Marvelous Tone Quality

With a PENN 3 ft. Cone Speaker you will really enjoy radio reception. This

Parts Complete

\$14¹⁵

INCLUDING GENUINE

Penn
CONE SPEAKER
UNIT

2 sh. Alhambra Fonotex
Penn Back Rings
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Spec. Ambroid Cement

remarkable speaker reproduces all the tones of every instrument in an entire symphony orchestra, from the low rumble of the kettle drum to the piping note of the piccolo. Equally wonderful on singing and speaking.

Only with either an expensive factory-built 3 ft. Cone Speaker or a PENN can you get these results. And PENN saves you 4/5.

From your Dealer or Us

Ask your dealer for the PENN Cone Speaker Unit and complete PENN parts. The price is but \$14.15. If he hasn't them and will not get them for you, we will ship f.o.b. N. Y. C., on receipt of price. Unit alone \$9.50.

Pamphlet, "How to Build a Giant 3 ft. Cone Speaker" for 10c coin or stamps.

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Exclusive Sales Agents for G. R. Penn Mfg. Co., New York City

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Leading manufacturers of cone speakers use Alhambra FONOTEX because it is the only material made with practically no grain so that it resonates uniformly at all frequencies.

Alhambra FONOTEX is not paper but a patented product made by a patented process exclusively for conespeaker cones.

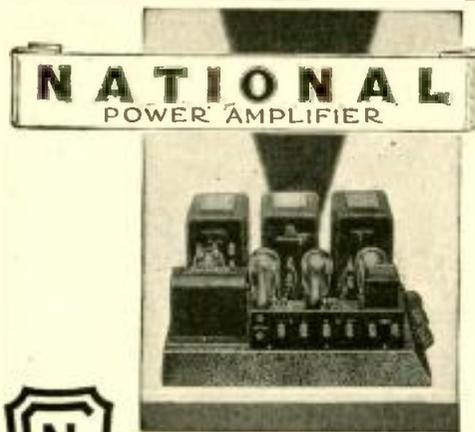


ALHAMBRA
FONOTEX
PRODUCT AND PROCESS PATENTED
FOR CONE TYPE LOUD SPEAKERS

Whether buying a cone or building your own be sure to use genuine Alhambra FONOTEX for complete and lasting satisfaction. Improves as it ages; becomes practically impervious to moisture. Alhambra FONOTEX is sold by dealers in 38" x 38" sheets at 75c per sheet. If your dealer hasn't Alhambra FONOTEX

and will not get it for you, we will ship f. o. b. N. Y. City, on receipt of 75c per sheet, plus \$1 to the total for packing charges.

FONOTEX CO., 34 W. 3rd St., Desk "L", New York City



N SUPPLIES all B current for your set and C bias for the power tube, and gives any Radio Receiver true quality and fidelity of tone with as great volume as desired. Uses either Raytheon BH or Rectron full wave rectifying tube.

NATIONAL COMPANY Inc., Cambridge, Mass.

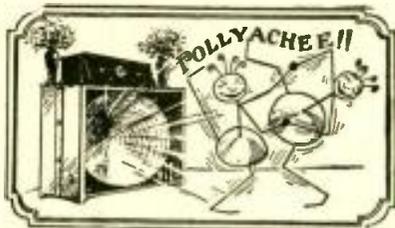
W. A. Ruddy, President, makes also B Eliminators, the famous NATIONAL Tuning Units with BROWNING-DRAKE Coils and Transformers, Impedanceformers, Velvet-Vernier Dials with or without illumination, and Variable Condensers, including the new Girder-frame Condensers.

Send for Bulletin 116 L-3.

"World's Finest 3-Ft. Cone or Roll-Type" Loud-Speaker

"ENSCO" KIT ONLY \$10

Assemble in Less Than an Hour



Complete parts furnished in kit form. We guarantee this speaker the equal of any manufactured cone speaker considering price. With this THREE FOOT CONE SPEAKER you hear all the tones. It brings out the true depth and beauty of orchestral and instrumental music. Can be operated softly for living room music or full volume for dancing, and without trace of distortion. Kit includes famous "ENSCO" cone unit, the only direct drive, distortionless unit for large cones; Alhambra Fonotex for big cone, with brass apex, two Blue Prints showing cabinet, stand, or roll-type construction. All necessary instructions for assembling. Buy this wonderful speaker under our absolute guarantee. *Your money back* if you are not convinced that it is the finest reproducing medium. It works on any set, with ordinary Tubes or with Power Output.

ORDER COUPON — SEND NO MONEY

Write your name plainly as indicated below, then mail and complete kit will be forwarded to you. Just pay postman \$10.00 upon delivery.

Name.....

Address.....

ENGINEERS' SERVICE CO.
25 CHURCH ST. Desk Z NEW YORK CITY

A small "B" battery may be carried in the pocket or haversack, or in a special pouch hung on the belt.

The uses of receivers carried in the hat are numerous. A Scout troop with a portable transmitter, and with its Scouts all provided with these receivers, could work as a unit even though the patrols or individual Scouts were several miles apart. Interesting tests and games may be arranged that will test thoroughly a Scout's ability to read the International Morse code, which all must learn before they wear the first-class badge.

Messenger service such as Scouts perform at many gatherings could be expedited by these peripatetic receiving stations, and when storms, floods or earthquakes crippled local wire service the Scouts could render even more efficient aid than they have given so often without the use of radio.

How to Dodge Interference from Electric Wires

A RADIO amateur recently was confronted by the problem of erecting an antenna where it seemed likely to pick up more interference from high-tension wires than useful energy from radio stations.

Along the north and east sides of his lot ran many wires, some carrying 4700-volt current; several of them cut across a corner, making a 100-foot stretch running from southeast to northwest. The house lighting mains came in from the northeast, and a line ran underground down the middle of the lot to a studio where a receiver was to be installed to supplement the one in the house. Every compass direction was covered by a wire that might cause interference, and across the street was a transformer station in which the current for the entire community was stepped down from 4700 to 2300 volts and distributed to more mains running in all directions.

The amateur placed a pulley sixty-five feet up in a tree at the middle of the west line of his lot. Through this he rove sash cord with which to hoist and lower the outer ends of the antennas that ran down to the house and studio. The drop from the tree to the points where the receivers were located was sufficient so that the lines of the two aerials cut the lines of all the surrounding wires at angles that reduced inductive effects to the minimum. When the receivers were tested, no hum from the wires or the transformers could be heard.

There is a suggestion in this experience for those who cannot avoid paralleling high tension wires if they erect flat top antennas. Place one end of the antenna high and the other low. Or a vertical antenna that will pick up little interference from horizontal wires.

Why Better Parts Sometimes Get Poorer Results

AN ENGINEER, speaking at a meeting of one of the important radio organizations, stated recently that radio users often complained that they had replaced the amplifying transformers in their sets with transformers of better design and construction but had failed to obtain better results. In some cases the results were much worse, although the new transformers were unquestionably superior to the old ones.

He explained that new transformers, installed without regard to the characteristics of the tubes used, often overload the tubes. Such overloading causes distortion and often shortens the life of the vacuum tubes.

The characteristics of different tubes vary greatly. The filament of a WD-11 type tube might be wrecked by a load that the new tubes designed for use in the last stage of low-frequency amplification could carry with ease. A competent engineer, in designing a receiving set, takes into consideration the characteristics of the tubes to be employed. He designs the set for a certain number of tubes of specified characteristics and designs his circuits so that each tube shall have a certain input and specified voltages on the filament, the grid and the plate, together with a load that shall not exceed a specified maximum. There may be several kinds of tubes that can be used in the set interchangeably, but the characteristics must not vary beyond certain limits, nor the load be increased, or the results will suffer.

He puts into the set inductance coils, condensers, rheostats, transformers and other parts that will work well together with the tubes recommended. Knowing definitely the characteristics of all these parts, he can tell in advance what results the set will deliver when properly installed and operated according to directions under average conditions.

The set goes into a home. It gives satisfaction up to a certain point, but no radio user ever got as much out of any set as he would like to. Some of us try to get more out of the air than there is in it. Some neighbor gets greater distance or volume, with a set in which there are transformers of a different type. They are widely advertised and highly recommended. So the user buys new transformers and installs them. They do not work as they do in the neighbors' set.

Then the trouble begins.

The manufacturer of the transformers probably would not recommend them himself for the place if he knew all the conditions. The local dealer may know that they are better in material and workmanship than the old ones and recommend them honestly, but without knowing what the radio engineer does who designed the set.

It is not often that a set, however

good it may be, will come through an overhauling by an amateur and deliver as good results afterward. The radio user should refresh his memory concerning the maker's guarantee, if there was one. If the set is not delivering results as guaranteed, the manufacturer should be notified, directly or through the local dealer. His instructions should be followed and he should be held accountable for the results. When the purchaser tampers with a set he automatically releases the manufacturer from much of the responsibility that honest concerns carry cheerfully as long as their goods are used according to directions.



Even as simple a piece of apparatus as a rheostat must be carefully tested to see that it performs satisfactorily.

How Rheostats Are Tested

EVERY piece of radio apparatus placed on the market by a reliable manufacturer is tested before it leaves his factory.

The man in the picture above is testing rheostats. Each one is connected in series with a battery and a meter; unless it proves that it can increase or decrease the current evenly as the knob is turned, it is rejected.

The rheostat being tested is of the pressure type, the resistance material being a mixture of powdered carbon and metal. This type is capable of very fine adjustment, probably finer than can be obtained with a wire rheostat having a vernier attachment. Twelve turns of the knob are required to cover the entire range of adjustment.

The usable portion of the range is smooth and continuous and gives a micrometer adjustment.

375,000 Miles of Wire For "Wireless"

A RADIO amateur who works in a factory where magnet wire and all small sizes for radio work are manufactured figured out how far the wire would reach that was made by the concern in one day. He found that an average day's output would reach fifteen times around the earth, the length of wire being approximately 375,000 miles.



PRECISION OCTAFORM COIL

A new type of inductance used in the Cockaday LC-26 Receiver. The only coil that can be used in this set. Price \$5.50.

COCKADAY COIL \$5.50 (New Octaform Base)

The fact that this coil was used in the 4-Circuit Tuner as designed by Mr. Cockaday, is significant recognition of the accuracy and efficiency of Precision Coils.

PRECISION



TAPPED CHOKE No. 380

This coil has been designed for those who desire a tapped choke. Slotted form winding lowers capacity. Price \$1.75.

Dealers Write for Catalog

The UNIVALVE RECEIVER

A single tube set giving loud-speaker volume.
A new development incorporating the little known shunt reflex. Every part fully guaranteed.

