

Popular Radio

Edited by **KENDALL BANNING**

25¢

*** JUNE • 1925**



In this Issue—

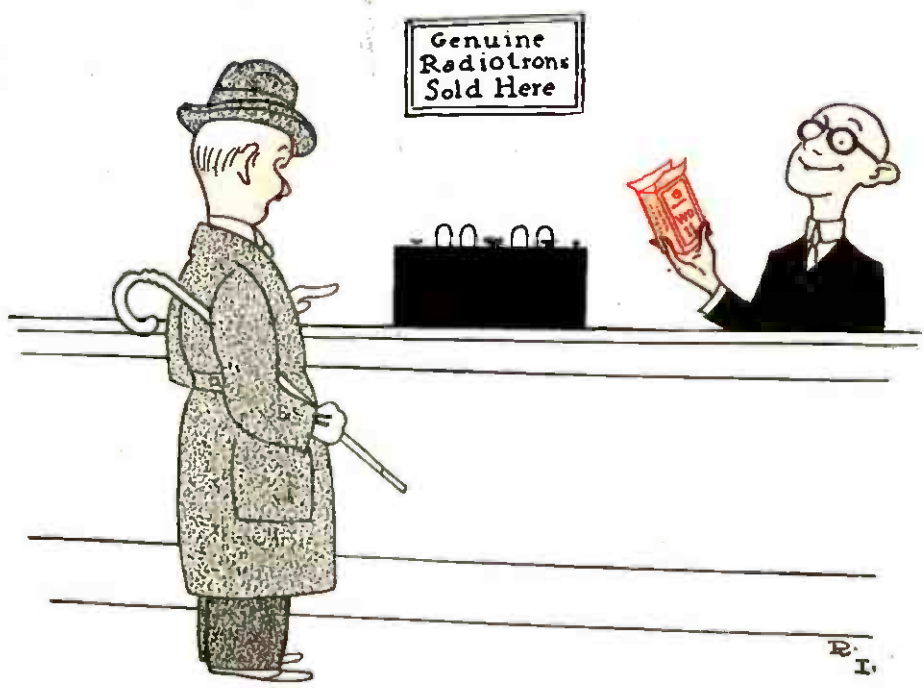
**New Developments in
VACUUM TUBES**

**—and What They Mean
to Radio Reception**



WD-11
 WD-12
 UV-199
 UV-200
 UV-201-a

Radiotrons with these model numbers are only genuine when they bear the name Radiotron and the RCA mark.



Do you believe in Names?

Do you buy things by name because the name tells the quality? Do you ask for a RADIOTRON, instead of just a "vacuum tube"—demand the standard by the name that marks it as genuine?

The most important part of a radio set is the tube, and you can't get the best out of any set without putting the best tubes into it. There's a Radiotron for every use, in every kind of set. Look for the name—and the RCA mark—and be sure it is *genuine*.

Radio Corporation of America
Sales Offices: Suite No. 46
 233 Broadway, New York 10 So. La Salle St., Chicago, Ill.
 28 Geary Street, San Francisco, Cal.

Radiotron

REG. U.S. PAT. OFF.

PRODUCED ONLY BY RCA



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tubes
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Bradleystat
PERFECT FILAMENT CONTROL

Two columns of graphite discs provide stepless, noiseless control.

Range of control is from 1/4 to 100 ohms, sufficient for all tubes without change of connections.

One-hole mounting for panels. Table mounting for baseboards.

Extremely compact. Easily substituted for wire rheostats.

\$1.85

In Canada, \$2.50

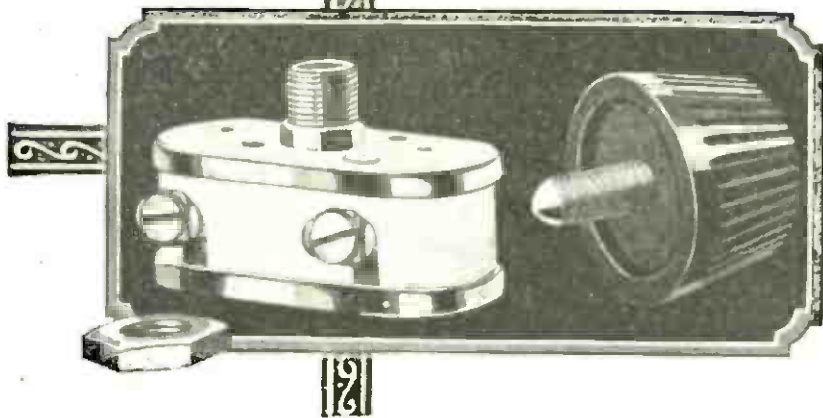
**There are many rheostats
—but only one Bradleystat**

The smooth, noiseless, stepless control of the Bradleystat is the outstanding characteristic that places this remarkable filament rheostat in the front rank of perfect radio devices. Many attempts have been made to duplicate Bradleystat performance by using substitutes for the scientifically-treated graphite discs, but without success.

It is not strange that the Bradleystat maintains its supremacy among radio rheostats! It was developed by engineers who have designed graphite disc rheostats for over twenty years. Have you improved your set with Bradleystats? Try one, tonight.

Allen-Bradley Co.

Electric Controlling Apparatus
276 Greenfield Avenue
MILWAUKEE, WISCONSIN



MAIL THIS COUPON

Please send me descriptive literature on the Bradleystat and other Allen-Bradley radio devices.

Name.....

Address.....



RESULTS!

What the Penetrola has done

THE following is an excerpt from a series of laboratory tests made in Chicago with the Penetrola on April 30, 1925. Tests were made for volume and selectivity and measured with a General Radio Co. type 164 Audiability Meter, a precision instrument giving actual values of signal intensity (the effect on the human ear is less than the actual differences recorded on the Audiability Meter) Standard regenerative, tuned R. F., neutrodyne, superheterodyne, reflex and other sets were tested.

SELECTIVITY TESTS

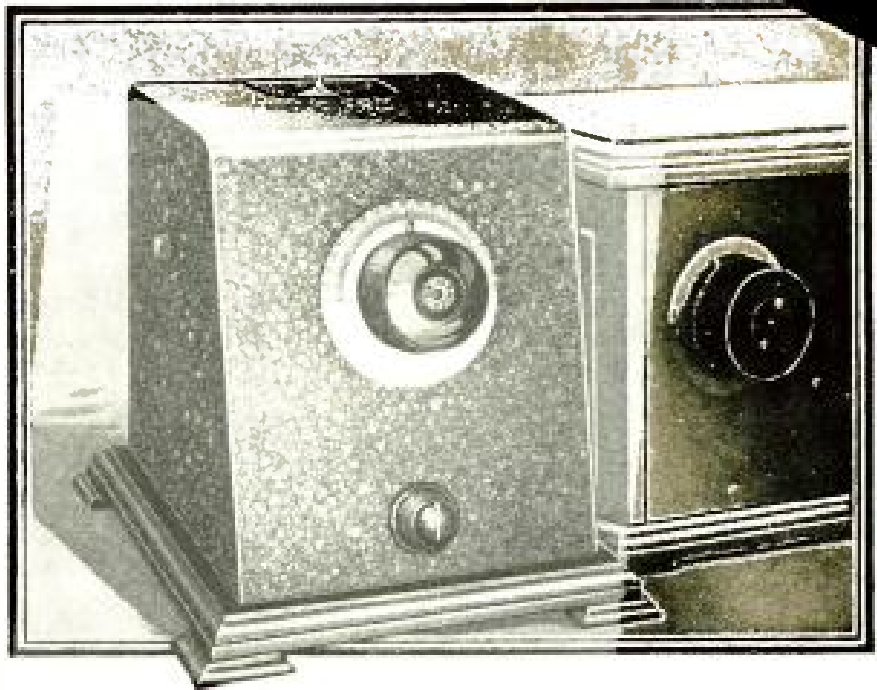
Receiver	Desired Station	Interfering Station
Tuned R.F. Receiver 5 tube	WCAL Northfield, Minn.	WCBD Zion
Without Penetrola	35	20
With Penetrola	2,000 +	0
2 tube Regenerative Set	WOC Davenport	WMAQ, WEBH, KVW, Chicago
Without Penetrola	0	2,000+
With Penetrola	300	0
5 tube Tuned R. F. Receiver	CNRW Winnipeg	WGN Chicago
Without Penetrola	0	150
With Penetrola	1,300	0

Without the Penetrola Unit, CNRW, for example, could not be heard, while WGN had a signal intensity of 150. With the Penetrola CNRW could be heard with a signal intensity of 1,300 while WGN was inaudible. Interference entirely eliminated.

VOLUME TEST

Receiver	Desired Station	Interfering Station
5 tube Tuned R. F. Receiver	WOAI San Antonio	None
Without Penetrola	11	—
With Penetrola	2,000 +	—

These figures show an actual increase of energy in the phone circuit of 188 times.



PENETROLA WINS!

MESSRS. M. B. Sleeper, L. M. Cockaday and J. Calcaterra, judges for the Walbert "\$1,000 for a Name" contest have selected "Penetrola" as the name best describing the new Walbert Auxiliary Unit. The winner is Mr. W. N. Johnson, Jr., of Marked Tree, Ark. The 25 other winners will be individually notified by letter.

What Will the Penetrola Unit Do?

PENETROLA was selected as the name best describing the qualities of the new Walbert Auxiliary Unit—a Unit which when hooked-up with any standard receiving set will:

1. Greatly increase selectivity, range and volume. (Actual figures of performance as determined by laboratory tests are given in the column to the left.)
2. Positively stop your set from radiating.
3. Reduce static by permitting use of shorter aerial while actually increasing signal intensity.
4. Tends to stabilize circuits primarily unstable—makes it unnecessary for you to operate your set close to the oscillating point.
5. Will not appreciably alter dial readings. (One dial reading only may be disturbed $\frac{1}{2}$ to $2\frac{1}{2}$ degrees.)

The Penetrola Unit is the outcome of two years laboratory experimenting and testing. For further details of principle employed see article by B. B. Minnium, Chief Engineer, Walbert Mfg. Co., entitled "The Isofarad Receiver," May 1925 issue of Q.S.T.

The Penetrola is made in three types for use with (a) outdoor antenna sets (b) loop sets (c) with sets where it is desired to replace outdoor antenna with loop. Equipped with all standard Walbert parts including Univernier, Socket, Isodon, colored cords for quick installation, etc. All coils, condensers, etc., are magnetically and electrostatically shielded. Finished in black, crystalline enamel, harmonious with any style of radio cabinet. Price \$35.00.

At your dealer or sent postpaid on receipt of purchase price. Please state type desired. Further details, including reprint of above mentioned article will be furnished if desired. Jobbers and dealers write for discounts.

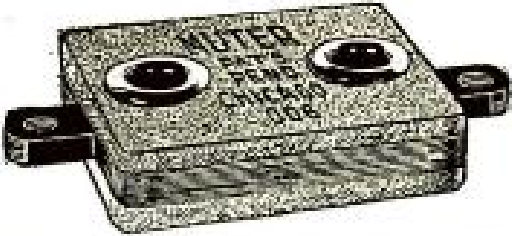
WALBERT

MANUFACTURING COMPANY

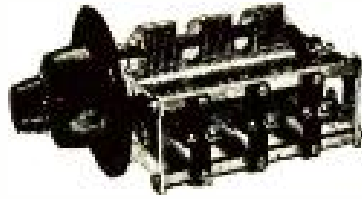
933 Wrightwood Avenue

Chicago, U. S. A.