COMPLETE LIST OF PARTS

2—Hammarlund Auto-couplers.....	\$7.00	1—Aerovox Mica Fixed Condenser, .0001 mfd.	\$.30
2—Cardwell Taper Plate Variable Condensers, type 169-E, .00035 mfd. equipped with 2 Cornell Etched Vernier Dials.....	9.50	1—Aerovox Mica Fixed Condenser, .0005 mfd.30
1—Karas Harmonik Low-Frequency Transformer 2:1 Ratio.....	3.00	1—Daven Grid-Leak, 4 megohms.....	.25
1—Thordarson Low-Frequency Transformer.....	7.00	1—Carter Small Single-Circuit Jack.....	.25
1—Carter Battery switch.....	.65	1—Bakelite Front Panel, 7 by 15 by 3/16 inches.....	2.50
1—Amperito No. 1 A.....	1.10	1—Hardwood sub-base, 7 by 14 by 1/2 inch.....	.50
1—Aerovox Mica Fixed Condenser with Grid-Leak Clips, .00025 mfd.40	1—Bakelite Binding-Post Strip, 1 by 9 by 3/16 in.30
		7—Eby Binding Posts.....	1.05
		2—Small Brass Brackets.....	.10
		1—Benjamin Vibrationless Socket.....	.75
			\$39.95
		1—Emerson Multivalve Tube.....	6.50
		POPULAR RADIO Blueprints.....	1.00

SIR OLIVER LODGE'S N CIRCUIT

A new model of economy. Uses the new Emerson Multivalve giving four tube volume with 2 tubes, including a UX-112 Power tube. Single dial control. Complete descriptive diagram and data for building with each kit. Order yours today while we have a few left. Every kit fully guaranteed.

ESSENTIAL KIT

1 Set of Precision "N" Coils.....	\$6.00
1 Prec. Var. Condenser type "N" .00023 Mfd. Cap.....	3.50
2 X-L Variodensers, type G-10.....	3.00
1 7x14x3/16 drilled panel.....	3.50
1 7x13 1/2 baseboard.....	.75

Including diagrams, etc. \$16.75

PRECISION COIL CO., INC., 209 Centre St., New York City
CREATORS OF COILS AND COMPILERS OF KITS
Popular Radio Kit Specialists. Mail Orders Filled

PARTS YOU WILL NEED BUT MAY HAVE

1 Eiectrad Royalty Resistance, 500,000 ohms.....	\$1.50
1 Eiectrad Fil. Switch.....	.40
1 Eiectrad Double Mfg. with 01 fixed Cond.....	1.75
1 Eiectrad Resistor, 1 meg.....	.60
1 Eiectrad Resistor, .5 meg.....	.60
1 Amperite 6 volt 1/2 amp.....	1.10
1 Amperite 6 volt 1/2 amp.....	1.10
1 Eiectrad gridleak 3 meg.....	.60
2 Samson transformers.....	10.00
1 Silver Marshall Dial.....	2.50
8 Fahnestock clips.....	15
2 Patent Sockets @ 65c.....	1.30
1 Eiectrad 00025 grid cond. with mig.....	.40
Including diagrams, etc.	\$22.00
Tubes you will need	
1 Cleartron Multi-valve.....	6.50
1 CTX-112 or Equiv.....	4.00
Total, including tubes.....	\$49.25

Your Radio Problems Solved

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, under the personal supervision of Laurence M. Cockaday which will, without charge, answer by personal letter any question, problem or request for information submitted by a subscriber. This service is, however, also available to readers, other than subscribers, at the very nominal rate of \$1.00 the inquiry.

In writing please confine your questions to one general subject, writing on one side of the

paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently, look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

- March, 1926
 - Why and How the Milliammeter Increases the Efficiency of Your Set.
 - What "Inductance" Really Is.
 - List of Broadcast Stations in the U. S.
 - How to Build the S-C Receiver for Short and Long Waves.
- April, 1926
 - How to Get an Operator's "Ticket."
 - What a Straight-Line Frequency Condenser Really Is.
 - How to Build a Power-Pack Amplifier.
 - The New "Crystal Pilot"
 - How to Build and Operate a Low-Power Transmitter.
 - The POPULAR RADIO Medal for Conspicuous Service.
- May, 1926
 - How to Draw Up Your Own "Tuning Graphs."
 - How to Build the Improved Raytheon Power-Pack.
 - How to Build an Antenna Mast for \$15.00.
 - Fifteen Ways to Reduce Static.
 - Do Your Coils Broadcast?
- June, 1926
 - How to Build the New Home Receiver.
 - How to Put Up a Good Outdoor Antenna.
 - How to Get the Most Out of Your Ready-made Receiver.
 - Audio-Frequency Amplification. How to Get it Without Distortion.
 - Four New Combinations of Units for Assembling the Raytheon Power-pack.
- July, 1926
 - How to Get the Best Reception in Summer.
 - The Best Crystal Set for \$13.00.
 - How to Build the Newest Portable "Town and Country" Receiver.
 - Four New Combinations of Units for Assembling the Raytheon Power-Pack.
 - How to Get the Most Out of Your S-C Receiver.
- August, 1926
 - A New Method of Using Harmonics for Determining Frequencies.
 - POPULAR RADIO Circuits.
 - How to Build the Improved Browning-Drake Receiver.

- How to Pick Out a Loudspeaker.
- How to Get the Most Out of Your "Town and Country" Receiver.
- Three Vacuum Tubes in One.
- September, 1926
 - Forecasting Radio Reception from the Weather Map.
 - How to Build an Impedance-coupled Amplifier.
 - A Radiant Crystal Pilot.
 - POPULAR RADIO Circuits.
 - How to Simplify Your Set with Automatic Filament Controls.
 - Inside Information on New Radio Receivers.
 - How to Wire Your House for Radio.
- October, 1926
 - How to Build the New LC-27 Receiver
 - The Radio Road Hog
 - POPULAR RADIO Circuits
 - Sets That Earn Incomes.
 - Inside Information on New Radio Receivers.
 - Why Signals Fade.
- November, 1926
 - How to Build the LC-Senior Power-Pack.
 - Waves and Wavelengths.
 - POPULAR RADIO Circuits.
 - How to Select Your Radio Parts.
 - How to Patent Your Radio Inventions.
 - How to Solder.
- December, 1926
 - Uncle Sam's New Short-Wave Net.
 - How Circuit Resistance Affects Selectivity.
 - POPULAR RADIO Circuits
 - How to Build the LC-Intermediate Power Pack.
 - Inside Information on New Radio Receivers.
- January, 1927
 - How to Build the New KH-27 Receiver.
 - To Start and Stop Your Set Automatically.
 - POPULAR RADIO Circuits.
 - The Quick Doctors of Radio.
 - How to Build the LC Junior Power-pack.
- February, 1927
 - The Coming of the "Radio University."
 - How to Get Quality Amplification.
 - How to Build and Use a Portable Test-Board.
 - How to Assemble the All-Amx Senior Three-tube Reflex Receiver.
 - What's New in Radio.

Department 38

POPULAR RADIO 627 W. 43d St., New York

FREE PARTS for the new Univalve Receiver

If you want to build your own set, here is your opportunity to secure FREE all the parts you need for this "Univalve Receiver." Call on all your radio friends, and on anyone who has a set and tell them of the many special features of POPULAR RADIO.

These liberal offers will make it possible for you to secure an order from every one you call upon. For each subscription with remittance you send us you will receive credits as per the following scale:

POPULAR RADIO

4 Months for \$1.00 counts 16 credits

6	"	1.50	"	25	"
8	"	2.00	"	33	"
12	"	3.00	"	50	"
24	"	5.00	"	75	"

Send us the full amount collected with names and addresses of subscribers and tell us the parts your credits entitle you to and we will send them to you. If the subscriptions you secure do not give you enough credits for the parts you want, we will allow you to purchase credits at the rate of 3 cents each. Example: With (7) seven 1-year subscriptions (350 credits) and 90 cents additional in cash you may have 2 Cardwell Taper Plate Variable Condensers, for which you need 390 credits.

If the parts you want are not listed in this advertisement, we are prepared to supply them. Let us know what you want and we will tell you how many credits you will need.

On page 313 are described POPULAR RADIO'S Simplified Blueprints. You can have any set of prints you want for only 40 credits. You may also secure a copy of "How to Build Your Radio Receiver" described on page 310 for 60 credits.

CREDITS Needed for Parts Required for the new "UNIVALVE RECEIVER"

(Described and illustrated in this issue of POPULAR RADIO).

Quantity	Item	Credits
2	Hammarlund Autocouplers	250
2	Cardwell Taper Plate Variable Condensers, type 169-E, .00035 mfd. Equipped with 2 Cornell Etched Vernier Dials	380
1	Karas Harmonik Low-Frequency Transformer	120
1	Thordarson Low-frequency Transformer, 2-1 Radio	280
1	Any Approved Battery Switch (Carter Switch Illustrated)	200
1	Any Approved Automatic Filament Control 25 amp. (Amperte Illustrated)	26
1	Any Approved Mica Fixed Condenser with Grid-leak Clips, .00025 mfd. (Electrad Condenser Illustrated)	44
1	Any Approved Mica Fixed Condenser, .0001 mfd. (Electrad Condenser Illustrated)	16
1	Any Approved Mica Fixed Condenser, .0005 mfd. (Electrad Condenser Illustrated)	12
1	Any Approved Grid-Leak, 4 megohms (Polymer Grid-leak Illustrated)	12
1	Any Approved Small Single-Circuit Jack. (Electrad Jack Illustrated)	10
1	Bakelite Front Panel, 7 x 15 x 3/16 inch	100
1	Hardwood Sub-base, 7 x 14 x 1/2 inch	20
1	Bakelite Binding-post Strip, 1 x 9 x 3/16 inch	12
7	Any Approved Binding Posts, marked Ant., Grnd., A Minus, A Plus, B Minus, B Amp. Plus, B Amp. Plus, respectively (Eby Binding Posts Illustrated)	42
2	Small Brass Brackets	4
1	Benjamin Vibrationless Socket	30
Total		1598

Write for List of Free Parts for Other Popular Radio Receivers

POPULAR RADIO

Department 31

627 West 43d St. New York City

The YES and NO MAN

FRANCIS B.D.—Edward Smalle and G. Underhill Macy make up the team of the Imperial Imps from WJZ. * * * How do we get our dope? Oh, we sniff around here and there. * * * Vincent Lopez had his 29th birthday on the 30th of December, 1926. * * * How old are we? Well, you'd go bust buying candles for our birthday cake—we can tell you that much!

RED HOT DADDY.—Why don't we have more poetry on the air? Well, we've not looked upon the absence of poetry as a shortcoming of the radio; like red pepper and synthetic gin, a little of it goes a long way. * * * There was a time when NTG of WHN "poemed" every night, but he seems to have recovered from that and the doctor says he's doing nicely now.

JAMES V.L.—Only a few of the announcers send out autographed photographs; we do not have a list of them. * * * Perhaps, if you insisted, you might convince any announcer that he really owed you a portrait. * * * We know of harder things to do; convincing the average announcer that he should not send you a picture of himself, for instance.

JAKE AND BILL.—Yes, Keith McLeod does actually play the vibraphone in the WJZ concerts; he has recently taken this up as a hobby, although 'tis said his landlady is giving him nasty looks in the hall.

MAC McL.—We don't know why Joseph Knecht left the Waldorf-Astoria; perhaps his contract with that house ran out.

BONES.—Will we ask Milton Cross personally to lift that "sad, gray intonation" from his voice? * * * While it is true that Cross is a trifle sanctimonious, it is his natural way, and an attempt to change his announcing would prove fatal. There are too darn many announcers now trying to be something other than they are. * * * Leslie Adams is the announcer of KFI. Yes, he's young—32 to be exact.

JIMMY.—Yes, Charles D. Isaacson, the program director of WRNY, is the author of "Face to Face With Great Musicians." * * * Lytton Spaulding is the KTAB announcer whom you have in mind; he's a young fellow, just out of college. I can't express an opinion concerning his talk; our receiving contraption will not work that station. * * * Still, we have many, many nice announcer boys to listen to, so we're not sorry. * * * Don't tell us that you don't like sopranos! Heavens, can you imagine that?