19
RECOMMEND
MUTER
DEPENDABLE
FIXED
CONDENSERS
 MICA INSULATION
 BRASS ELECTRODES
 ACCURATE CAPACITIES



Used by Leading Set Builders
FOR BETTER RESULTS
Sold by Dealers Everywhere



MULTI UNIT
CONDENSER
 —AND A
SINGLE DIAL CONTROL
 FOR ANY CIRCUIT OF
 ONE STAGE OR MORE

Patented Shafts, Pig-tail Connections and Geared Verniers insure Rigidity, Low Loss, and Sharp Tuning.

Double and Triple Units
in All Capacities

"A three unit condenser tested within one half of one per cent in capacity."
 —SLOANE LABORATORY.

WE also carry a complete line of straight-line wave-length and straight-line frequency single type condensers designed and built with the same scrupulous attention to detail which guarantees uniformity of quality.

Literature Sent on Request

Lombardi Radio Mfg. Co.
 67-71 Minerva Street Derby, Conn.
(Interesting Trade Proposition)

THE POPULAR RADIO ATLAS AND LOG

CONTAINS

- An Alphabetical List of All Broadcasting Stations of the United States and Canada
- The Wave Lengths of all the Principal Stations
- Maps Showing Where They are Located
- Maps Giving Time Zones
- Maps of the World
- Space for Logging Three Dial Readings
- Radio Districts and Headquarters

TO receive the full benefit of your set you should have a complete log of the principal broadcasting stations and a convenient place to note your dial readings when you "pick-up" any of them.

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 15" 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. In addition these maps show time zones and Radio Districts with Headquarters and also the district zoning of the American Radio Relay League.

There is also included in this Atlas a list of all United States and Canadian stations, alphabetically arranged, giving signals, wave lengths, kilocycles, ownership and other important data, with space for logging three dial readings.

The Leading Radio Monthly

In POPULAR RADIO each month you will find the very latest news of the radio field with many entertaining, interesting and instructive articles of interest to Radio Fans.

POPULAR RADIO
 627 West 43d Street New York City

With POPULAR RADIO and the "POPULAR RADIO International Radio Atlas and Log" you will have available the two most useful adjuncts to full enjoyment of your radio receiver.

SPECIAL FREE OFFER

You may have a copy of the "POPULAR RADIO International Radio Atlas and Log" free, with POPULAR RADIO for (8) eight months

For Only \$2.00

Pin \$2.00 in bills to the coupon below.

If you are a subscriber, your subscription will be extended eight months.

Date.....

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 627 West 43d 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."

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Address.....

City..... State.....

First in the Field
Specializing in
Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan
50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished.
These Kits are sent to you completely mounted and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved; in a solid Mahogany Cabinet. Genuine parts used as listed below; exactly as specified by Mr. L. M. Cockaday. COMPARE OUR OFFER!

5 TUBE NEW A C RECEIVER KIT

- 1 General Radio Variometer, No. 269
- 2 "Precision" R. F. Coupling Units
- 2 Hammarlund condensers, .0005 mfd.
- 3 Kurz-Kasch 4 inch dials
- 5 Federal Sockets, No. 16
- 1 General Radio A. F. Transformer, No. 285
- 1 Dongan Special Step-Down Transformer, Type B
- 1 Daven Resisto-Coupler mountings
- 2 Dubilier Mica, fixed condenser, .006 mfd.
- 1 ea. Daven resistor, 1/4 megohm, 1/2 megohm
- 1 Daven grid leak, 4 megohms
- 1 Dubilier fixed condenser, .00025 mfd.—clips
- 1 Dubilier Mica fixed condenser, .00015 mfd.
- 1 Dubilier Mica fixed condenser, .0001 mfd.
- 1 Pacent single circuit jack
- 1 Genuine Bakelite Panel Drilled and Engraved 7 x 24"
- 1 Veneered Baseboard
- 1 Antenna Binding Post Strip
- 1 Battery Binding Post Strip, small brass brackets, A C Leads, Binding Posts, etc.

READY-TO-WIRE KIT PRICE, \$52.50
UNASSEMBLED KIT PRICE, 45.00

For Price of this set completely wired in Genuine Mahogany Cabinet, write us.

McCullough A.C. Radio Tubes in Stock

8 TUBE NEW COCKADAY SUPERHETERODYNE REFLEX RECEIVER KIT

- 1 General Instrument .0005 Condenser (Isolantite Insulation)..... \$5.50
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- 1 Haynes Griffin input transformer (new type)..... 5.00
- 3 Haynes Griffin intermediate transformers (new type)..... 15.00
- 1 Precision Autodyne Coupler..... 3.50
- 1 Karas Harmonik Audio Frequency Transformer..... 7.00
- 1 Amplex Grid-Denser .0005..... 1.25
- 1 Benjamin Clea-tone Socket..... 1.00
- 7 Federal Sockets No. 16..... 8.40
- 1 Pacent Double Jack..... 60
- 1 Pacent Single Jack..... 50
- 2 Na-Aid 4 inch Dials..... 1.50
- 1 Amisco Rheostat 2 Ohms..... 1.35
- 1 Amisco Potentiometer 400 Ohms..... 1.50
- 1 Daven Grid Leak Mounting..... 35
- 2 Daven Resisto-Coupler Mountings..... \$2.50
- 2 Daven Resistors .5 Megohms..... 1.00
- 1 Daven Resistor 5 Megohms..... .50
- 1 Daven Resistor .005 Megohms..... 1.00
- 2 Daven Resistors .25 Megohms..... 1.00
- 2 New York Mica Condensers .0001 Mfd..... .70
- 4 New York Mica Condensers .006 Mfd..... 3.00
- 1 New York Mica Condenser .00025 with clips..... .45
- 1 Duratran Radio Frequency Transformer..... 4.00
- 1 Walbert "A" Battery Switch..... .50
- 7 Eby Binding Posts..... 1.40
- 1 Sub-Panel 1 x 9 Genuine Bakelite..... .15
- 1 Baseboard (Hardwood)..... .35
- Genuine Bakelite Panel, Drilled and Engraved..... 3.00

KIT PRICE... \$78.00

WIRED COMPLETE IN GENUINE MAHOGANY CABINET \$110.00
INCLUDING KORACH LOOP

COCKADAY'S Authorized ANTENNA COUPLER for \$2.00 the 8 Tube Super-Het for use with outdoor aerial

Write for Circular about these Parts and Kits.
Also for our Radio Catalog.

Transportation Prepaid. One-third must accompany all C. O. D. orders. Not insured unless insurance charges included

\$2.00
ALL
TYPES

A GUARANTEED! Guarantee!

Identified by a serial number on each SUPERTRON tube

A GUARANTEE WITHOUT MEANS OF IDENTIFICATION MEANS UNASSURED SATISFACTION—IT MEANS NOTHING MORE OR LESS THAN "MAY-BE"—THINK IT OVER

BUY SUPERTRONS WITH ABSOLUTE ASSURANCE

A Guarantee Certificate bearing a Serial Number accompanies each SUPERTRON tube which has a number that corresponds with the Guarantee Certificate

SUPERTRON is all a tube can possibly be
At the Public Demand Price \$2.00

SUPERTRON MFG. CO., INC.
32 Union Square New York
EXPORT DIVISION
The N. Simons & Son Co., 220 B'way, N. Y.

REG. U.S. PAT. OFF.
SUPERTRON
A GOOD TUBE

59

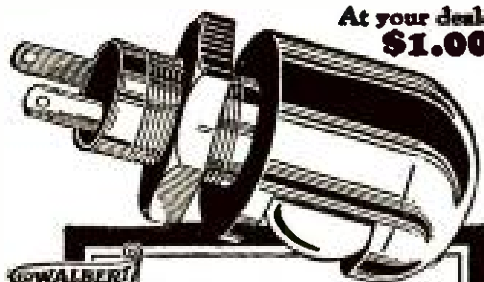


At your dealer
\$1.25

TUNES-IN
Hard-to-get-stations
THOSE elusive distant stations so often missed when tuning with ordinary dials are quickly, easily and clearly tuned-in by means of the



WALBERT MFG. CO., CHICAGO



At your dealer
\$1.00

NOW

You can put your radio set in that convenient out-of-the-way corner without straining your eyes while tuning—

LIGHT UP
your panel with the



WALBERT MFG. CO., CHICAGO

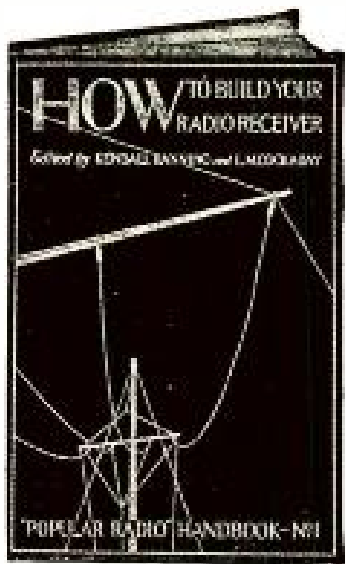
INSTRUCTION BOOK

and

RADIO MANUAL FREE

with

POPULAR RADIO



Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO, have compiled a book that will prove to any one that he can build a set which will give distance, selectivity and tone volume, and at the same time a very definite basic knowledge of radio.

BUILD YOUR OWN SET AND SAVE MONEY

In "How to Build Your Radio Receiver," you will find complete specifications, constructional diagrams, photographs and instructions for building all of the following sets:

- A \$5 Crystal Set
- The Haynes Single Tube Receiver
- A Two-Stage Audio-frequency Amplifier
- The Cockaday 4-Circuit Tuner
- A 5-Tube Tuned Radio-frequency Receiver
- The "Improved" Cockaday 4-Circuit Tuner
- The Regenerative Super-Heterodyne Receiver

ADVISORY SERVICE ALSO FREE

POPULAR RADIO maintains a big modern laboratory with a trained staff of investigators under the personal supervision of Mr. Cockaday. This Laboratory is always available through our Technical Service Bureau to answer, free of charge, by personal letter any problems you encounter which are not answered in either the "Handbook" or the magazine.

In POPULAR RADIO each month you will find the very latest news of the radio field as well as helpful suggestions and instructive and entertaining articles on radio and allied scientific phenomena.

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You can secure a copy of "How to Build Your Radio Receiver" FREE, and have all the privileges of the Technical Service Bureau without additional expense, if you will send a remittance of \$3.00 in full payment of 12 months' subscription for POPULAR RADIO. (Or as an alternative, you may have the book and privileges of the Technical Service Bureau with POPULAR RADIO for 7 months only—for \$2.00. A two dollar bill will do.)

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Enclosed remittance of \$3.00 is payment in full for a 12 months' subscription for POPULAR RADIO, with advisory service and copy of "How to Build Your Radio Receiver" FREE.

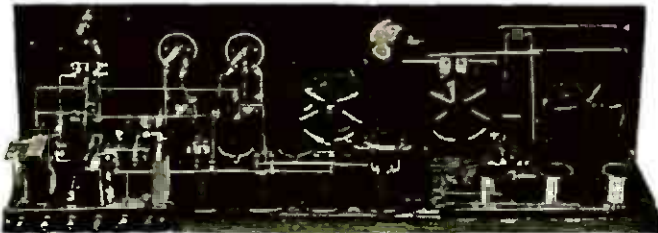
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Check here if you want the \$2.00 offer of POPULAR RADIO with "How to Build Your Radio Receiver" and Technical Service Bureau privileges for 7 months only.

NEW MODEL A—Haynes De Luxe Super-Heterodyne



BLUEPRINTS OF THE NEW HAYNES SUPER-HETERODYNE

Actual size working prints showing panel and instrument layout, picture wiring diagram, schematic wiring diagram and battery connections.

Everything so plain and easy to understand that you can't go wrong.

Price, complete set **\$1.25**

Postage prepaid

Universally acknowledged as a distinct advance in super-heterodyne design.

The New Model A De Luxe Super-Heterodyne uses a special type of tuned radio frequency amplification ahead of the straight super-heterodyne and gives the highest practical degree of sensitivity and selectivity, with a marked increase in distance range.