DR. B.L.—We're sorry, but we don't happen to know of a station that would be interested in a lecture on "Natural Results With Herb Cures," but perhaps, if you had this set to music, you might get WHN to broadcast it.

J.H.B.—There is no telling what will eventually become of Graham MacNamee; like all good men, he'll probably wind up in the Hall of Fame. * * * Have we ever broadcast? Yes, from WOR and WGR, long, long ago.

GUM DROPS.—Kenneth Fickett is the announcer and studio director of WGR, Buffalo. * * * Yes, he has a very pleasant voice; to our way of thinking, he's one of the best announcers on the air; he's certainly not troubled with the Napoleon complex.

TEDDY.—What happened to Lewis Reed the old WCPH announcer? Oh, he's up there with WCPH, that big, powerful percolator at 57th Street, New York, where they advertise cheese and darning needles.

LITTLE MAN.—Kenneth Ormiston has never announced from a New York studio; during his recent visit to New York he was not in a broadcasting mood. * * * So you thought Francis Alda was disappointing? * * * Well, radio does treat the big stars rather harshly at times, doesn't it?

D.H.C.—Judge, Jr. does not broadcast any more from WJZ. * * * The program of the Walla Walla Meat and Storage is broadcast from KOWW. * * * Ralph Wilkins was the tenor you had in mind; he's gone West.

ALBERT SPALDING.—Rutherford Hayner is program manager and announcer at station WHAZ. * * * No, he's not a student at Rensselaer Polytechnic. * * * This office is not a Bureau of Missing Announcers. * * * Edward B. Huseig is still a member of the WJZ staff; he might have been a very good announcer had he not been smitten with Brokenshire's style and tried to mimic it.

CARLTON L.—Myer Davis is now musical director of the Waldorf-Astoria in N. Y. * * * So you'd like to hear a good concert by a whiskey tenor? Well, we've had everything but whiskey tenors on the air and personally we'd like to hear "Sweet Adeline" as only a partly stewed coal wagon driver can do it.

HAROLD B.H.—Percy Boyd is the manager of KOKA studio; write to him direct. * * * How to invent a fresh announcer exterminator? Gosh, we wish we knew!

HARRY HOWE.—Mr. Schenk, the new announcer at WEA, was formerly a baritone with Roxy, and he hails from Mt. Vernon, N. Y. He is a graduate of the Naval Academy. 'Tis said that he is only 25 years old. * * * Fred Smith is the chief announcer of WLW and he seems to be satisfied with his work. * * * We have never heard of the Bolonga Boys, and their sausage songs; we have, however, heard the 3-in-One Oilers and their oil cans.

DAVIDSON.—Kalin Hagen, the WGY announcer, wrote "Gentlemen Prefer Blinds;" glad you liked it. * * * Yes, Hagen is an old timer; he's been announcing at WGY since 1922. He's one of the very few ideal announcers and good announcers are extremely scarce. * * * Sorry we can't help you get a job in a studio; besides, if you have a good job, stick to it; the woods are full of radio-struck people.

JEROME S.—Charles Wellman is the announcer of KFWB; he has a wife and family—and a very good publicity man. No Wellman has never been in the movies. * * * If we mention a “certain” announcer again in our “frightfully sarcastic way” you are going to send us poisoned candy, eh? Well, go ahead. If we receive any candy from a stranger we will forward it to the announcer in question, so there!

B.B.V.—You are all wrong about N.T.G.* * * He was not the model for the Glostoria advertisement; however, we understand that big throat lozenge people are anxious to make a deal with him.* * * If you ever heard him roar through “Boots” you would know why.

A.W.C.—We are sorry to learn that Vincent Lopez makes you so mad in rhyming “radio” with “lady-o” that you have to beat your wife.* * * Try Ben Bernie.

DR. L. O. P.—Harry Richman is not broadcasting now.* * * He is a funny fellow and we miss him, too.

V.P.—Send your crochet needle to Mr. Norman Brokenshire, at WPCH, New York City.* * * He will probably appreciate your poem “An Ode to Norm” very much.

R.W.R.—Phillips Carlin lives in New York City; he is the manager of WEAF’s studio which, of course, makes him Mr. McNamee’s boss.

G.G.—We don’t know what has happened to May Green; she is probably writing songs and doing her house cleaning. We also think that she is the best banjoist on the air.* * * Yes, she is married and has a very beautiful daughter about ten years old.

N.V.N.—Milton Cross lives in Brooklyn, N. Y., and he does a great deal of professional singing outside the studio.* * * Yes, we think that he is a very resourceful announcer; as a matter of fact, we think that he is best announcer in this big country of ours, although he is rather verbose at times.

A.L.M.—And who told you that Graham McNamee had a son at Yale? * * * You are wrong; McNamee was a voice instructor before he began to broadcast.

R.H.—You are wrong about the microphone at that, Newark, N. J. station. It is an oil can and not a hot-water bottle.* * * That funny noise that you hear may be the handful of dried beans that were unwittingly left in the big vacuum tubes before they were sealed up, and the hissing noise you heard was probably the valve on the steam radiator.* * * No, the announcer is not troubled with asthma.

B.N.B.—No, the broadcasting equipment of WRNY is not located under Ben Bernie’s bed on the 11th floor of the hotel Roosevelt.* * * It is a standard Western Electric station troubled with shortness of breath. Yes, the location was very bad.

BIG BEN.—You lose your bet; MacNamee announced both the Army and Navy games.* * * Mac lives on Riverside Drive, New York, and comes from Minnesota or some such place.



\$17.50 complete

\$12.50 complete

The Lowest Priced Quality “B” Eliminator

Livermore Falls, Maine. Have been using your Eliminator for a year and well satisfied with it as it gives good results and is free from any hum.

ELMER A. RIGGS.

Duluth, Minn. Your Eliminator has given me wonderful continuous service for the past year.

F. A. LOHMER.

St. Louis, Mo. Your Eliminator is wonderful. I am recommending it to all my patients as I think it’s wonderful value.

DR. A. C. BURIAN.

Columbus, Ohio. Your Eliminator has been in service for a year and I am very well satisfied with it.

LEO C. SPRAGUE.

San Jose, Calif. Have had your Eliminator for a year and it has given perfect satisfaction.

W. S. SAWDEY.

Cleveland, Ohio. After nineteen months of service my Ferbend Eliminator is still giving excellent results and has stood up against much higher priced outfits.

R. ST. BARHOFF.

Beaver, Penn. I have been using your Eliminator for a year now and have wonderful results with it.

R. L. McCULLOUGH.

Corliss, Texas. One year ago I bought one of your Eliminators and have been very well pleased with it.

DR. HUBERT B. LOVE.

Aledo, Ill. The Eliminator I bought from you a year ago works fine.

WILLARD RUSE.

The moment you see the good Ferbend “B” Eliminator you understand why during its first two years of successful service it has made nearly 50,000 friends. “Singular Value” is written all over this fine instrument.

Outstanding Quality, however, is confirmed only through proof of lasting good performance—so we ask you to read the interesting endorsements reproduced here. They are only a few out of thousands—but actually your best means of verifying the information we give you.

How can we produce a Quality Instrument at a price so spectacular? Because we are pioneer specialists in the manufacture of “B” Eliminators—because every component part is designed, made and assembled under one roof—because our overhead is many times lower.

The Original Ferbend “B” Eliminator operates direct from your Electric Light Socket on 110-120 volt A. C. Lighting Circuit. Delivers up to 100 volts. Price \$12.50. The electrolytic method combined with full wave rectification gives results equal or superior to those obtained by any other method.

The New Ferbend High Voltage Model for extremely large sets and all sets using power tubes. Delivers up to 180 volts. One Control adjusts voltages on all taps. Price \$17.50.

Equal to Any—at a cost less than half! Sooner or later you will purchase a “B” Eliminator. Why pay more?

Money-Back Guarantee

See Your Dealer—or Send Direct

Shipment made direct on receipt of price, or C.O.D. if preferred. Use for 10 days to convince yourself—if unsatisfactory write us within that time and purchase price will be refunded. Send Coupon TODAY.

FERBEND ELECTRIC COMPANY

419 West Superior Street

Chicago, Illinois

FERBEND “B” ELIMINATOR

FERBEND ELECTRIC CO.
419 W. Superior St., Chicago, Ill.

- Send \$12.50 model.
- Send \$17.50 model.
- Send at once. Payment enclosed.
- Send C. O. D. Send Literature.

Makers of the original and genuine



Name

Address

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

Approved and passed by the rigid Laboratory Tests of the two foremost Radio Laboratories in America—Radio News and Popular Radio.

Lowest Wholesale Prices!

UNIVALVE KITS NOW READY FOR DELIVERY

Before purchasing parts for this new wonder circuit get our proposition.

Kits in Stock

R. B. "Lab," Cockaday LC-27, Hammarlund-Robert, Alden Truphonic, AmerTran Power Pack, LR-4, Infradyne, Benjamin Controlladyne, Ultimax, Ultradyne, Harkness, Bremer-Tully.

Jobbers—Dealers Professional Set Builders

Before buying, get our quotations on our *Guaranteed Kits*. 3-Hour Shipping Service.

1927 Buying Guide

A few copies left for Dealers and Professional Set Builders. Send for yours today. It's free!

Address Dept. P. R.

We are the exclusive direct representatives of the Committee of 21 Manufacturers.

Allen-Rogers
Incorporated
Kit Headquarters
118 East 28th St., New York, N.Y.

The POPULAR RADIO Atlas and Log

will give you a list of all the NEW Broadcasting Stations with wavelengths and other necessary information

A Complete Atlas and Station Log

The "POPULAR RADIO International Radio Atlas and Log" will supply you with full information regarding broadcasting stations of the United States and Canada.

This most useful and practical Atlas consists of 16 pages, size 12" x 16", printed on good paper, from clear type in two colors and contains a complete series of double page maps, including—The World—The United States—Canada—North and South America, showing location of principal broadcasting, leading commercial and governmental radio stations.

SPECIAL FREE OFFER

You may have a copy of the "POPULAR RADIO International Radio Atlas and Log" free, with POPULAR RADIO for 8 months.

For Only \$2.00

Put \$2.00 in bills to the coupon below. If you are a subscriber to POPULAR RADIO your subscription will be extended eight months.

POPULAR RADIO, Dept. 32A Date _____
627 West 43rd St., New York City.

Enclosed is my remittance of \$2.00 for which you are to enter my subscription (extend my subscription) for (8) eight months for POPULAR RADIO and send FREE a copy of the "POPULAR RADIO International Radio Atlas and Log."

Name _____
Address _____
City _____ State _____



BROADCASTS

CONDUCTED BY CHARLES L. REESE, JR.

The First Opera Premiere by Radio

FOR what is believed to be the first time, an opera premiere was performed exclusively for the benefit of the radio audience when "Hassan der Chwaerner" a new work by Wilhelm Kienzl was broadcast from a Vienna station. Rather than delay the production for the tremendously expensive stage premiere, Kienzl allowed the opera to be broadcast, thus subjecting it to the severest test a new opera can meet, for the music must stand entirely on its own merits without the aid of scenery or costume.

* *

A Church Protests Church Propaganda

WHAT is believed to be the first definite action taken by a religious body against the mass of propaganda of a religious nature that now fills the air is the circular that has recently been sent out to all members of the Christian Science Church, formally disapproving the anti-Catholic and anti-Jewish talks that they say are being broadcast from a New York station, WHAP, by a group of persons using the term "Christian Science" without authority from the governing board of the Church.