Mr. Haynes' remarkable new set fully meets the requirements of thousands of radio builders who demand something even finer and more efficient than the super-heterodyne.

Send for complete information and prices. It will be sent at once without charge or obligation of any kind.

HAYNES-GRIFFIN RADIO SERVICE, Inc.

41 West 43rd Street, New York, N. Y.

111 S. Clark Street, Chicago, Ill.

HALE SECTIONAL RADIO CABINET

Inside Dimensions

Upper Section
32 $\frac{1}{8}$ " wide x 10 $\frac{1}{4}$ " deep
12 $\frac{1}{4}$ " high

Battery Section
32 $\frac{3}{8}$ " wide x 9 $\frac{1}{4}$ " deep
12 $\frac{1}{4}$ " high

Sections interchange with HALE bookcase sections.

Honestly constructed and backed by the absolute HALE guarantee.



Ready for immediate delivery in Quarter-sawed Oak \$32.00

Furnished in various finishes

Birch (mahogany finish) .. 32.00

Genuine mahogany 40.00

F. O. B. Herkimer, N. Y.

For further information write to F. E. HALE MFG. CO., Herkimer, N. Y.

Complete parts for the McCULLOUGH AC TUBE SET

The set that operates without a storage battery.

Write for free information and price list of all parts.

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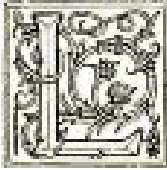
COCKADAY WILL HELP YOU BUILD

A

"PORTABLE TOWN AND COUNTRY RECEIVER"

WITH

SIMPLIFIED BLUEPRINTS



AURENCE M. COCKADAY has personally supervised the preparation of *Simplified Blueprints* of seven 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 \$1.10 per Set of Three Prints

Set No. 2—"Non-Regenerative Tuned Radio-Frequency Receiver" (Simplified Neutrodyne, four tubes, three dials, as described in the April 1924 issue of POPULAR RADIO).

Set No. 3—"Cockaday Distortionless Audio-Frequency Amplifier" (four tubes, combination of resistance-coupled and push-pull amplification, as described in the May 1924 issue of POPULAR RADIO).

Set No. 4—"Cockaday Four-Circuit Tuner with Resistance-Coupled Amplifier" (five tubes, distortionless, two dials, automatic vacuum tube control, as described in the October 1924 issue of POPULAR RADIO).

Set No. 6—"The Cockaday 8-tube Super-heterodyne Reflex Receiver" (eight tubes, two tuning dials,

loop, non-radiating, distortionless, as described in January 1925 issue of POPULAR RADIO).

Set No. 7—"The Craig 4-Tube Reflex Receiver with the New Sodian Detector" (four tubes, two tuning dials, short antenna, non-radiating as described in February 1925 issue of POPULAR RADIO).

Set No. 8—"The Improved Cockaday DX Regenerative Receiver" (four tubes, one tuning dial, one regeneration dial, short or long indoor or outdoor antenna, resistance coupled amplification as described in March 1925 issue of POPULAR RADIO.)

Set No. 9—"Portable Town and Country Receiver" (six tubes, three stages of transformer, coupled, radio-frequency amplification, loop antenna, tuned by variable condenser as described in May 1925 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. 64

New York City

POPULAR RADIO, Inc., Dept. 64
627 West 43d St., New York City Date.....

Enclosed is my remittance of \$..... for which kindly send me Blueprint Set (s) consisting of Panel Pattern, Instrument Layout and Wiring Diagram as checked below:

Set Number 2 Set Number 6
 Set Number 3 Set Number 7
 Set Number 4 Set Number 8
 Set No. 9

Name

Address

City State.....

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Write for terms on these fast selling Blueprints. An attractive Display Chart free with orders.

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

ZENITH RADIO

Tunes straight through the locals, gets distance. Brings in more stations—clearly and with volume—in a given length of time than any other set. Direct comparisons invited. Zenith receiving sets *cost* more, but they *do* more. —The exclusive choice of MacMillan for his North Polar Expedition.

Seven Models—\$100 to \$475

Models 4R and 3R licensed under Armstrong U. S. Patent No. 1,113,149. They are NON-RADIATING.

Zenith 4R - - \$100
Zenith 3R - - \$175

Super-Zenith VII - - \$240
Super-Zenith VIII - - \$260
Super-Zenith IX - - \$355
Super-Zenith X - - \$475

Only dealers who are equipped to give service handle Zenith. Ask your nearest Zenith dealer for a demonstration.

Zenith Radio Corporation
332 S. Michigan Avenue, Chicago

The Five Tube
Set which
startled/
the World!

**FRESHMAN
MASTERPIECE**

The Greatest Value
Ever Offered in A
Radio Receiving Set

At all dealers!

*Keen Competition Among
Set Mfg'rs. Raises Standard
of Condensers Used.*

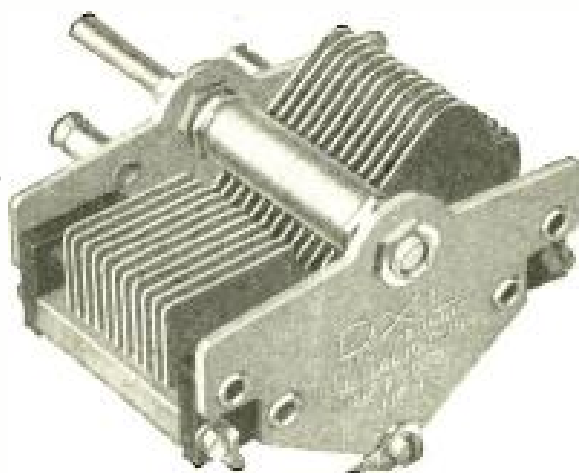
TRADE MARK

DXL

**Straight Line
Low Loss**

Condensers

*Built for Manufacturers
Whose Sets Will Win*



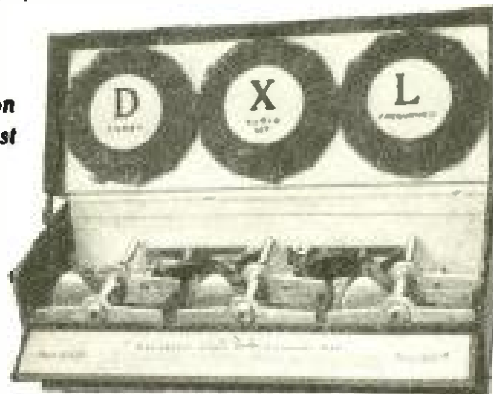
Manufacturers who are using DXL Condensers sell their sets with confidence. They know the high degree of selectivity and power will be maintained—the sets will continue to deliver satisfaction.

From a standpoint of production, you have no plates to straighten—every shipment of 100 DXL Condensers contains 100 condensers ready to function 100 per cent. Attractive quotations.

**DXL
Balanced Tuned
R. F. Kit**
Biggest Value in Radio

Complete
Description
On Request

\$18.50
List



DXL RADIO CORPORATION
5767 Stanton Avenue
DETROIT, MICH.

POPULAR RADIO LABORATORY

LAURENCE M. COCKADAY, Director

Approves **Amplex** *A.C. Set*

The Amplex A. C. Kit and Set were especially designed for the famous McCullough A. C. Tubes. It was perfected only after a great deal of time spent in research and experiment by Amplex engineers and approved by Laurence M. Cockaday, Director of POPULAR RADIO Laboratories.

The Amplex A. C. Set is of the 5 tube tuned radio frequency type. It operates without "A" batteries. Simply plug it on any 110 volt A. C. current socket and tune in.

The Amplex A. C. Kit

makes it easy for you to build your own A. C. set. Every part, from the beautiful, mahogany, bakelite panel, right down to the last wire is included. The panel is already laid out, drilled and engraved for you and complete instructions and diagrams make the assembling and wiring easy. In an hour or so after you receive the kit, you are ready to plug into your light sockets and tune in that D X station.

And remember, all the parts are of Amplex precision manufacture and especially designed and selected for this new circuit. The entire kit, parts and circuit, have the unqualified endorsement of Mr. Cockaday and POPULAR RADIO Laboratories.

Build this Amplex A. C. Set with this Kit

- | | |
|--|------------------------------|
| 1 mahogany bakelite panel,
drilled and engraved | 2 Amplex Transformers |
| 3 Amplex A. C. Tuners (3 A. C.
Low Loss Coils—3 Low Loss
.0003 Condensers) | 1 Baseboard |
| 5 Sockets | 1 Mica Condenser |
| 3 Mahogany 4 inch dials | 1 Grid Leak |
| | 1 S. C. jack |
| | Binding Posts |
| | Wire, Spaghetti, etc. |
| | Blue prints and instructions |

How to get this set or kit: either from your dealer or else send direct to us.

Amplex Instrument Labs. 88 W. Broadway, N.Y.

\$32 50

Type "B" Transformer
\$6.00 Extra

Assembled and wired in beautiful
mahogany cabinet, \$45.00

Always the Latest in Radio from MORISON

McCullough AC Tubes and Complete AC Receiver Kit

IN making AC tubes and receiver parts available to customers throughout the country as soon as offered for sale in the leading radio centers, Morison merely maintains service standards.

Establish connections with Morison now before the fall rush. Whether you construct sets for yourself or others you will find Morison service invaluable. Our experts are always as ready to advise you on your problems as to supply your needs promptly and intelligently at honest prices.



The
McCullough
AC Tube
Price \$6

McCullough AC 5-Tube Receiver

1	General Radio Variometer No. 269.....	\$5.00
2	Precision R. F. Coupling Units.....	5.00
2	Hammarlund Condenser .0005.....	10.00
5	Federal Sockets No. 16.....	6.00
1	General Radio Audio Transformer No. 285.....	7.00
1	Daven Mtg. No. 41.....	1.00
1	Dubiller .006 Cond. No. 601.....	.75
1	Daven Resistor .25 Meg.....	.50
1	Daven Resistor 4. Meg.....	.50
1	Daven Resistor .5 Meg.....	.50
1	Dubiller Condenser .00025 No. 601-G.....	.45
1	Dubiller Condenser .00015 No. 601.....	.35
1	Dubiller Condenser .006 No. 601.....	.75
1	Dubiller Condenser .0001 No. 601.....	.35
1	Pacent Jack No. 61 S. C.....	.50
1	Radlon Panel 7 x 24.....	3.00
1	Baseboard 9 7/8 x 22 3/4.....	.75
1	Antenna Binding Post Strip.....	.15
1	Battery Binding Post Strip.....	.25
1	Cabinet 7 x 24.....	12.50
3	4 inch Kurz Kash Dials.....	3.00
1	Dongan Transformer.....	6.00
A.	C. Leads.....	
		\$64.30

Two Hookups that Solve Summer Radio Problems

Cockaday's 8 Tube Superheterodyne Reflex Receiver

1	General Instrument Low-Loss Condenser (Isolantite Insulation) .0005 mfd.....	\$5.00
1	General Instrument Low-Loss Condenser (Isolantite Insulation) .001 mfd.....	5.50
1	Set of 4 Matched Haynes-Griffin Intermediate Transformers.....	20.00
1	Precision Autodyne Coupler.....	3.50
1	Karas-Harmonic Audio-Frequency transformer.....	7.00
1	Amplex Grid-denser .0005 mfd.....	1.25
1	Benjamin Cle-ra-tone Socket.....	1.00
7	Federal Sockets No. 16.....	ea. \$1.20 8.40
1	Pacent Double Circuit Jack.....	.60
1	Pacent Single Circuit Jack.....	.50
2	Na-aid 4 inch Dials No. 3043.....	ea. .75 1.50
1	Amsco 2 Ohm Rheostat.....	1.35
1	Amsco Potentiometer 400 Ohms.....	1.50
2	Daven Resisto coupler mountings.....	ea. \$1.00 2.00
1	Daven Grid-leak Mounting.....	.35
2	Daven Resistor .5 Megohms.....	ea. .50 1.00
1	Daven Resistor 5 Megohms.....	.50
1	Daven Resistor .005 Megohm.....	1.00
2	Daven Resistor .25 Megohm.....	ea. .50 1.00
1	Radlon Panel 7 x 24 ins.....	3.00
2	.0001 N. Y. Coll Mica Condensers.....	ea. .35 .70
4	.005 N. Y. Coll Mica Condensers.....	ea. .75 3.00
1	.00025 N. Y. Coll Mica Condenser with Grid-leak Mounting.....	.45
1	Duratran Radio-Frequency Transformer.....	4.00
1	Walbert A Battery Switch.....	.50
1	Baseboard 9 3/8 x 22 3/4 x 1-2 ins.....	.75
1	Connection Block 1 x 9 x 3-16 ins.....	.25
7	Eby Blinding Posts.....	ea. .15 1.05
	Material for making brackets.....	.25
1	Korach Tuned Loop.....	16.50
1	Mahogany Cabinet.....	12.50
		\$103.90

Town and Country Receiver

1	Remier Variable Condenser .00035 with dial.....	\$5.00
1	Amsco 20-Ohm Rheostat.....	1.25
1	Amsco 400-Ohm Potentiometer.....	1.50
2	Cutler-Hammer Battery Switches.....	ea. .60 1.20
1	Adams Jack No. 502.....	.70
1	Adams Jack No. 501.....	.60
1	Dubiller .00025-601-G Condenser.....	.45
1	Dubiller .00025-601 Condenser.....	.35
1	Daven 4 meg. Resistance.....	.50
6	Benjamin No. 199 Sockets.....	ea. \$1.00 6.00
3	Dubiller Duratrans.....	ea. 4.00 12.00
2	Pacent Audioformers No. 26.....	ea. 5.00 10.00
9	Eby Blinding Posts.....	ea. .15 1.35
1	7 x 18 Radlon Panel.....	2.25
1	Brass Strip for Brackets.....	.15
1	Hard Rubber Strip 1 x 9 ins.....	.25
1	Baseboard 7 x 16 3/4.....	.50
1	Dixie Assortment of Screws, etc.....	.50
15	Lengths Bus Bar.....	ea. .02 .30
1	7 x 18 Cabinet.....	7.50
1	Hoyt Bezel Holc 0-6 Voltmeter.....	3.00
		\$55.35



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PROMPTLY**

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With MORISON Now
Before the Fall Rush

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Ask us for any parts
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C-10

Navy Model Super-Heterodyne

The supreme achievement in receiver design, setting a new high standard of efficiency not even contemplated heretofore.

A High Powered Receiver employing 10 tubes

Simple tuning

Compact (size only 28x8x8)

Wave length range 50-600
meters

Selectivity far in advance
of others

Total amplification almost
2,000,000 times

Perfect tone reproduction
and volume

In actual tests the C-10 completely outclasses other receivers in all respects.

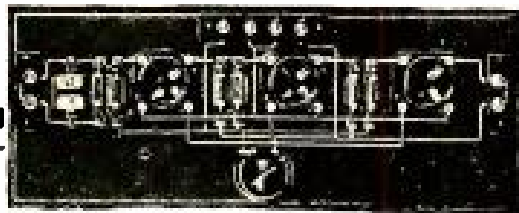
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Resistance-Coupled
Amplifier Kit No. 1.

Price \$5.00

Write for free diagrams
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ELECTRAD, Inc.

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Unlike
Any Tube
Heretofore
Made
Now \$ **3**⁵⁰
Formerly \$6



Improve Summer Reception

TRUE BLUE Power Plus Tubes used in any receiver having 3 volt type sockets will give you Standard True Blue Tube results.

They are ideal for superheterodynes or portable sets for car or camp use.

Although made for smaller sockets their characteristics duplicate True Blue Standard Type Tubes. Their sterling silver contact points will not corrode from salt air. They are non-microphonic and constructed to operate noiselessly under hard use. Guaranteed absolutely uniform and interchangeable, you do not have to carry a complete set of matched tubes for spares. Power Plus True Blue Tubes will work in any position, in any radio set. Cased singly or in sets of 3, 6 and 8.

The New Storage Battery Tube to Fit 3 Volt Sockets

The filament of True Blue Power Plus Tubes should be lighted with a 6 volt storage battery. Used as a detector 45 volts B Battery is required on the plate, 90 to 150 volts as amplifier.

Standard Type True Blue Tubes fit 6 volt sockets, safety cased singly or in sets of 3 and 5.

Jobbers have been cut off, and their excessive discounts cut out of True Blue distribution costs. An economy at \$6.00, they are now only \$3.50.

**10 Day Return Privileges
60 Day Written Guarantee**

True Blue Tubes must sell themselves in 10 days' trial or you can return them for refund. Any True Blue Tubes failing to operate perfectly due to

mechanical defect may be returned within 60 days for replacement.

**You Can Order Direct if your Dealer
has not yet been Supplied**

Mail check or money order to our nearest office. Please include dealer's name.

BRIGHTSON LABORATORIES INC.
Waldorf Astoria Hotel, 16 West 34th St., New York City

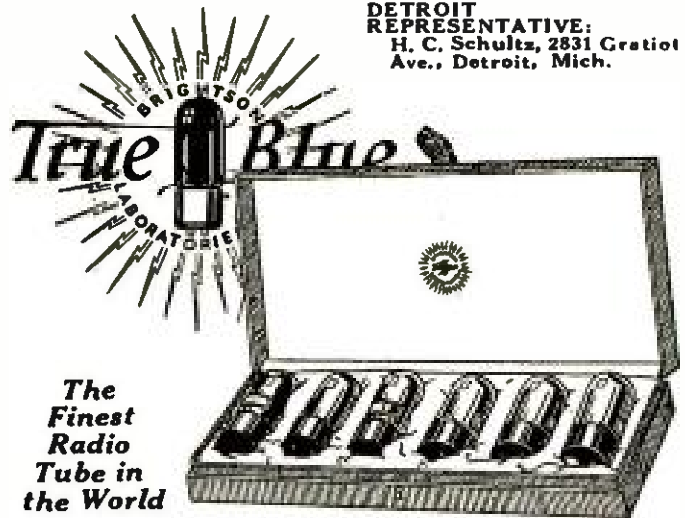
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BRIGHTSON Safety Cased TRUE BLUE TUBES

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



CONTINENTAL
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JUNIOR

Here's the Vernier That Gives Your Condensers a Chance!

No friction devices nor geared attachments to affect the efficiency of your tuner. Continental Junior is a miniature condenser of advanced design with *no perceptible losses*. Shunted across a standard condenser it provides a perfect micrometric control with gradations impossible to get on any existing vernier devices.

On the new close wave length assignments the *Junior* is a positive means of eliminating interference and heterodyning.

The price of the Junior is \$1.50—boxed with knob, pointer, and attachments that require no soldering. One hole mounting.

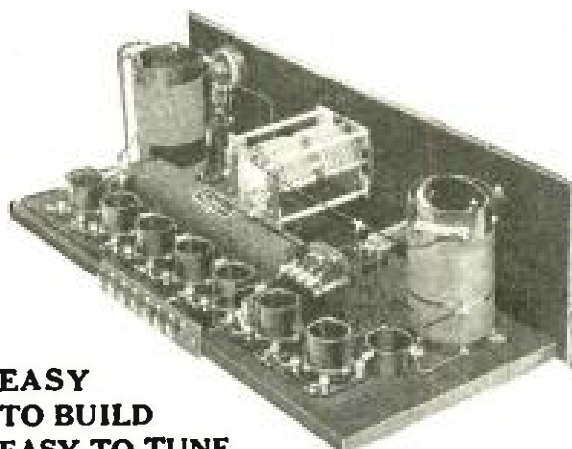
When you buy the Junior ask your dealer to show you the New Continental *Separator* for low wave length tuning. If he can't supply you, write Condenser Headquarters.

Gardiner & Hepburn, Inc.

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McLAUGHLIN ONE - CONTROL SUPER



EASY
TO BUILD
EASY TO TUNE

Simplicity — Economy — Distance
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All "officially approved" parts for duplicating Mr. McLaughlin's laboratory set are contained in the

U-NI-DIAL Kit

Write to

U-NI-DIAL Radio Co., 35 Greenwood Av.
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EXCLUSIVE SALES AGENCY

for

McCullough AC Tube

Price \$6 list

Step-down Transformer Type L

Price \$6 list



Any jobbers interested write or telegraph for selling rights on AC Tube or Transformer.



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25 West Broadway New York City

Exclusive Selling Agents for
McCULLOUGH SALES CO.

Niagara Produces Another Wonder!

The Absolute ARAGAIN Radio Receiver

THE name ARAGAIN guarantees the finest quality obtainable by unusual design, highest workmanship, and best materials. The Model B Receiver illustrated will appeal to those who value quality. No excuses are ever needed. Each thoroughly tested and sealed before leaving the factory and guaranteed perfect.

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SPECIFICATIONS — Two stages of ARAGAIN radio-frequency with minimum distributed capacity. Thoroughly shielded radio-frequency transformers insuring a remarkable degree of selectivity. All wiring is of pure gold-plated copper wire. Housed in heavy brown mahogany cabinet

\$180.00 f. o. b. Niagara Falls

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The
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AMPERITE
The "Self-Adjusting"
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As the heart controls the flow of blood through the body, so AMPERITE, the self-adjusting rheostat, controls the flow of current through the tubes—automatically—never allowing too much to injure the tubes, and always permitting true tone qualities with proper volume. No hand rheostats. No guessing. Simplifies wiring. Improves operation. Used in over 50 leading sets and circuits. \$1.10 everywhere.

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AMPERITE
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"means right amperes"

Popularity of Summer Radio is Increasing

The use of Kellogg transformers in your set will prove a delight in clear, powerful reception.

Kellogg radio frequency transformers are of the low loss, high efficiency type. No "dope" to hold windings in place. Minimum amount of insulating material. No. 603 for selective tuning. No. 602 when exceptional selectivity is not desired.

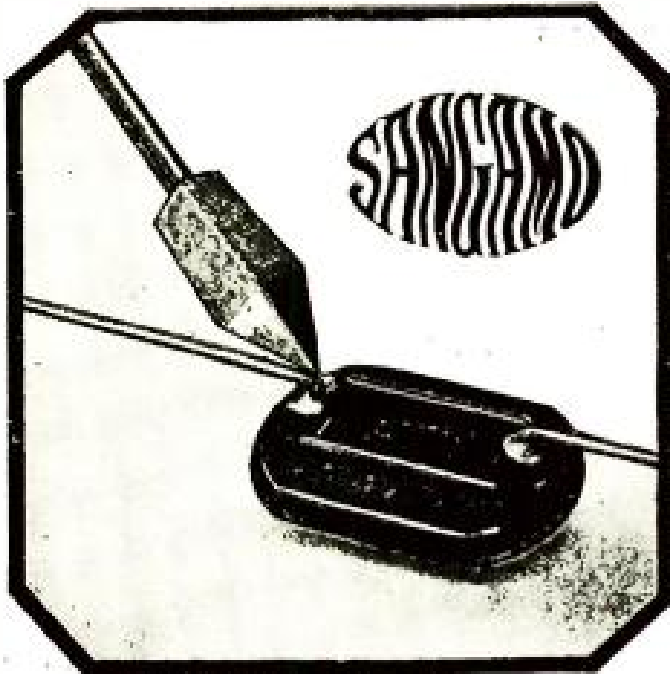
Kellogg audio frequency transformers are built right for the kind of service you expect. They amplify the highest or lowest tones with absolute fidelity. Built in 3 and 4 1-2 to 1 ratios.