* *

A Laughing Contest that Was a WOW

NEARLY a solid hour of laughs offered by more than 100 persons were broadcast recently in the first radio laughing contest, from station WOW at Omaha, Nebraska. Each contestant was allowed 30 seconds to charm the radio audience; the judges picked the "champion laugher" from the receivers in their own homes.

* *

Will the Courts Clear the Air?

A NEW way out of the present chaos in radio broadcasting and one that jeopardizes the existence of hundreds of new stations hangs on the latest decision in the WGN-WGES case in Chicago. In that decision Judge Wilson decided that

under common law, WGN, having broadcast first on its wavelength, has the right to a free and unobstructed ether channel. Already WHN, a New York station has moved for an injunction to prevent WRNY from interfering with its broadcasts by transmitting on a channel too near its own. Although the offending station in the first case was only ordered not to interfere, this order would have the effect of forcing most new stations entirely off the air. With approximately 700 stations operating on the wavelength channels available, which number under 100, a great many broadcasters must necessarily find it impossible to operate on a wavelength to which no other station has a prior right, and on which they will cause no interference. If other courts affirm Judge Wilson's decision, the congestion on the air may soon be cleared up without Congressional action.

* *

New York City's "Radio University"

THAT New York's free public lectures, often called the "university of the people," are to be put on the air, was recently announced by William O'Shea, City Superintendent of Schools. This change, it is believed, will bring the lectures to more people than ever before, while at the same time making it possible to use fewer speakers and lecture centers. The lectures will be broadcast through station WNYC on Monday evenings.

* *

Short-Wave Trans-Atlantic Telephones

FOLLOWING fast on the opening of the new trans-Atlantic telephone service comes an announcement from England that secret tests with a short-wave beam system, promise a trans-oceanic telephone service that will be cheaper, more reliable and more private than the one now in use. The tests, which are being conducted by Marconi engineers, have been made between London and Montreal on 30 to 60 meter beams; much less power is necessary than with the 5000-meter wavelength now in use.

"Radio Weather" Forecasts

MR. R. G. LYNCH of the *Milwaukee Journal* forecasts each day the "radio weather" for the evening, and indicates from what points the fans may expect good reception. Although he has so far been able to make general forecasts with some degree of success, his task is complicated by the fact that no one knows for certain all of the factors that govern radio reception as well as by the rapidity with which pressure areas (which are believed to affect reception) move.

A Hospital Where Patients Pick Their Programs

PROBABLY the best radio-equipped hospital in the world, is the new Allison Hospital at Miami Beach, Florida, where each patient has a complete radio set to himself, with a separate antenna, so that he may tune any station or program he desires. As only single-control receivers are used each patient has no trouble in tuning in. Ordinarily, in hospital installations, a master set is used and the patient has no choice of programs.

Amateurs Hold an 8,000-Mile Daylight Conversation

WHAT is said to be a record for daylight amateur communication on short waves was established recently when Lyndon Farwell (U-6ZAT) of Los Gatos, California talked for half an hour with M. Samuel (G-5HS) of London, England. Both transmitters were home-made and operated with a 200-watt input on a wavelength of 20 meters.

Canada Bans Direct Radio Advertising

DIRECT radio advertising, generally and wisely shunned by American broadcasters, was given a death blow in Canada recently when it was prohibited by law, except, in the special cases of charitable announcements. This ban does not affect the broadcasting of programs paid for or furnished by commercial firms, but it does aim to prevent the misuse of radio by the broadcasting of straight advertising talks which listeners believe is out of place on the air.

Socialists Plan a Station as a Memorial

A POWERFUL broadcasting station in one of the largest cities of the country is the unique monument that the Socialist Party hopes to erect in honor of its dead leader, Eugene V. Debs. With the idea that such a station will be "in keeping with Debs's record as a fearless defender of free speech" the party hopes to raise \$200,000 by public subscription to build or buy the memorial station and to put on the air the doctrines that made Debs famous.

SM

Look - You'll Find Them



Possessing a 3:1 turn ratio, the 220 audio transformer has the highest primary impedance of any known transformer. The impedance values—the criterion of uniform amplification—are 19,000 ohms at 30 cycles and 626,000 ohms at 1000 cycles, approximately.

THAT'S the S-M sales story—just that S-M parts must be right, or you wouldn't find them in over half of the important circuits. Turn where you will, the proof of good engineering judgment lies at hand in the selection by authorities of S-M parts for the circuits you'll build.

Do you realize that in the new field of A.C. operated receivers that over half of all designs ever offered use S-M power units as a basis—that they have led all others by a wide margin?

Do you know that S-M Audio Transformers are found in more of this season's receiver designs than any others—that independent testing laboratories everywhere prove them to be superior—that less than one in every four thousand of these transformers comes back to the factory for refund? Yet each is guaranteed to give more satisfying qualities than any other amplifying devices that the market offers!

There can only be one answer—that S-M products are right. Prominent engineers say so and have backed their opinion by using them—every important magazine authority says so. And sales talk—just ask any live dealer what his fastest selling parts are, and he'll answer "S-M."

That's only half the story—the list below is why you, too, will eventually use S-M parts.

S-M audio transformers, output transformers, coils or power units have been selected for the following circuits—and in many form the basis of design. In this list are included the most popular recent designs.

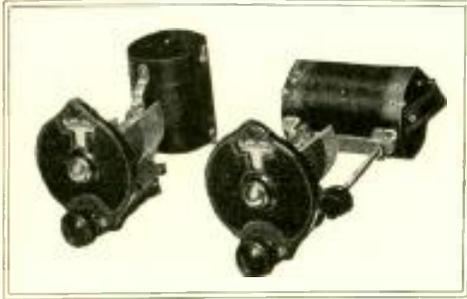
*Infradyne
Shielded Six
Silver-Cochaday
Best's A.C. Browning Drake
Best's A.C. Diamond of the Air
Radio News Batteryless Receiver
Radio Broadcast Super
Radio Age Super
Radio Broadcast Local
LC-27 Junior Power Pack
Citizens Call Book Monolune Receiver
Call Book Power Pack
Callies Super
Radio Mechanics "A," "B" and "C"
Eliminator
Radio Engineering "A," "B" and "C"
Eliminator
Radio Mechanics Man-o-War Super
Lincoln Super*

*Best's Short Wave Set
Hush-Hush II Short Wave Set
Popular Mechanics Super
Christian Science Monitor 6 tube Brown-
ing-Drake
Radio Engineering Short Wave Set
New York Sun "B" and "C" Eliminator
for Resistance Amplifier
Chicago American Short Wave Set
Chicago Post Power Amplifier
Best's new Super
Radio News Power Amplifier
Loftin-White
Popular Radio Town and Country
Radio News Super
Nakken's Ultra-Fine
Taylor's Pre-Selector
Chicago News Short Wave Adopter*

Silver-Marshall, Inc.

844 W. Jackson Blvd. Chicago, U.S.A.

BROWNING-DRAKE RADIO



BUILD the NEW Browning-Drake OFFICIAL KIT SET

Designed by

Glenn H. Browning

BROWNING-DRAKE Radio is known to almost every radio fan. Countless radio designs have come and gone since 1923 but Browning-Drake continues to grow in popularity and evokes the same genuine enthusiasm that it did over three years ago. Any development based on such sound scientific research as the Browning-Drake work at Harvard University, was bound to endure.

For the fan who desires to build his own, Browning-Drake is now offered in a new OFFICIAL design APPROVED by Glenn H. Browning and Dr. Frederick H. Drake. The constructing is made easy by instructions contained essentially in every kit, or sent in booklet form upon receipt of twenty-five cents.

If your dealer cannot supply you with the Browning-Drake Corporation Kit, send us his name and address and we will take care of your requirements immediately.

DEALERS: The new Browning-Drake kit, designed complete in conjunction with several well-known manufacturers, is now available from your distributor. If you are unable to secure kits and specified parts from distributors in your territory, we will see that your order is filled.

BROWNING-DRAKE CORP.
BRIGHTON MASS.

Radio Gives War Tanks a Voice and An Ear

THE crew of a tank, up till now nearly as isolated as the occupants of a penitentiary cell, will now be able to keep in communication with other tanks or with their base, up to fifty miles distance by means of a new wireless apparatus that has just been invented by an English officer. When this apparatus is used it is possible to transmit and receive clear speech even when the tank is bumping its way along over broken ground and fallen trees.

* *

Bored Radio Fan Stops Legislature's Speech

ONE of the dangers of broadcasting the discussions of legislative bodies were illustrated to legislators recently in Finland, when a listener in 100 miles away, bored by a long discourse on ham and bacon, broadcast from the Finnish Diet, telephoned in to tell the long-winded orator that he would certainly be defeated in the next elections if he did not stop at once. The speaker took the hint.

* *

A Curfew Hour Set for Radio

MIDNIGHT was recently judged to be a reasonable hour for a curfew on noisy radio reception by Magistrate Brodsky of a New York City Court. Complaints had been made that an ardent radio fan kept his neighbors awake until all hours of the night by his apparently successful attempts at loudspeaker DX reception. The magistrate decided that people are entitled to their rest after midnight and the ardent fan promised to shut off his set by that time or use earphones for the rest of the evening.

* *

Europe Plans Utopian Broadcasts

EUROPEAN listeners in may soon be presented with the finest broadcast programs that have ever been put on the air if present plans for an international exchange of programs are carried out. A new society (the *Commission de Rapprochement Intellectuel Artistique et Social*) has been formed at Geneva, Switzerland to promote an exchange of programs between the European nations; the project includes a proposal to set aside a certain evening for each nation to broadcast a program that shall contain the best from both a literary and musical standpoint that the nation itself has been able to produce.

* *

The photograph of the North Pole taken by American airmen discloses only a hole in the ice. It is presumed that some unscrupulous Eskimo stole the thing for his antenna.

—LONDON OPINION

FREE PARTS for the "LC-27 Broadcast Receiver"

If you want to build your own set, here is your opportunity to secure FREE all the parts you need for the LC-27 Broadcast Receiver. Call on all your radio friends, and on anyone who has a set and tell them of the many special features of POPULAR RADIO.

These liberal offers will make it possible for you to secure an order from every one you call upon. For each subscription with remittance you send us you will receive credits as per the following scale:

POPULAR RADIO

4 Months for	\$1.00 counts	16 credits
6	1.50	25
8	2.00	33
12	3.00	50
24	5.00	75

Send us the full amount collected with names and addresses of subscribers and tell us the parts your credits entitle you to and we will send them to you. If the subscriptions you secure do not give you enough credits for the parts you want, we will allow you to purchase credits at the rate of 3 cents each. Example: With (7) seven 1-year subscriptions (350 credits) and \$1.50 additional in cash you may have an Amertran De Luxe first-stage radio-frequency transformer, for which you need 400 credits.

If the parts you want are not listed in the advertisement, we are prepared to supply them. Let us know what you want and we will tell you how many credits you will need.

On page 313 are described POPULAR RADIO'S Simplified Blueprints. You can have any set of prints you want for only 40 credits. You may also secure a copy of "How to Build Your Radio Receiver" described on page 310 for 60 credits.

CREDITS Needed for Parts Re- quired for the LC-27 BROADCAST RECEIVER

(Described and illustrated in the October 1926 Issue of POPULAR RADIO.)

Quantity	Item	Credits
1	Hammalund mid-line dual condenser, .00275 mfd	300
1	Hammalund mid-line single condenser, .00075 mfd	186
1	Precision Duo-Coil form coil set, one antenna coupler and two interstage couplers	420
1	Amertran De Luxe first-stage transformer	400
1	Amertran De Luxe second-stage transformer	400
1	Amerchoke No. 854	240
1	Dubilier No. 902 filter condenser, .4 mfd	20
1	Dubilier No. 907 Filter Condenser, .4 mfd	24
1	Mar-Co illuminated control, scale 0 to 100	140
2	Mar-Co small controls for LC-27	60
1	Carter battery switch	26
1	Samson radio-frequency choke coil No. 85	60
3	Avervex mica fixed condensers, .00025 mfd	42
1	Durham resistor, 4 megohms	20
1	Lynch grid leak mounting	14
1	Carter Gem Jack	10
1	Carter resistance, 0-10,000 ohms	80
10	Eby binding posts	60
5	Benjamin UX sockets	150
1	Amperte	44
	Mechanical Kit consisting of aluminum shields, binding post strip, decorated panel and Talt brackets	500
	Total	3408

Write for List of Free Parts for
Other Popular Radio
Receivers

POPULAR RADIO

Department 31A

627 West 43d St., New York City

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

During the month of January, 1927 the following changes were reported in the list of broadcasting stations:

STATIONS ADDED

KGDW	Humboldt, Nebraska	241.8
KGEF	Los Angeles, California	516.9
KGEH	Eugene, Oregon	238.1
KGEK	Yuma, Colorado	252.0
KGEL	Jamestown, North Dakota	225.0
KGEN	El Centro, California	281.0
KGEQ	Minneapolis, Minnesota	330.0
KGER	Long Beach, California	325.9
KGES	Central City, Nebraska	205.4
KGEU	Lower Lake, California	222.0
KGEW	Fort Morgan, Colorado	256.0
KGEY	Denver, Colorado	204.0
KGRC	San Antonio, Texas	315.0
KKPK	Seattle, Washington	260.0
KMED	Medford, Oregon	250.0
KMIC	Inglewood, California	387.0
KOMO	Seattle, Washington	305.9
KPCB	Seattle, Washington	521.0
KROW	Portland, Oregon	231.0
WABQ	Philadelphia, Pennsylvania	280.7
WAOK	Ozone Park, New York	247.8
WBMH	Detroit, Michigan	352.7
WCOT	Olneyville, Rhode Island	265.3
WGL	New York, New York	442.4
WJAW	Cleveland, Ohio	435.7
WJPW	Ashtabula, Ohio	239.9
WLBT	Crown Point, Indiana	230.0
WLBV	Canaanota, New York	220.0
WLBW	Mansfield, Ohio	230.6
WLBX	Oil City, Pennsylvania	321.0
WLBZ	Long Island City, New York	230.6
WLBV	Iron Mountain, Michigan	248.9
WLBZ	Dover-Foxcroft, Maine	299.0
WMBA	Newport, Rhode Island	248.9
WMBD	Peoria Heights, Illinois	279.0
WMBE	St. Paul, Minnesota	220.0
WMBG	Richmond, Virginia	220.0
WMBH	Chicago, Illinois	280.0
WMBJ	Monessen, Pennsylvania	277.6
WMBK	Hamilton, Ohio	380.0
WMBL	Lakeland, Florida	410.0
WSEA	Virginia Beach, Virginia	516.9
WSIX	Springfield, Tennessee	250.0

STATIONS DELETED

KFGQ	Boone, Iowa
KFRW	Olympia, Washington
WKBR	Auburn, New York
WTAB	Fall River, Massachusetts

CHANGES IN CALL LETTERS

WAHG	Richmond Hill, N. Y.	change to	WABC
KGEA	Seattle, Washington	change to	KUJ
WJBV	Woodhaven, N. Y.	change to	WSOM

CHANGES IN WAVELENGTHS

WEHS	Evanston, Ill., 202.6	change to	241.8
WCBS	Providence, R. I., 242	change to	242.
KFKB	Milford, Kan., 431.4	change to	434.5
WKBO	Jersey City, N. J., 303.9	change to	220.4
WAFD	Detroit, Mich., 275.1	change to	312.3
KRLD	Dallas, Tex., 353	change to	357.1
WSBT	South Bend, Ind., 315	change to	315.6
KUJ	Seattle, Wash., 345	change to	352.5
KVI	Tacoma, Wash., 242.5	change to	312.5
KJBS	San Francisco, Cal., 234.2	change to	220.4
WBRL	Tilton, N. H., 365	change to	420.0
WWAE	Chicago, Ill., 384.4	change to	241.8
KLZ	Denver, Col., 265.3	change to	284.4
WSOM	Woodhaven, N. Y., 469.9	change to	288.3

CHANGES IN LOCATIONS

WEHS	Chicago, Ill., change to	Evanston, Ill.
WAFD	Port Huron, Mich., change to	Detroit, Mich.
WBMS	North Bergen, N. J., change to	Union City, N. J.
WWAE	Plainfield, Ill., change to	Chicago, Ill.
KFEQ	Oak, Neb., change to	St. Joseph, Mo.
WREC	Coldwater, Miss., change to	Whitehaven, Tenn.

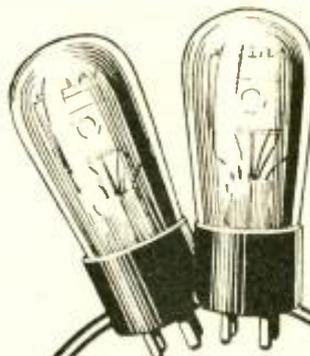
Trans-Oceanic Calls Heard

THE following stations were received and logged at the amateur station of Louis Groizelier (F-SJC) at 12, Route d'Etain, Verdun-S-Meuse, France on a regenerative detector and one stage of audio.

U-1AVL—Dec. 12, 1926; signal strength R8; 50-cycle AC note on 39 meters; noticeable interference and atmospheric.

U-5JF—Dec. 10, 1926; signal strength R6; 50-cycle AC note; bad fading and atmospheric.

U-2AKJ—Dec. 12, 1926; signal strength R8; 50-cycle AC note on 39 meters; noticeable interference and atmospheric.



Apparently Alike-

Tubes of the same make and type. Both "light". Both "work". Yet one is very sensitive. The other is not why?

Tubes 'run down,' too

Easy-Takes only 10 minutes for all tubes



BECAUSE your tubes work is no sign that they do your set justice. Tubes quickly lose sensitivity. The set loses power and volume, requires more current. You are puzzled—

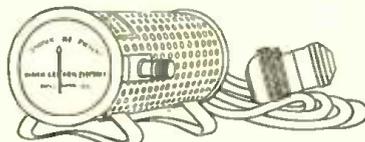
A well-posted dealer will advise you to buy a Jefferson Tube Charger. Once a month, connect it for ten minutes to the "A" terminals of your set. Thereafter with tubes always like new, enjoy top-notch reception every night. Longer life of tubes and batteries more than repays you. Patented, guaranteed and made only by Jefferson. \$5. Get one this week!

JEFFERSON ELECTRIC MFG. CO.
Largest manufacturers of small transformers
508 So. Green Street, Chicago
(PATENTED)

Jefferson

No. 275 Tube Charger

Vitrohm Trickle Charger

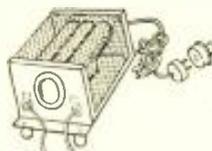


For use on all 110-volt direct current lines. Used as a continuous duty A-battery charger. Charging rate is 0.3 amperes.

Charges storage B-batteries in units up to 90 volts.

Vitrohm Trickle Charger is equipped with separable plug, 6 foot extension cord and polarity indicator.

Vitrohm Standard Charger



For use on all 110-volt direct current lines. Used as a standard A-battery charger. Charging rate is approximately 3 amperes.

Compact, unlimited life, and easily installed. Vitrohm Battery Charger is equipped with separable plug and 6 foot extension cord.

A polarity indicating Ammeter shows charging rate.

Bulletin 507 lists all Vitrohm Resistors for radio. It will be sent free upon request.

Ward Leonard Electric Company
Mount Vernon New York

A Novel and Efficient Detector Receiver for Home . . Office . . Hotel

THE TALKING BOOK

Brings a new story every night



Complete Radio Receiver

Pair of standard Ear Phones, Aerial and Ground Leads, Indoor Antenna, Self-contained in attractive book.

Connected in a second. It runs for a lifetime. No trouble—No overhead.

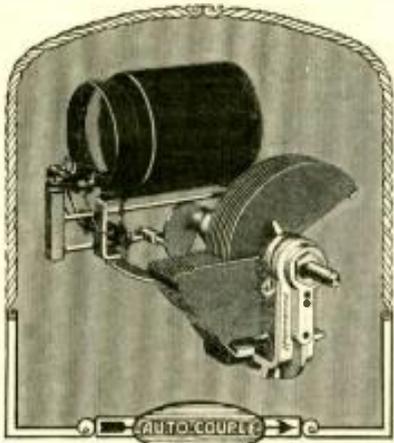
Equipped with New CELERUNDUM RECTIFIER
No battery required
Tone Quality unequalled

Price \$3.50
With Ear Phones \$6.00

Live Distributors Wanted
Manufactured & Guaranteed by

THE LISTEN-IN CO.
115 Federal St. Boston, Mass.

Messrs. Haynes and Cockaday Score Another Success



And Two Hammarlund Auto-Couple Units Share the Applause

THE "Uni-Valve" Circuit designed by A. J. Haynes and Laurence Cockaday makes one tube do the work of three. That's a big job for the designers—but a bigger one for the tube. It needs all the help it can get.

The two Hammarlund Auto-Couple Units used in the "Uni-Valve" Receiver, deliver maximum input signal strength at each condenser setting and aid materially in gaining selectivity and control over undesirable oscillations.

Primary coil couplings are automatically varied by cams attached to the full-floating rotor shafts of the "Midline" Condensers.

"Auto-Couple" units can be used with equal efficiency in any other circuit, where variable primary coupling is desired. The "Midline" condenser has a removable rotor shaft, making it adaptable to any scheme of single-control, multiple condenser operation.

You can gamble on success with Hammarlund Precision Products because all of the gamble has been taken out of them. Twenty-eight leading designers have officially specified them for use in their latest receivers.

Write for Folders

HAMMARLUND MFG. CO.
424-438 W. 33rd Street, New York City

For Better Radio
Hammarlund
PRECISION
PRODUCTS

FREE SIMPLIFIED BLUE PRINTS

You know how helpful, interesting and practical POPULAR RADIO is. You fully appreciate that at \$3.00 a year it is a real bargain. Consequently you should find it easy to convince one, two or more of your friends, who are not now subscribers, of the unusual value when any one of these sets of Simplified Blueprints (described on Page 313) is offered free with their twelve months' subscription for POPULAR RADIO at the regular price of \$3.00. In addition to the Blueprints given to your friends we will allow you one set free for each new subscription you send us with a \$3.00 remittance. Five new subscriptions and remittance of \$15.00 would entitle you to five sets free.

Only one set of Blueprints free with a renewal subscription whether your own or a friend's.

POPULAR RADIO, INC., Dept. 33
627 West 43d Street, New York City

Enclosed is my remittance of \$..... covering annual subscriptions for POPULAR RADIO (names on sheet attached). Send me set(s) checked below.