Kellogg transformers are on sale at all radio dealers. Their use with Kellogg low loss condensers will give you an ideal tuning and amplifying combination for your set, with results that will be most pleasing.



Kellogg Switchboard & Supply Co.
Chicago Illinois

SANGAMO Mica Condensers



doesn't change their capacity

No matter how often the hot soldering iron touches Sangamo Mica Condensers, their capacity remains unchanged. Sangamo condensers are solidly molded in smooth brown bakelite, made without paraffin, and so thoroughly heat- and moisture-proof that they can be boiled in water for hours without affecting the capacity. Strong, too; dropping on concrete will not hurt them.

Sangamo Mica Condensers are the most accurate condensers you can buy, and they stay accurate. In reflex circuits especially, this sustained accuracy helps to make a set *reliable*, and not as variable as the weather. They are made by a company with a world-wide reputation for building accurate electric meters.

Notice the neatness of these condensers; they harmonize perfectly with other finely finished radio parts and clean-cut workmanship.

Made in all standard capacities with or without resistor clips, and sold at surprisingly reasonable prices for high quality.



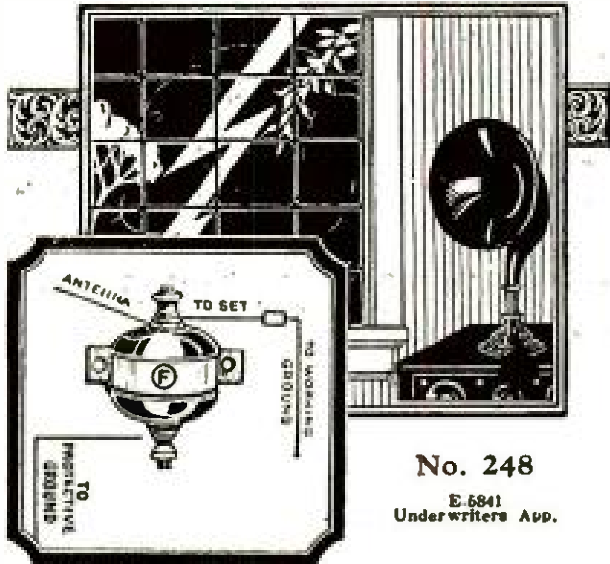
Sangamo Electric Company
Springfield, Illinois

RADIO DIVISION, 50 Church Street, New York

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1320-3



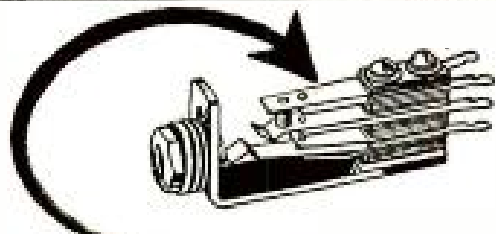
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“Little Joe” Lightning Arrester

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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The spring's the thing!

Don't underestimate the importance of good jacks.

Don't buy jacks because they're cheap.

Use Pacent No. 61 jacks in your A. C. Receivers.

Write for catalog of complete Pacent Line
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SERVICE AND VALUES } TO GLADDEN THE HEART OF FANS

Our Money Back Guarantee Is Satisfaction Insurance

"HOOK-UP" with the WHOLESALE RADIO SERVICE, and you will soon learn the true meaning of "Service!" and "Value!" Thousands of satisfied customers all over the country have come to know and appreciate our policy which insures your getting one hundred cents' worth of BETTER VALUE for EVERY dollar you invest, no matter how large or how modest the sum is. Your money is STILL YOUR money until you are thoroughly and completely satisfied!

Our Money Back Guarantee Is Satisfaction Insurance

Browning-Drake 4-Tube Kit Complete \$49.50

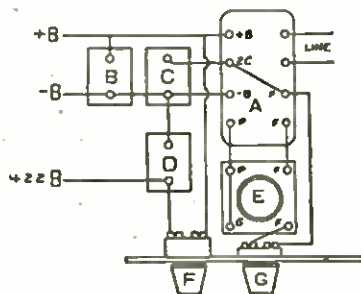
Tuned radio frequency principle in highly improved form. Highest degree of selectivity and sensitivity attained in a receiver of this type. In efficiency and productiveness, it will stand comparison with the superhetrodyne!

- One Panel—7 x 24. Drilled and engraved
- One Baseboard—8 1/2 x 23 1/2
- One National Tuning Unit B-D1 (Contains .0005 mfd. Natl. DX Cond. with 4 in. Velvet Vern. dial and antenna coil mtd. as unit)
- One National Unit B-D2 (Contains .00035 mfd. Natl. DX Cond. with 4 in. Velvet Vern. dial and Natl. Regenerator mounted as unit)
- One Rathbun 3 pt. Vern. Cond. for balancing
- Four sockets
- One GR 6-1 audio transformer
- One Samson 3-1 audio transformer
- Two Rheostats (one of 10 ohms and one of 30 ohms resistance)
- One 25-ohm fixed resistance
- One Hoyt 2 in. voltmeter 0 to 6 volts
- One .0001 mfd. fixed condenser
- One .001 mfd. or .002 mfd. fixed cond.
- One .00025 mfd. fixed grid-condenser
- One Eiectrad variolhm for variable grid-leak
- One double circuit jack
- One single open circuit filament control jack
- One filament switch
- One .1 mfd. by-pass condenser
- Nine Binding Posts
- Twenty feet of wire for connecting parts.

Sold With Money Back Guarantee

New "B" Filter Circuit Roberts' "Knock-Out" 4-Tube Kit Complete \$42.50

To eliminate "B" Batteries



Method of wiring Type B.T. 200 Transformer for "B" battery supply using 110v-60 Cycle AC line
 A—Type B.T. 200 Marie Transformer
 B—4 mfd. condenser
 C—2 mfd. condenser
 O—1/4 mfd. condenser
 E—Serco socket and 201A tube
 F—WRS 5,000 to 100,000 ohms variable resistance
 G—Serco 30 ohm rheostat
 One 7 x 10 drilled panel
 Five binding posts
 Bus bar, screws, etc.

Complete \$17.50

All laboratory specified and tested parts. Combines best features of radio and audio amplification. Does not radiate. Extremely sensitive, highly selective

- One 7 x 21 drilled and engraved panel
- 1 Baseboard to fit
- 2 Serco .0005 low-loss cond.
- 5 Roberts Spiderweb Coils
- 1 All American A. F. Trans. 5-1 Sickies
- 2 Como OR Modern push-pull trans.
- 4 Bestone double spring contact sockets
- 3 Pacent 20 ohm rheostats
- 1 Dubilier .00025 Grid-condenser
- 1 Tubular Grid-leak
- 2 Dubilier .0025 mfd. condenser
- 1 Dubilier .005 mfd. condenser
- 3 Univernier dials for fine tuning
- 2 4 1/2 volt "C" batteries
- 1 Pacent double circuit jack
- 1 Pacent single circuit jack
- 1 Neutralizing Condenser
- 1 Switch lever
- 7 Switch points
- 2 Switch stops
- 1 Drilled and engraved binding post strip
- 7 Unmovable binding posts
- 1 pkg. screws, washers, lugs, etc.
- 40 feet of tinned bus wire

Complete blue prints and wiring instructions

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Cockaday Kits Sets

Built of genuine, specified parts of finest quality. Kits are complete as above with detailed wiring diagram. List of parts and "SERVICE AND VALUE" prices complete in

WRS Catalog

Stop Searching, Here Are the Hard to Get Things!

NEW AC Tubes
 HAMMARLUND .0005 Variable Condensers
 KURZ KASCH 4 inch dials
 FEDERAL Sockets
 GR Audio Frequency Trans. No. 285
 DAVEN Resistor Coupler Mountings
 —1/4 to 4 megs.
 DUBILIER Micadyne .006-.0001-.00025 .00015
 PACENT Jacks
 PRSH AC Leads

Write Us

Popular Radio's Portable Town and Country 6 Tube Kit

Ideal for traveler and vacationist! EASY to build, easy to operate with a single dial tuning control. Furnished with every specified part and accessory, exactly as detailed in POPULAR RADIO, complete with wiring instructions and diagrams. For prices and list of apparatus, see our new

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WHOLESALE RADIO SERVICE CO.

ORIGINATORS AND WHOLESALE DISTRIBUTORS OF RADIO ACCESSORIES AND APPARATUS
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Why Buy "B" Batteries?

Better than "B" Batteries

Music as smooth and clear as though it comes in on "greased wires"—the elimination of sandpaper noises resulting from chemical action in the cells, and the annoyance of weak signals due to run down batteries—these are some of the advantages of using the Rhamstine* "B" RECTIFIER for your source of B-power.

Plugs into electric light circuit of 110 volts AC 60 cycles. Range of detector voltage 0 to 50; amplifier voltage 0 to 110. Operates efficiently on any tube set. Has no hum, no distortion, no acid, and cannot possibly burn out tubes. Approved by Popular Radio Testing Laboratories.



ONLY \$25

Five Day Trial

Use the Rhamstine "B" RECTIFIER on your own set under your local conditions for five days. See what volume you get on local stations—what silky smooth reception you get on DX—then if you are not more than satisfied—return it and Rhamstine* will refund your money. This is the same hard and fast guarantee thousands of Rhamstine* Needlephones have been sold under—it is your assurance of absolute satisfaction. Mail the coupon today.

J. THOS. RHAMSTINE ★

RHAMSTINE ★

"B" RECTIFIER

Mail This Coupon Today

Dealers Note

This is the most efficient, fastest moving source of B-power on the market. One Detroit jobber sells two and three dozen a day. Write for dealer proposition before someone else gets it.

J. Thos. Rhamstine* (6)
Woodbridge at Beaubien, Detroit, Mich.

Send me your "B" RECTIFIER by express C. O. D. subject to inspection, at \$25. It is distinctly understood that if I am not entirely satisfied, I will return it within 5 days and receive a refund of the purchase price.

Name.....

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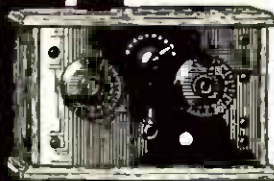
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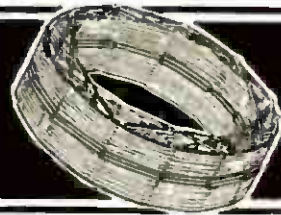


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Don't miss this big special offer to supply FREE all parts necessary to construct a high-grade 1000-mile receiving set. You can sell this set alone for practically the entire cost of the course. Send for the facts now. Find out all about this big-pay field. Address

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READY 22 YEARS WHEN RADIO CAME

THERE is one radio set that rode into the industry on half a million automobiles. That set is the Atwater Kent.

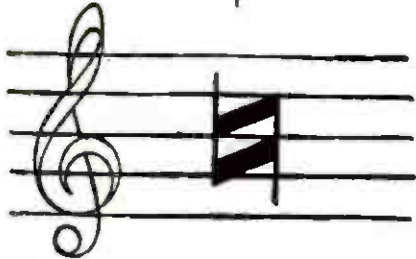
A quarter of a century ago we built our first Ignition System for automobiles and motor boats. That business grew and grew. Its growth expressed the confidence of leading motor manufacturers and of owners that we were truly trying to produce "the spark that couldn't fail."

And when radio came, it called for the same sort of manufacturing machinery, performing the same operations and run by the same experienced hands.

Perhaps the fact that we were ready, coupled with an earnest desire for precision and care, explains the confidence with which the Radio Industry regards Atwater Kent Receiving Sets and Radio Speakers.

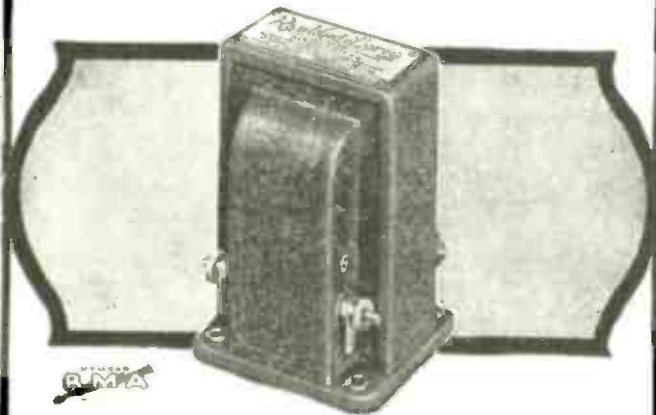
ATWATER KENT MFG. CO.
Philadelphia





Natural

Not only is Rauland-Lyric an instrument of superb amplification, but through skillful design it goes far in compensating for imperfections in the loudspeaker. Thus is reproduced in your home the beauty of actual tones as they are created in the broadcasting studio—pure, flawless, *natural*.



Rauland-Lyric is a laboratory-grade audio transformer designed especially for music lovers. The price is nine dollars. Descriptive circular with amplification curve will be mailed on request. All-American Radio Corporation, 2686 Coyne St., Chicago.

Rauland-Lyric
AN

ALL-AMERICAN
TRADE MARK
TRANSFORMER

The Choice of Noted Music Critics

The **LARGEST RADIO STORES** in AMERICA

Hook-ups!
All the latest and best Kits in our new
RADIO CATALOG

FREE

Just Out! Our new 1925, ninety-six page Radio Catalog including all the best and latest Kits, Parts and Accessories. Also our new 32 page bargain section—write for your **FREE** copy to-day!

Save Money! We buy up manufacturers' jobbers, and dealers surplus and bankrupt stocks—but only brand-new fully guaranteed, nationally advertised apparatus. Our enormous buying power permits us to pay spot cash and get rock-bottom prices—even way below manufacturer's costs. That's why our catalog is crammed with thousands of wonderful Radio Bargains.



509 So. State St., CHICAGO, ILL., Dept. P. R. 6

Improve Your Summer Tuning

WITH

E-Z-TOON

(EASY TUNE)

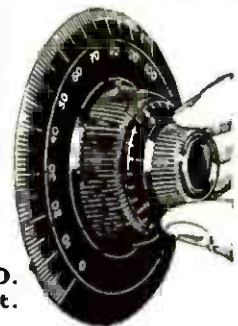
RADIO DIALS

"The Key to Simplified Tuning"

E-Z-TOON dials will improve the tuning of any radio set. Replace your old dials with E-Z-TOON and marvel at the simplicity of tuning—takes but a moment to install—only a small screw-driver necessary—no holes to drill, no complicated adjustments. A fine smooth, 80 to 1 Vernier adjustment. 3 in. dials, Black, \$2; Mahogany, \$2.20. 4 in. dials, Black, \$2.25; Mahogany, \$2.45. 2 in. non-Vernier dials, for rheostats, switches, etc., Black, 40c; Mahogany, 45c.

If your dealer cannot supply, write us

E-Z-TOON RADIO CO.
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\$6 List

Dongan Type B Transformer
for McCullough AC Tubes

Designed
and built
for
use with
new

AC
Radio
Tube

DONGAN

Type B - AC
Tube

Transformer

Dongan Electric Manufacturing Co.
Manufacturers of Radio Transformers and Voltmeters

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Better Contact

An easy way to get distant stations clearly

IT'S important at all times—but doubly important in summer when static is apt to be troublesome—to have clean, perfect contact between tubes and sockets. If you don't, the almost unnoticeable films of corrosion act as barriers for the delicate current; magnified, they cause annoying noises.

"It's the contact that counts"

NA-ALD Sockets remove those barriers. The exclusive side-scraping contacts (not just side pressure) of Na-Ald DeLuxe Sockets cut

the corrosion from the sides of tube terminals. A turn or two of the tube—and the tube terminals are clean.

The Alden-processed Bakelite conserves all the current energy. Laboratory tests proved Na-Ald Sockets most efficient in low loss and low capacity.

Na-Ald Adapter No. 429 and Na-Ald Socket No. 499 are especially made for use with UV-199 and C-299, and No. 411 for WD-11 tubes, all of which are used with dry batteries. They are a big aid to the highest tube efficiency.

Use Na-Ald Sockets not only in the set you build but also install them in the set you buy. At all dealers.

Mail coupon for free booklet, "What to Build," giving tested, selected circuits.

ALDEN MANUFACTURING COMPANY

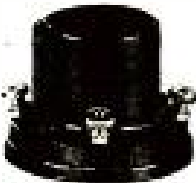
Also makers of the famous Na-Ald Dials
Dept. C7. Springfield, Mass.



Na-Ald Socket
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Send me free booklet, "What to Build."

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We ask for no deposit. Simply send name and address and style wanted. Battery will be shipped the day we receive your order Express C. O. D., subject to your examination on arrival. Our guarantee accompanies each battery. We allow 5% discount for cash in full with order. You cannot lose! Act quick. Send your order today—NOW.

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1215 South Wabash Ave.
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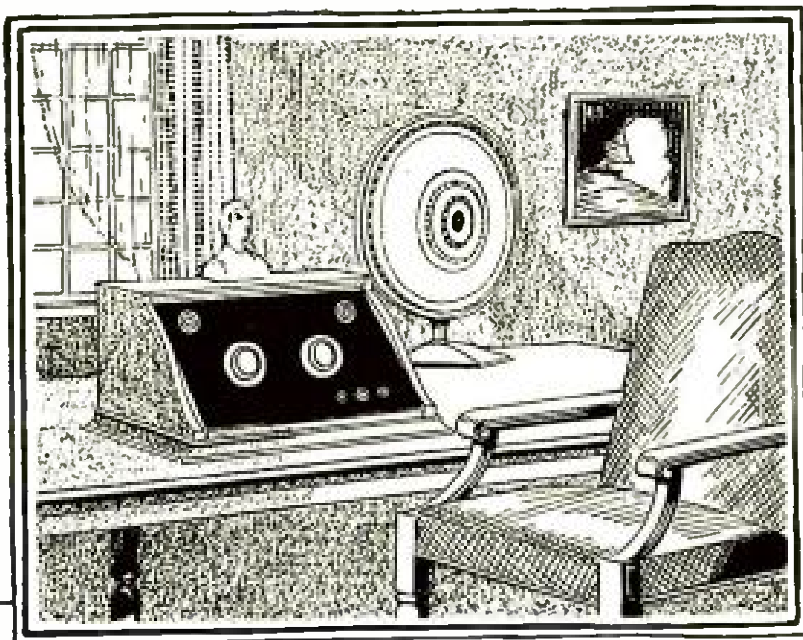
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Tuned Loop
Tuning Feature
Directional
Can Be Logged
Collapsible

Patent Applied For

Approved! Recommended and used on the famous COCKADAY 8-TUBE SUPERHETERODYNE REFLEX. The Editorial on page four of Feb. POPULAR RADIO tells how Cockadys, using the Korach Loop, logged the following Foreign Stations: 2BD, Aberdeen, Scotland; 5NO, Newcastle, Eng.; 2PY, Plymouth, Eng.; ESP, Paris, France; 2LO, London, Eng.; PTT, Madrid, Spain; WKA2, Porto Rico and CYC, Mexico City. Positively the last word in loop construction. Exclusive features give you selectivity and distance unheard of before with loop aeriels. Operates successfully on all sets designed for loop construction. If your dealer cannot supply you, order direct from us. Price \$16.50. Send \$2.00 as good faith deposit with your order, balance C. O. D. Parcel Post. Satisfaction guaranteed.

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It is more necessary than ever this year to judge a radio set by the material it contains. Price competition last year brought in the type of apparatus that would perform beautifully for a week or two and then quit. And price competition is still with us.

Formica is used by nearly all the great makers of high quality apparatus. They swear by it as they always have. Be sure you have it in the set you buy.

Dealers: Formica is the standard panel in the eyes of the amateur. He wants it, and dealers who give it to him make the most from their panel business.

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Hear the Formica Orchestra over WLW every Tuesday evening from 9 to 10 Central Standard Time.



Coils for Roberts Circuit, No. 18
Price \$8.00 a Set

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DIAMOND-WEAVE COILS

Patented Aug. 21, 1923

For Craig, Roberts and Hoyt Circuits

Sickles Coils were chosen by Albert G. Craig in designing his remarkable new Reflex Receiver using the new Sodion detector, and are specified by him for this circuit in the February issue of POPULAR RADIO. This coil set, No. 20, is priced at \$4.50.

For the very popular Roberts Circuit the Sickles Coil Set No. 18 (\$8.00) is standard equipment. Unit No. 1 has primary and secondary coils. Unit No. 2 has primary, secondary, neutralizing coil and tickler. Broad variation in coupling adjustments is provided for. Tickler is provided with 180 degree dial control.

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An entirely new system of Radio Reception

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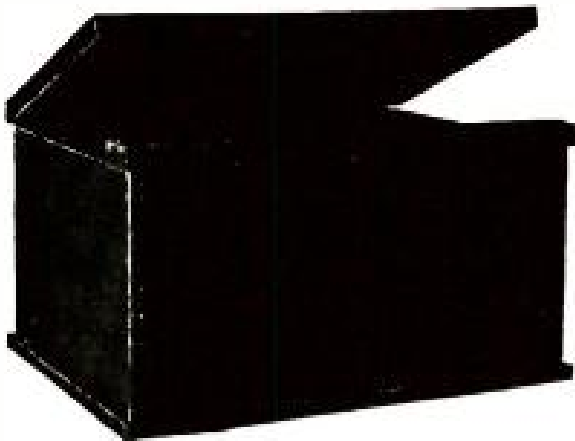
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Please send information of Hoyt System

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Popular Radio



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Remember that we pay mail and express charges—it makes quite a difference when comparing prices.

SPECIFICATIONS

Hardwood, rubbed mahogany finish. Top hinged, ends of top splined to prevent warping.

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7 x 26	10	4.50
7 x 27	9	5.00
7 x 28	10	6.00

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Dept. P. Hickory, N. C.

Statement of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of "Popular Radio," published monthly at New York, N. Y., for April 1, 1925. State of New York, County of New York. Before me, a Notary Public in and for the State and county aforesaid, personally appeared Douglas H. Cooke, who, having been duly sworn according to law, deposes and says that he is the Business Manager of "Popular Radio," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411. Postal Laws and Regulations, to wit: That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Popular Radio, Inc., 627 West 43d Street, New York City; Editor, Kendall Banning, 627 West 43d Street, New York City; Managing Editor, None; Business Manager, Douglas H. Cooke, 627 West 43d Street, New York City. 2. That the owner is: Popular Radio, Inc., whose stockholders are: New Fiction Publishing Corporation, 627 West 43d Street, New York City, whose stockholders are: Douglas H. Cooke, 627 West 43d Street, New York City; Vernal W. Bates, 46 George Street, New Haven, Conn.; Wiley Blair, 4607 Ross Avenue, Dallas, Texas; Harold B. Emerson, 9 East 40th Street, New York City; Estate of William Green, 627 West 43d Street, New York City; *Harris Corporation, 34 Pine Street, New York City; Le Roy Sargent, St. Petersburg, Fla.; Abel I. Smith, 120 Broadway, New York City; Louis H. Strouse, Samuel Falk and Frank C. Fisher, Trustees in bankruptcy of Metropolitan Finance Corporation, 9 East 40th Street, New York City. *Harris Corporation with the following as Trustees in dissolution of Harvey Fisk & Sons (1921) now dissolved; John Donovan, 30 Church Street, New York City; Harvey Fisk, 34 Pine Street, New York City; Wilfred Jessup, Connersville, Ind.; Henry W. Peacock, Jr., 34 Pine Street, New York City; Joseph M. Shellabarger, 30 Church Street, New York City. 3. That the known bondholders, mortgages, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. Douglas H. Cooke, Business Manager. Sworn to and subscribed before me this 20th day of March, 1925. Joseph T. Cooney, Notary Public, New York County. (My commission expires March 30, 1926.)