- | | |
|-------------------------------------|-------------------------------------|
| <input type="checkbox"/> Set No. 18 | <input type="checkbox"/> Set No. 24 |
| <input type="checkbox"/> Set No. 19 | <input type="checkbox"/> Set No. 25 |
| <input type="checkbox"/> Set No. 21 | <input type="checkbox"/> Set No. 26 |
| <input type="checkbox"/> Set No. 22 | <input type="checkbox"/> Set No. 27 |
| <input type="checkbox"/> Set No. 23 | <input type="checkbox"/> Set No. 28 |

(See page 313 for description of Sets)

Name.....

Address.....

Foreign postage 50c extra No extra for Canada.

Build Your Improved Browning-Drake Popular Radio SIMPLIFIED Blue Prints

Easy, Quick and Accurate

The Improved Browning-Drake Broadcast Receiver, designed by Arthur H. Lynch, former Editor of Radio Broadcast and built and approved in the POPULAR RADIO LABORATORY.

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

High efficiency that emphasizes fine tone quality is the outstanding characteristic of this new model.

By using POPULAR RADIO Blue Prints in building your Improved Browning-Drake Broadcast Receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model (see page 313).

If your local dealer cannot supply you with Blue Prints of the Improved Browning-Drake, they will be sent postpaid upon receipt of \$1.00 per set.

A full description of this set, with detailed directions for building, was published in the August, 1926, issue of POPULAR RADIO. Send 35c for copy.

POPULAR RADIO
Service Bureau 34-C
627 W. 43rd St., New York City

Outstanding Program Features of the Month

FEBRUARY 20th TO MARCH 15th

DURING the coming month, February 20th to March 15th, the following regular and special program features are scheduled. This list, which will be augmented monthly as advance information is received, will be published in each issue of the magazine; all broadcast stations are invited to report coming program features of outstanding interest of importance. Reports should reach the Editor of POPULAR RADIO on or before the 23rd of the month preceding.

FEBRUARY

(Eastern Standard Time)

- 20th; *Capitol Theatre Grand Orchestra*, WEAJ, 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WSAI, WCAE and WTAG). *Atwater Kent Hour*, WEAJ, 9:15 P.M. (Also broadcast from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD). *Godfrey Ludlow*, WJZ, 9:30 P.M. (Also from WGY). *Maxwell House Coffee Hour*, WJZ, 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).
- 21st; *Willys-Overland Hour*, WJZ, 8:30 P.M. *A & P Gypsies*, WEAJ, 9:00 P.M. (Also from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ). *Fire-side Boys*, WJZ, 9:15 P.M. *B. A. Rolfe's Palais D'Or Orchestra*, WEAJ, 11:00 P.M.
- 22nd; *Classical music*, WRNY, 8:00 P.M. *Vikings*, WEAJ, 8:00 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC). *Jolly Buckeye Bakers*, WEAJ, 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB). *Eveready Hour*, WEAJ, 9:00 P.M. (Also from WEEI, WFI, WCAE, WCCO, WTAM, WGN, WSAI and WTAG). *Champion Spark Pluggers*, WJZ, 8:00 P.M. (Also broadcast from WGY and WRC). *Keystoners*, WJZ, 9:00 P.M. (Also from WRC and WGY). *Auction Bridge Instructions*, WEAJ, 10:00 P.M. (Also from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD). *Amazo Hour*, WJZ, 10:00 P.M. (Also from KDKA and KYW). *George Olsen's Orchestra*, WJZ, 10:45 P.M.
- 23rd; *Eastman Theatre Orchestra*, WJZ, 6:30 P.M. (Also from WHAM). *Davis Saxophone Octette*, WEAJ, 8:30 P.M. (Also from WEEI, WJAR, WLIT, WRC, WTAG and WCAE). *Ident Half Hour*, WJZ, 8:30 P.M. (Also from WBZ, KDKA and KYW). *Sixty White Minutes*, WJZ, 9:00 P.M. (Also from WBZ, KDKA and KYW). *Ipana Troubadours*, WEAJ, 9:00 P.M. (Also from WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO). *Smith Brothers*, WEAJ, 10:00 P.M. (Also from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF). *Armchair Hour*, WJZ, 10:00 P.M.
- 24th; *Clicquot Club Eskimos*, WEAJ, 9:00 P.M. (Also from WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ). *Goodrich Zippers*, WEAJ, 10:00 P.M. (Also from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC). *RCA Radiators*, WJZ, 9:00 P.M. (Also from WBZ, KDKA and KYW).
- 25th; *Happiness Boys*, WEAJ, 8:00 P.M. *Royal Typewriter Orchestra*, WJZ, 9:00 P.M. (Also from WRC, WBZ and WJZ). *Breyer Hour*, WJZ and WRC, 9:00 P.M. *LaFrance Orchestra*, WEAJ, 9:00 P.M. (Also from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
- 26th; *New York Symphony Orchestra with Walter Damrosch*, WEAJ, 9:15 P.M. (Also from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).
- 27th; *Capitol Theatre Grand Orchestra*, WEAJ, 7:20 P.M. (Also from KSD, WRC, WWJ, WSAI, WCAE and WTAG). *Atwater Kent Hour*, WEAJ, 9:15 P.M. (Also from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD). *Godfrey Ludlow*, WJZ, 9:30 P.M. (Also from WGY). *Maxwell House Coffee Hour*, WJZ, 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).
- 28th; *Willys-Overland Hour*, WJZ, 8:30 P.M. *A & P Gypsies*, WEAJ, 9:00 P.M. (Also from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ). *Fire-side Boys*, WJZ, 9:15 P.M. *B. A. Rolfe's Palais D'Or Orchestra*, WEAJ, 11:00 P.M.

MARCH

- 1st; *Classical music*, WRNY, 8:00 P.M. *Vikings*, WEAJ, 8:00 P.M. (Also from WEEI, WJAR, WTAG, WGR, WFI

- WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
Jolly Buckeye Bakers, WEAf, 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG, WLIB).
Eveready Hour, WEAf, 9:00 P.M. (Also from WEEL, WFI, WCAE, WCCO, WTAM, WGN, WSAI and WTAG).
Champion Spark Pluggers, WJZ, 8:00 P.M. (Also broadcast from WGY, WRC).
Keystoners, WJZ, 9:00 P.M. (Also from WRC and WGY).
Auction Bridge Instructions, WEAf, 10:00 P.M. (Also from WEEL, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
Amazo Hour, WJZ, 10:00 P.M. (Also from KDKA and KYW).
George Olsen's Orchestra, WJZ, 10:45 P.M.
Eastman Theatre Orchestra, WJZ, 6:30 P.M. (Also from WHAM).
Davis Saxophone Octette, WEAf, 8:30 P.M. (Also from WEEL, WJAR, WLIT, WRC, WTAG and WCAE).
Ident Half Hour, WJZ, 8:30 P.M. (Also from WBZ, KDKA and KYW).
Sixty White Minutes, WJZ, 9:00 P.M. (Also from WBZ, KDKA and KYW).
Ipana Troubadours, WEAf, 9:00 P.M. (Also from WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
Smith Brothers, WEAf, 10:00 P.M. (Also from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
Armchair Hour, WJZ, 10:00 P.M.
Cliequot Club Eskimos, WEAf, 9:00 P.M. (Also from WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
Goodrich Zippers, WEAf, 10:00 P.M. (Also from WEEL, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSAI, WWJ, WSI and WADC).
RCA Radiotrons, WJZ, 9:00 P.M. (Also from WBZ, KDKA and KYW).
Happiness Boys, WEAf, 8:00 P.M.
Royal Typewriter Orchestra, WGY, 9:00 P.M. (Also from WRC, WBZ and WJZ).
Breyer Hour, WJZ and WRC, 9:00 P.M.
La France Orchestra, WEAf, 9:00 P.M. (Also from WEEL, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
New York Symphony Orchestra with Walter Damrosch, WEAf, 9:15 P.M. (Also from WEEL, WGR, WFI, WCAE, WWJ, WTAM, WGN, KSD, WCCO and WDAF).
Capitol Theatre Grand Orchestra, WEAf, 7:20 P.M. (Also from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
Atwater Kent Hour, WEAf, 9:15 P.M. (Also from WSAI, WEEL, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD).
Godfrey Ludlow, WJZ, 9:30 P.M. (Also from WGY).
Maxwell House Coffee Hour, WJZ, 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).
Willis-Oerland Hour, WJZ, 8:30 P.M.
A & P Gypsies, WEAf, 9:00 P.M. (Also from WEEL, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
Fireside Boys, WJZ, 9:50 P.M.
B. A. Rolfe's Palais D'Or Orchestra, WEAf, 11:00 P.M.
Classical music, WRNY, 8:00 P.M.
Vikings, WEAf, 8:00 P.M. (Also from WEEL, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
Jolly Buckeye Bakers, WEAf, 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
Eveready Hour, WEAf, 9:00 P.M. (Also from WEEL, WFI, WCAE, WCCO, WTAM, WGN, WSAI and WTAG).
Champion Spark Pluggers, WJZ, 8:00 P.M. (Also from WGY and WRC).
Keystoners, WJZ, 9:00 P.M. (Also from WRC and WGY).
Auction Bridge Instructions, WEAf, 10:00 P.M. (Also from WEEL, WCSH, WTAH, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
Amazo Hour, WJZ, 10:45 P.M.
Eastman Theatre Orchestra, WJZ, 6:30 P.M. (Also from WHAM).
Davis Saxophone Octette, WEAf, 8:30 P.M. (Also from WEEL, WJAR, WLIT, WRC, WTAG and WCAE).
Ident Half Hour, WJZ, 8:30 P.M. (Also from WBZ, KDKA and KYW).
Sixty White Minutes, WJZ, 9:00 P.M. (Also from WBZ, KDKA and KYW).
Ipana Troubadours, WEAf, 9:00 P.M. (Also from WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
Smith Brothers, WEAf, 10:00 P.M. (Also from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
Armchair Hour, WJZ, 10:00 P.M.
Cliequot Club Eskimos, WEAf, 9:00 P.M. (Also from WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
Goodrich Zippers, WEAf, 10:00 P.M. (Also from WEEL, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSAI, WWJ, WSI and WADC).
RCA Radiotrons, WJZ, 9:00 P.M. (Also from WBZ, KDKA and KYW).