This Amazing New-Type Coil is Revolutionizing Radio Set Building

MODERN electrical science has discovered a new principle in radio frequency amplification—a new improved transformer that gives the most amazing results.

It is known as the Erla Circloid. Simply clip the coupon below—and let us send you the complete technical story.

4 vital improvements

The story of Circloid advantages is a fascinating study—even for those who are not interested in the technical side of radio.

As practically everybody knows, in the ordinary radio set, not only the antenna but the radio frequency coils themselves act as pick-up devices of broadcasting signal. This is one of the chief causes of what most radio fans call "broad tuning."

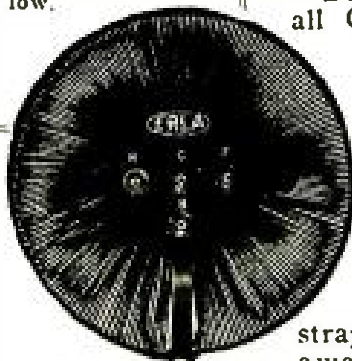
With Erla Circloids, independent pick-up of signals by the coils is completely done away with. Selectivity of the receiver is always at maximum. Sharp tuning and less interference are the direct result.

Static disturbance has been reduced to the very minimum. For everybody knows that static has no particular wave length. It invades them all. And because the Circloids have no pick-up qualities, only such static as happens to be present on the exact wave length to which the receiver is tuned can

Three Great Advantages

1. The absence of an external field eliminates the effect of the coil upon nearby coils or adjacent wiring circuits.
2. The Circloid has no pick-up quality and is rendered immune from outside electrical influence.
3. Its efficiency is higher than any other type of coil and losses are unbelievably low.

The New Erla Balloon Circloid Radio Frequency Transformer and Coupler



Each \$4.00 Patent Pending

come through. Thus here at last is a radio set that offers new delights in summer-time radio. No other receiver can provide such perfect freedom from annoying interference.

Another Circloid improvement is greater stability—smoothness of operation and ease of control.

The tendency of conventional receivers to squeal and howl

uncontrollably is due to excessive feed back between coils and wiring circuits.

With Circloids feed back of energy is eliminated between coils and confined solely to the wiring circuits where it is subject to complete control. Thus perfect stability is obtained. Oscillation that is sudden and violent in the average receiver, making it necessary to start tuning all over again, is now controllable. Just the slight turn of one control and it is completely controlled.

But the most important of all Circloid improvements is its effect upon tone quality. Any radio engineer will tell you that excessive "feed back" is the greatest cause of distortion or blurring.

And Circloids, because they have no external field, eliminate stray feed back effects and do away completely with this principal source of tonal distortion.

Only with the Circloid principle can supreme musical clarity and fidelity of reproduction be obtained. No other radio set can offer you these exclusive advantages. No other set can offer these supreme achievements.

4 ways to buy the Circloid

Erla Circloid Transformers are offered for sale, \$4.00 each—in kits of three, \$12.00—in kits of three with Erla Condensers, \$21.50—and in Factory-Bilt Kits, \$49.50. They may be obtained direct from your nearest dealer. Or write direct for detailed information.

ERLA * CIRCLOID Radio Frequency Transformer

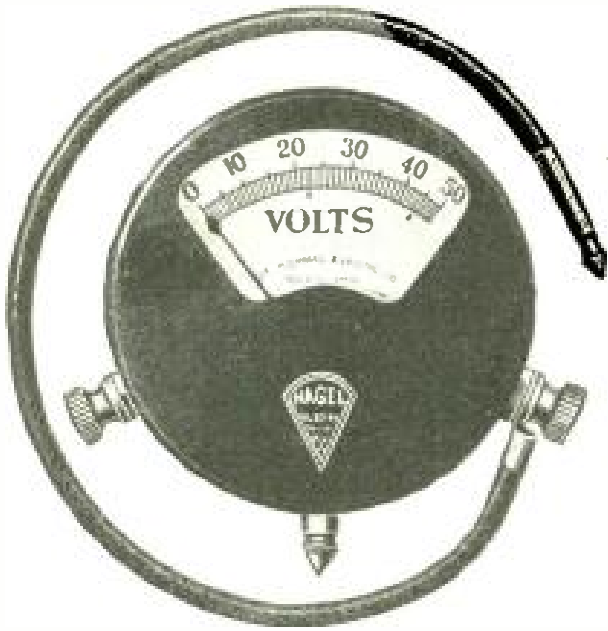
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Address



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HIGH-RESISTANCE VOLTMETERS
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THE CARE and RECHARGING of YOUR BATTERIES DURING WARM WEATHER WILL MEAN BETTER SUMMER RADIO and LESS EXPENSE LATER ON

Less of the sputtering and "frying" noises caused by static—more pleasure and clearer reception—can be yours by frequent battery charging during summer months. There's no work or bother involved if you leave it to the Sterling Rectifier. No lamps nor liquids to meddle with. Just connect the two terminals to your battery and turn the switch. That's all for 6 volt "A" 24, 48, or 72 volt B Batteries.

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60 and 60 cycle, \$22.50
25 cycle..... 25.00
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“See? I told ya we could get it”

“All right. Quit rubbin’ it in. I’ll believe the broadcastin’ you do about your DX stuff now.”

The persistent urge to show the other fellow makes boys the greatest salesmen in the world. Let Shorty question Step-Ladder’s claims about distance, and Step-Ladder is right on his heels with the proof. Is it a hook-up that is disputed? Then the young combatants get right down to facts and results. No airy arguments ending in boasting assertions. Boys carry *their* arguments to the point where the other fellow has to back down and agree.

Radio manufacturers have recognized this amazing genius for persuading the other fellow. This knack, coupled with the almost unbelievable enthusiasm which boys devote to radio, makes the appeal to the boy the strongest, most profitable, most lasting there is.

In reaching these persistent, tireless boosters, many manufacturers naturally

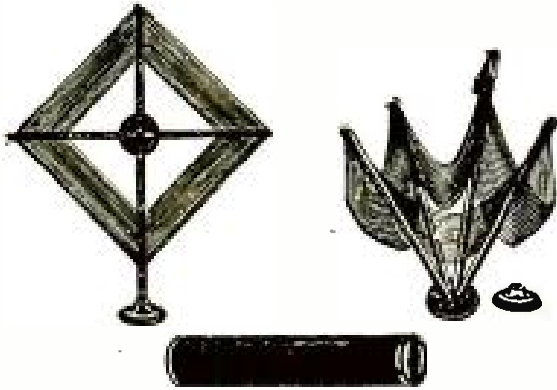
turn to the advertising columns of **THE AMERICAN BOY**. A half-million young readers are loyal believers in its editorial contents. You should see an American boy devour **THE AMERICAN BOY** articles on radio! You should see him eat up the fascinating stories built around the romantic achievements of radio! The average reader-age of these up-to-the-minute enthusiasts is 15½ to 16 years—just the age when the radio virus works best. The loyal, unswerving devotion which **THE AMERICAN BOY** readers give to **THE AMERICAN BOY** clinches beyond question the sticking power of your advertising.

Tell these boys about your product. They’re the most tireless boosters you can get. Win their preferences. Make them believe in your goods. Let Shorty and Step-Ladder and the rest of the bunch have a chance to say, “See? I told ya we could get it,” for your radio equipment. Copy received by June 10th will appear in August.

The
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The Biggest, Brightest, Best Magazine for Boys in All the World
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Adjustment Equivalent—8 to 86 feet.

Any Tube Set Now Made Portable.

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Perfected by Radio's Master Loop Craftsmen.

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Bring your old Super up-to-date and increase its amplification from 1½ to 2½ times, by equipping it with a set of S-M Two-Ten (Interstage) and Two-Eleven (Filter) transformers, and a Silver Coupling Unit.

Approved by Laurence Cockaday as an outstanding achievement.

Each transformer is supplied with its own characteristic curve on a tag—your assurance of laboratory testing. A set will improve the efficiency of any super to a remarkable degree. Three matched and charted transformers (2-210s, 1-211,) and 101B coupling unit, with all instructions:

Price \$26.50

Mail Orders Promptly Filled
Send for FREE Book, "The Why of Silver Circuits."
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Send for
FREE Bulletin 94

Whether you plan to build or to buy a receiving set, it will pay you to know something about the "insides" of radio. This booklet gives you the "inside dope" on some of the recent inventions embodying the latest ideas of radio engineers. In this bulletin is full information about the

Premier "HEGEHOG" Audio Transformer

Ratios 1 to 3, 1 to 4 and 1 to 5, \$3.50 Ratio 1 to 10, \$4.50

This light weight audio transformer has earned a place in the very front rank for its remarkable volume, and pure, natural tone. It is 100% self shielded against foreign noises.

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FREE HOOK-UP DIAGRAMS also sent on request. All popular types. Address



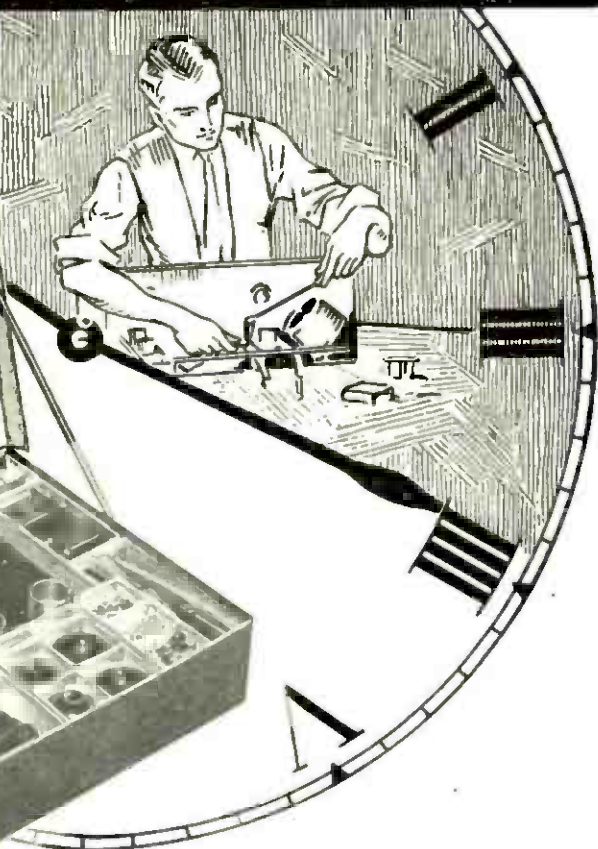
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FIVE TUBE NEUTRODYNE KIT



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Made from exactly the same parts as a factory-built King Neutrodyne Receiver.

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Dealers:

A complete line of Radio.

A liberal margin of profit.

Quick turn-over possibilities.

The King Dealer's plan will tell you about these in detail.

Write today!