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1 Amertran De Luxe first stage transformer.	10.00	1 Lynch Grid Leak Mounting35
1 Amertran De Luxe second-stage transformer.	10.00	1 Carter Gem Jack25
1 Amerchoko # 854	6.00	1 Carter variable resistance, 0-10,000 ohms.	2.00
1 Dubilier or Tobe 4 mfd. Filter condenser	5.50	12 Eby binding posts	1.80
1 Dubilier filter condenser, 1 mfd.60	5 Benjamin UX Sockets	3.75
1 Mar-Co illuminated control, scale 0 to 100 50 to 0	1.50	1 Amperite No. 1	1.10
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- 11th; *Happiness Boys*, WEAf; 8:00 P.M.
Royal Typewriter Orchestra, WGY; 9:00 P.M. (Also from WRC, WBZ and WJZ).
- 11th; *Bryer Hour*, WJZ and WRC; 9:00 P.M.
La France Orchestra, WEAf; 9:00 P.M. (Also from WEEL, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
- 12th; *New York Symphony Orchestra with Walter Damrosch*, WEAf; 9:15 P.M. (Also WEEL, WGR, WFI, WCAE, WWJ, WTAM, WGN, KSD, WCCO and WDAF).
- 13th; *Capitol Theatre Grand Orchestra*, WEAf; 7:20 P.M. (Also from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
Atwater Kent Hour, WEAf; 9:15 P.M. (Also from WSAI, WEEL, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD).
Godfrey Ludlow, WJZ; 9:30 P.M. (Also from WGY).
- Maxwell House Coffee Hour*, WJZ; 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).
- 14th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
A & P Gypsies, WEAf; 9:00 P.M. (Also from WEEL, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
Fireside Boys, WJZ; 9:50 P.M.
B. A. Rolfe's Palais D'Or Orchestra, WEAf; 11:00 P.M.
- 15th; *Classical music*, WRNY; 8:00 P.M.
Vikings, WEAf; 8:00 P.M. (Also from WEEL, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
Jolly Buckeye Bakers, WEAf; 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
Eveready Hour, WEAf; 9:00 P.M. (Also from WEEL, WCAE, WCCO, WTAM, WGN, WSAI and WTAG).
Champion Spark Pluggers, WJZ; 8:00 P.M. (Also from WGY and WRC).
Keystoners, WJZ; 9:00 P.M. (Also from WRC and WGY).
Auction Bridge Instructions, WEAf; 10:00 P.M. (Also from WEEL, WCSH, WTAH, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
- Amazo Hour*, WJZ; 10:45 P.M.
- 16th; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
Davis Saxophone Octette, WEAf; 8:30 P.M. (Also from WEEL, WJAR, WLIT, WRC, WTAG and WCAE).
Idont Half Hour, WJZ; 8:30 P.M. (Also from WBZ, KDKA and KYW).
Sixty White Minutes, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).
Ipana Troubadours, WEAf; 9:00 P.M. (Also from WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
Smith Brothers, WEAf; 10:00 P.M. (Also from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
Armchair Hour, WJZ; 10:00 P.M.

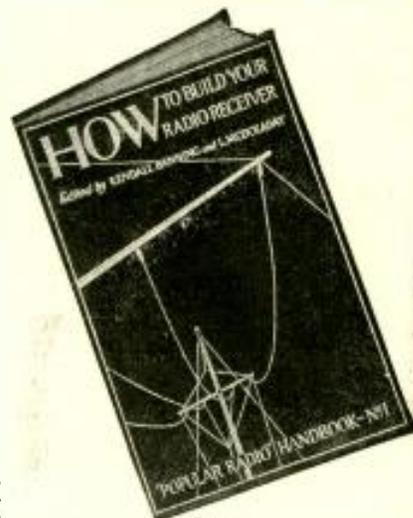
The First Grand Opera Broadcast

RADIO history was made on Friday, January twenty-first, when the greatest audience that ever heard a performance of grand opera listened in to the second act of "Faust" broadcast direct from the stage of the Auditorium Theatre in Chicago by the Chicago Civic Opera Company—the first time that such a program has ever been presented to American listeners in. Fifteen microphones picked up the sound; then land wires carried the impulses to broadcasting stations from San Francisco to New York that relayed on to listeners in all over America, opera presented by what is considered to be one of the two finest opera companies in the world.

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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.

CONTENTS

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- A 5-TUBE TUNED RADIO-FREQUENCY RECEIVER
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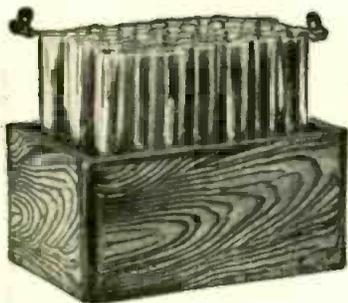
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Extreme sensitivity (2 precision stages of R. F.); low interference (complete shielding); cuts thru locals clean and clear; smooth tuning on all waves; wonderfully pure tone due to its Truphonic Audio. . . these qualities make the Elkay Senior a satisfaction any month of the year. Price, \$125.

OUT NOW—the new \$80 Junior “Six.” Embodies highest grade of material. Designed after the most approved engineering practice—Elkay quality thruout. Dealers, Jobbers. Write for terms.

The Langbein-Kaufman Radio Co.
Dept. P.
62 Franklin Street New Haven, Conn.

What Radio is Doing for Aspiring Musicians

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

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

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

“Then,” as they say at WCCO, “one day last winter he burst in on us.” That very evening Melaney was singing before the microphone. During the next week hundreds of applause letters swept into the office with requests for “more from Melaney.”

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

—RAYMOND HENDERSON

Double Impedance Amplifier



True tone amplification without overloading.

Write to us for instruction book covering all types of circuits.

Price \$7.00

PARAGON
Anti-Flutter

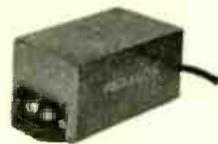
Prevents
“Motor-boating”



Price \$2.00
including
three extra
resistors.

PARAGON

PARAGON
Output Filter
Placed between output of set and loudspeaker improves tone quality and protects speaker.



Price \$5.00



Paragon Electric Corp.

Original licensees under basic Patent No. 2619592

Upper Montclair, N. J., U.S.A.

Handy Tools for Radio Fans: No. 11

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Free 1927 Radio Guide

The big 164-page Barawik Guide book is used by hundreds of thousands of radio enthusiasts. It's the handiest and most reliable radio reference guide, and a big money-saver. Keep up to date by utilizing Barawik service.

164 Pages of Bargains

It gives 164 pages replete with reliable information about the newest and most advanced ideas in radio development, describes and illustrates the latest improvements. It will keep you posted on what's up to date. It will help you to build a better set, improve your old one and make it up to date or buy a complete new modern one. Every radio set owner, amateur, beginner and fan, should have a copy.

Lowest Prices on Parts

It will pay you to get our prices for complete parts for the popular circuits featured in POPULAR RADIO and other magazines. Whenever a new circuit appears for which you want complete parts, write or wire us and they'll be on their way to you quickly. We know what parts to send you. Simply give name of circuit and we'll take care of the rest. We guarantee you a big saving on every order.

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Get our new radio catalog today before you spend another cent on radio. Just mail the coupon and free copy will be sent you. Also please include name of a friend interested in radio.



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Mail This Coupon Now! For Free Copy

Name.....
Address.....
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THE UNIVALVE RECEIVER

The new single tube set giving loud speaker volume! Design incorporates one stage high-frequency amplification, a detector and two stages of low frequency amplification. Easy to build; economical; inexpensive to buy.

COMPLETE LIST OF PARTS

2—Hammarlund Autocouplers.....	\$7.00
2—Cardwell Taper Plate Variable Condensers, type 169-E, .00035 mfd. equipped with 2 Cornell Etched Vernier Dials.....	9.50
1—Karas Harmonik Low-Frequency Transformer.....	3.00
1—Thordarson Low-Frequency Transformer, 2-1 Ratio.....	7.00
1—Carter Battery Switch.....	5.00
1—Ampert's Automatic Filament Control, .25 amp.....	.65
1—Aerovox Mica Fixed Condenser with Grid-Leak Clips, .00025 mfd.....	1.10
1—Aerovox Mica Fixed Condenser, .0001 mfd.....	.40
1—Aerovox Mica Fixed Condenser, .0005 mfd.....	.30
1—Bradley Grid-Leak, 4 megohms.....	.30
1—Carter Small Single-Circuit Jack.....	.25
1—Bakelite Front Panel, 7 by 15 by 3/16 inches.....	2.50
1—Hardwood Sub-base, 7 by 14 by 1/2 inch.....	.50
1—Bakelite Binding-Post Strip, 1 by 9 by 3/16 in.....	.30
7—Eby Binding Pots.....	1.05
2—Small Brass Brackets.....	.10
1—Benjamin Vibrationless Socket.....	.75
1—Emerson Multivalve.....	\$39.95
Complete with tube and POPULAR RADIO Blueprints.....	6.50
	\$47.45

Orders filled within 24 hours. Morison guarantees every part. All charges prepaid on retail mail orders.

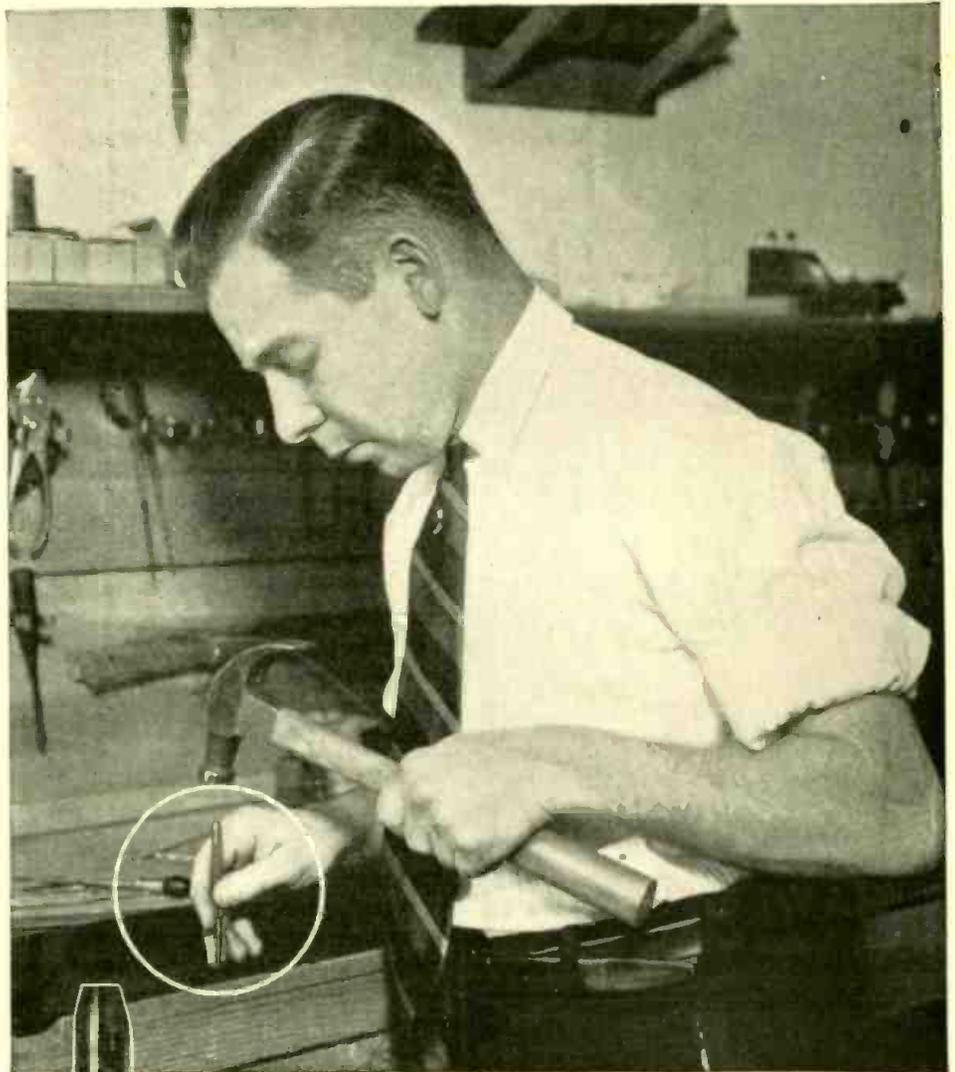
WHOLESALE RETAIL

MORISON

Electrical Supply Co. Inc.

15 EAST 40TH STREET.

NEW YORK CITY



From a photograph made for POPULAR RADIO

THE CENTER PUNCH

A tool for punching "starting" holes for drilling panels

THIS instrument is made somewhat on the general style of the scriber. It is, however, made of heavier stock than the scriber and instead of hand pressure being used to make a mark, it may be struck a sharp blow with a hammer to make a larger dent in the material being marked. After the positions for the holes have been pin-pricked with the scriber, the center punch is used to deepen them so that the point of the drill will fit and a true start will be made in drilling. This handy tool is usually fashioned as shown in the photograph, with a knurled surface running down to a rugged point at one end, and with the other end finished off flat and hardened so that it will withstand the blows from the hammer.

The preceding suggestions in this series were SIDE-CUTTING PLIERS, SCREW-DRIVERS, THE HYDROMETER, THE BATTERY-TESTING VOLTMETER, THE FILE, THE JACK KNIFE, THE ELECTRIC SOLDERING IRON, THE SOCKET WRENCH, THE HAND DRILL and THE SCRIBER.

SIMPLIFIED BLUEPRINTS

MAKE IT EASY FOR ANYBODY TO BUILD A SET



AURENCE M. COCKADAY has personally supervised the preparation of *Simplified Blueprints* of nine of POPULAR RADIO's most popular circuits. Each set consists of three separate *Actual Size* Blueprints; first a Panel Pattern; second, an Instrument Layout; and third, a Picture Wiring Diagram all simplified in the fullest sense of the

word because

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.

Priced at \$1.00 per Set

Set No. 18—"The Improved Raytheon Power-Pack" (as described in the May, 1926, issue of POPULAR RADIO).

Set No. 19—"The New Home Receiver" (three tubes, two stages of radio-frequency-amplification with crystal detector, as described in June, 1926 issue of POPULAR RADIO.)

Set No. 21—"The Improved Browning-Drake Receiver" (as described in the August, 1926, issue of POPULAR RADIO).

Set No. 22—"The LC-27 Broadcast Receiver" (as described in the October, 1926, issue of POPULAR RADIO.)

Set No. 23—"The LC-Senior Power-Pack" (as described in the November, 1926, issue of POPULAR RADIO.)

Set No. 24—"The LC-Intermediate Power-Pack" (as described in the December, 1926 issue of POPULAR RADIO.)

Set No. 25.—"The LC-Junior Power Pack" (as described in the January, 1927 issue of POPULAR RADIO.)

Set No. 26.—"The KH-27 Receiver" (an entirely new type of audio-frequency amplification, as described in the January, 1927 issue of POPULAR RADIO.)

Set No. 27.—"The Univalve Receiver" (a circuit which was developed to utilize the new multi-valve as described in the March, 1927 issue of POPULAR RADIO.)

Full constructional and parts details for these Receiving Sets will be found in the issue of POPULAR RADIO indicated. Back issues of POPULAR RADIO will be furnished at the rate of 35c a copy

Popular Radio

627 West 43d Street

Dept. 34

New York City

POPULAR RADIO, Inc., Dept. 34
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:

- | | | |
|--|--|--|
| <input type="checkbox"/> Set Number 18 | <input type="checkbox"/> Set Number 22 | <input type="checkbox"/> Set Number 25 |
| <input type="checkbox"/> Set Number 19 | <input type="checkbox"/> Set Number 23 | <input type="checkbox"/> Set Number 26 |
| <input type="checkbox"/> Set Number 21 | <input type="checkbox"/> Set Number 24 | <input type="checkbox"/> Set Number 27 |

Name.....

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fast selling
Blueprints.

THE NEW ROLA CONE

is a Speaker worthy of your Set

THE new Rola Cone Speaker with its marvelous laminated-armature driving unit (an exclusive, patented feature) brings to modern radio reception a quality of reproduction vastly superior to all previous achievements.

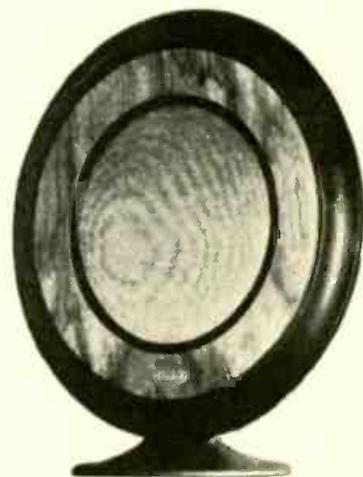
Rola engineering now gives Radio an enormous audio reproducing range, laboratory tests showing effective response to frequencies from 70 to over 16,000 per second.

This complete range, free from objection-

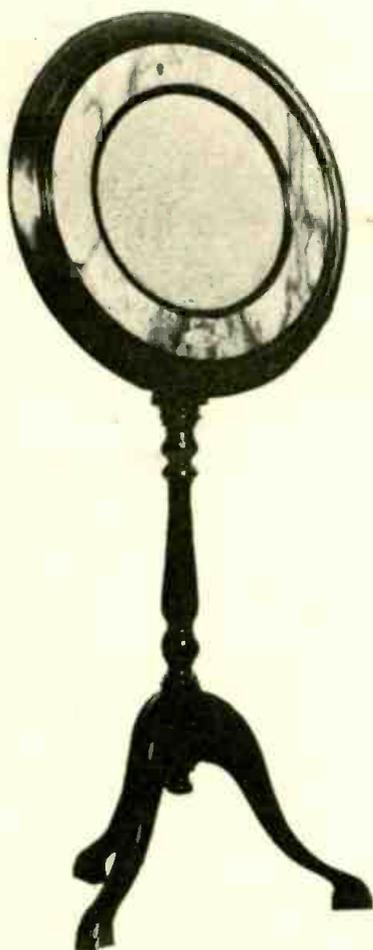
able harmonics and resonances, gives rich and full-toned reproduction at all volumes, with perfect preservation of those delicate tone-colorings that are so essential to fullest musical enjoyment.

You can only appreciate the possibilities your set possesses when you use a Rola Cone Speaker.

Ask your dealer for a demonstration in your home.



Rola Cone Speaker
(Table Type) . . \$28.50



Rola Cone Speaker
(Pedestal Type) \$32.50

Rola

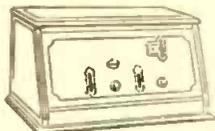
CONE SPEAKERS

Manufactured by

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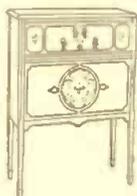
CROSLLEY 1927 RADIOS

Each set giving the utmost in radio enjoyment at its price. All prices slightly higher West of the Rocky Mountains. All prices are without accessories.



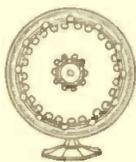
The 5-50—\$50

Enthusiastic owners report amazing performance—a drum delivering stations loud, clear and sharp—each an almost imperceptible turn of the drum apart. Write station letters on drum, return to them at will. Single drum Station selector. Acuminators, power tube adaptability and all metal chassis that shields the units from each other. Beautifully finished—Mahogany cabinet with rose gold trimmings. Also made with 6 tubes—6-60—\$60.



"6 Tube RFL-90"
Console, \$98

Introducing the double drum station selector! Crosley's winning non-oscillating perfectly balanced tuned radio set. Includes Musicone skillfully built into exquisite console mahogany cabinet of two-tone finish to match finest surroundings. Room for batteries and all accessories; 40 inches high; 30 1/2 inches wide.



THE CROSLLEY
MUSICONE

The secret of the popularity of this biggest selling loud speaker on the market lies in its actuating unit. This and NOT the cone shape is the reason for its perfect reproduction of all audible sound. BEWARE of imitations. There is only one genuine Musicone. It is built solely by Crosley under mass production methods which makes its unmatched value possible.

Ultra Musicone, \$9.75
Super Musicone, 14.75
Musicone, 32.00 (pictured below).

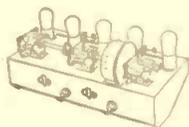


Crosley sets are licensed under Armstrong U. S. Patent No. 1,113,149, or under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.



CROSLLEY 1927 FEATURES

Many exclusive — others found only in highest priced radios. THE "CRESCENDON" When, on ordinary radios, ears must strain to catch a station miles away, a turn of the Crescendon on Crosley radios instantly swells reception to room filling volume. An exclusive Crosley feature.



ALL-METAL SHIELDED CHASSIS

This truly great radio achievement, found in several Crosley sets, furnishes a substantial frame for mounting elements, produces excellent alignment of condensers, shields the units from each other, prevents interstage, improves the stability of the circuit, increases selectivity and saves costs by standardizing

this phase of manufacture. THE SINGLE DRUM STATION SELECTOR Nothing in radio equals the joy or the convenience of single drum control. Crosley single drum control enables you to find the stations sought without log book or "tuning." "THE ACUMINATORS" Crosley Acuminators permit tuning in—loud and clear—weak stations passed over

and entirely missed by ordinary single dial radios. In tuning high powered and local stations they are not used. They are an exclusive Crosley feature.

POWER TUBES Power tube adaptability marks the Crosley "5-50," "5-75" and "RFL" sets. This feature typifies Crosley provision for best radio reception at moderate cost.

Single Drum Control

5-75 CONSOLE

\$75.

Marvelous exclusive Crosley "Crescendon" and "Acuminators" increase volume on distant stations and bring in programs entirely missed and passed by on ordinary one-dial control radios.

In this 5-75 Console, Crosley again brings to the radio public all the advanced ideas in radio at a price within the reach of all. Console model stands 40 inches high. The Crosley Musicone is skillfully built into the cabinet. Ample space for batteries and all accessories. A mahogany cabinet with rose gold trimmings makes it possible to match the surroundings in any home.

6 Tube Model—The 6-85—\$85

Write Dept. 16



THE CROSLLEY RADIO CORPORATION

HOWEL CROSLLEY, JR., President

Cincinnati, Ohio

Prices slightly higher West of the Rocky Mountains.

DISTANCE



from the *Clear Glass** Tube

THE patented clear glass Zetka Process increases amplification—thereby giving more volume. It gives a lower output impedance—thereby bringing out the lower notes. It progressively eliminates gases thereby increasing tube life.

With ZETKA Tubes that elusive DX station can now be logged. . . . enjoyed with "local" volume and smoothness. . . . and be always at your command.

This patented clear glass process—total elimination of "silvering"—has remedied a multitude of radio ills. Put a set of Zetka tubes in your receiver, and instantly—a marked improvement in its performance. Tone is glorified to its perfect naturalization. . . . clear, mellow, non-metallic. A plate voltage range of from 22½ to 250 volts (impossible, for sustained performance, with any other 201 A type tube) gives considerably greater power. The desired volume for every radio occasion.

And to these unparalleled features are added—extra tube life, hours longer of service with an actual increase in efficiency.

You can prove the superiority of these tubes at the Zetka dealer in your city. Ask him to give them the Zetka-Weston meter test. Compare them with any other tube in this "show-down" test, and you'll insist on nothing but Zetka.

YOUR SET DESERVES THIS FINER EQUIPMENT. . . . PRICES NO HIGHER.

ZETKA

The Clear Glass Tube

*The revolutionary, new, clear glass Zetka Process has been adapted to a complete line of Power Tubes. Ask for the CLEAR GLASS tube in the BLUE and ORANGE box.



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73 WINTHROP STREET, NEWARK, N. J.