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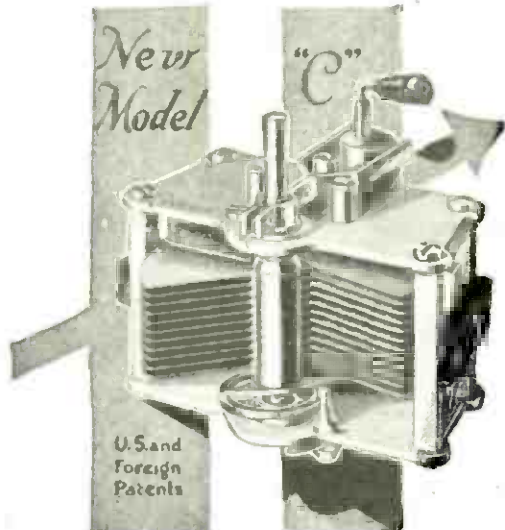
NEUTRODYNE

Perfected Radio



For Better Radio Hammarlund PRECISION CONDENSER

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Just a few years ago, a condenser of Hammarlund quality couldn't be purchased for \$100.

Today it is an outstanding example of radio engineering and it can be purchased at a popular price.

You will find Hammarlund Precision Condensers in many of the finer factory-built receivers. You will find even more Hammarlunds being specified for the newer, high-power circuits.

Ask any radio engineer what he thinks of Hammarlund Condensers. Abide by his judgment.

All capacities, plain and vernier; single, dual and triple models; also "Hammarlund, Jr." — a midget.

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Greater Distance, Clarity and Volume

PYREX Insulators bring in greater distance with more clarity and volume. They stop leakage and the full wave energy is transmitted through to the set. Used by the U. S. Government for the most exacting service.

45c Each at Good Dealers

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VARIABLE GRID LEAK

NEW!

A BALL-BEARING GRID LEAK THAT STAYS PUT

Screw adjustment, expansion contact and resistance unit that cannot wear or tear.

VOLT-X GRID LEAKS are positive and smooth in action with an accurate range of from one-half to fifteen megohms. Balancing Resistances for Super-Heterodyne and other circuits 30,000—150,000 ohms.

They fit any standard leak mounting, and get the absolute maximum from your tubes. They do not wear out.

Grid Leak \$1.00
Grid Leak Mounting30



BURTON & ROGERS
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Balanced

Electrically and

Mechanically

for Perfect Performance in Radio Reception.



The Subject of Condenser Losses

Total condenser losses at radio frequencies are the sum of conductivity losses, eddy current losses, and dielectric losses.

Conductivity losses most seriously affect the efficiency of a condenser under working conditions. They arise from poor contacts between plates and from poor bearing contacts. Soldered plates and positive spring bearings reduce these losses to a minimum.

Eddy Current losses occur in metal end plates and condenser plates themselves. The use of hard rubber end plates eliminates entirely eddy current losses introduced by metal end plates.

Dielectric losses are due to absorption of energy by the insulating material. When a good dielectric such as hard rubber is used in the end plates they have less effect upon the efficiency of a condenser at radio frequencies than any other set of losses.

For use at broadcast wavelengths General Radio Type 247 condensers represent the best balance between low conductivity, eddy current, and dielectric losses that is consistent with efficient design and popular price.

The plates of the rotor and stator groups are individually straightened before assembly and firmly soldered in a jig while they are in perfect alignment. The use of high grade hard rubber in the end plates eliminates entirely eddy current losses from the end plates.

Specially shaped plates assure a uniform wavelength variation.

Positive contact spring bearings provide a good connection with the rotor group and eliminate the disadvantages of a pig tail connection. Mechanically as well as electrically General Radio condensers are the standards of excellence.

Rotor plates are counterbalanced to permit smooth operation and accurate dial settings.

Lower losses and lower prices make General Radio condensers the outstanding values for popular use.

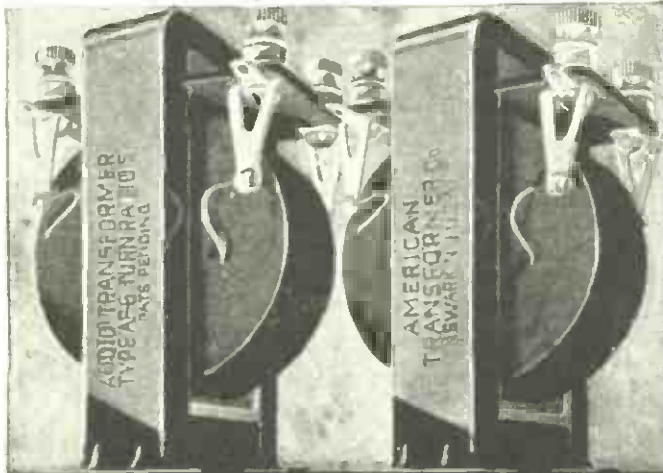
Type 247-H 500 MMF Vernier.....	\$5.00
" 247-F 500 MMF Plain.....	4.00
" 247-M 250 MMF Vernier.....	4.50
" 247-K 250 MMF Plain.....	3.50

Write for descriptive folder, 'Quality Condensers' and our latest catalog 920-P.

GENERAL RADIO CO.
Cambridge, Mass.

GENERAL RADIO

Quality Parts



Resourcefulness

AMERTrans are resourceful. Their name, their power and consistently good performance place them on the top rung of audio transformers.

High, even amplification in AmerTrans is a known fact. It can always be depended on. You pay only a little more, and you buy with the surety of satisfaction.

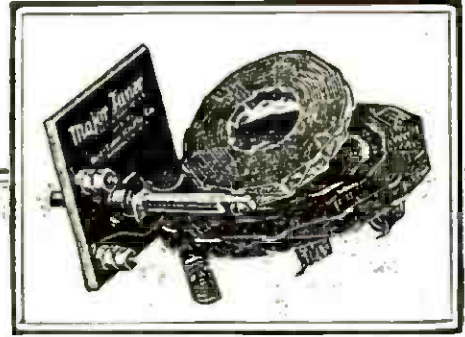
AmerTran is made in two types, one quality—AF6, ratio 5:1 and AF7, ratio 3½:1. Price either model, \$7.00 at your dealer's.

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COMPANY

175 Emmet St., Newark, N. J.

"Transformer builders for over 24 years"

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



Have you met

Major Tuner

Reg. U. S. Pat. Office.

MAJOR TUNER will end those "interference blues." A set built with the MAJOR TUNER gets only one station at a time—the one you want to get and no other.

MAJOR TUNER is the most advanced form of three circuit Low-Loss tuner. It is packed with complete picture wiring diagrams and full instructions.

(If your dealer cannot supply you, write us.)

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\$4

U.S. TOOL
TRADE MARK

TYPE 6

The micrometer dial, a unique feature which forms an integral part of Type 6 U. S. Tool Condensers, affords a smoothness and slow turning accuracy that imparts to the entire rotor all the efficiency of a vernier. Performs perfectly in any circuit, under any conditions.

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On Sale from Coast to Coast. If your Dealer cannot supply you, order direct.

THE *Red Morris* HOTEL
Philadelphia

The first 100% Radio Equipped Hotel in the World. Tower Scientific Headsets were used exclusively.



THE TOWER MFG. CORPORATION
98 BROOKLINE AVE.
BOSTON MASS.



Tower Scientific Headset



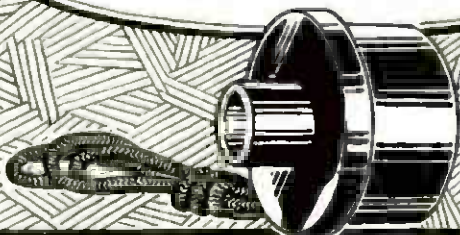
Little Spitfire Headset



Little Spitfire Loud Speaker



Tower Scientific

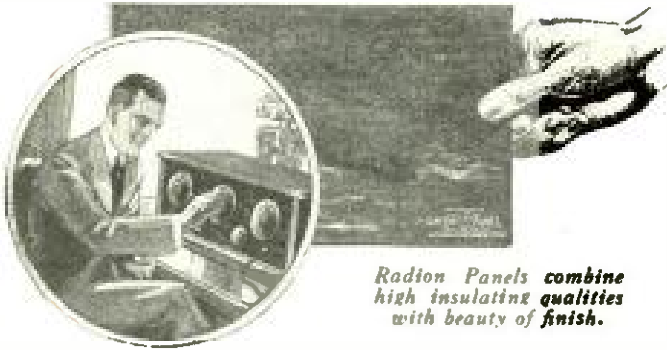


\$3.95

Tower's Scientific Phonograph Attachment

WORLD'S GREATEST LOUDSPEAKER VALUES

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



Radion Panels combine high insulating qualities with beauty of finish.

Why set manufacturers should use Radion Panels

Appearance—Radion Panels have a high-polished, satin-like finish that enhances the attractiveness of any set. They come in two colors, standard black and Mahoganite; the Mahoganite panels with their beautiful coloring and graining give an effect that is especially distinctive. Radion takes engraving beautifully.

Efficiency—Built to order exclusively for radio purposes, Radion meets the most exacting tests for high insulating qualities. Surface leakage and dielectric absorption have been proved to be exceptionally low. This is an aid in getting distance and volume.

Convenience—Another feature that recommends Radion Panels to the manufacturer is the ease with which they can be cut, sawed and drilled. Edges are smooth and even; holes are trim and clean-cut. Radion does not chip or peel as do some other panel materials.

We invite manufacturers' inquiries

WE ARE always glad to co-operate with manufacturers in meeting their requirements. We invite them to send us samples or specifications of panels and other insulated parts of radio instruments or radio sets. Radion is used on the leading makes of condensers.

AMERICAN HARD RUBBER COMPANY
Dept. B-6, 11 Mercer St., New York City

RADION

The Supreme Insulation

PANELS

Dials, Sockets, Binding Post Panels, etc.



Pat. Pending
Bridge meas. max. cap. .000045 Mfd. Frequency meas. max. cap. .000027 Mfd. . . . \$1.50

For Hair-Line Tuning

If you want finer adjustment than you've been able to get with ordinary verniers, shunt a Chelten Midget across the terminals of your main condenser. It can be mounted anywhere on the panel without introducing additional losses.

CHELTEN

Low Loss Midget Vernier

Used also as a STABILIZER in most radio circuits.

The CHELTEN is the ORIGINAL midget variable condenser. All others are IMITATIONS.

At Your Dealer's or Direct by Parcel Post

CHELTEN ELECTRIC COMPANY
PHILADELPHIA



\$3.25 RADIO Storage "B" Battery

12 Cells 24 Volts Lasts Indefinitely—Pays for Itself

Economy and performance unheard of before. Recharged at a negligible cost. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other important institutions. Equipped with Solid Rubber Case, an insurance against acid and leakage. Extra heavy glass jars. Heavy, rugged plates. Order yours today!

SEND NO MONEY Just state number of batteries wanted and we will ship day order is received. **Extra Offer:** 4 batteries in series (96 volts), \$12.75. Pay expressman after examining batteries. 5 per cent discount for cash with order. Mail your order now!

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 77, Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. \$12.25; 120 Amp. \$14.25; 140 Amp. \$15.00. All equipped with Solid Rubber Base.

World FOR STORAGE BATTERIES RADIO



HDNA - WEAF - WGN - WJZ - KRLJ - RGO - KFAE - WJY - KOP

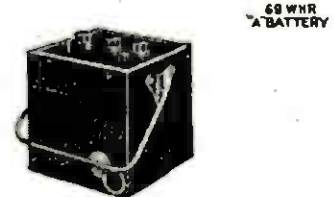
Prest-O-Lite

RADIO CHART

Voltage of Tubes	No. of Tubes	Type of Tubes (see foot-note)	Total Rated Amperes Drain	Recommended Prest-O-Lite "A" Batteries		
				Order by following Types	Days between Charging	
5-Volt Tubes	1	UV-200	1	69 WHR OR 67 WHR	22 16	
	2	UV-201A	1/2	67 WHR	33	
	2	1 UV-200 1 UV-201A	1 1/4	611 WHR OR 69 WHR	22 17	
	3	UV-201A	3/4	69 WHR OR 67 WHR	29 22	
	3	1 UV-200 2 UV-201A	1 1/2	611 RHR OR 69 WHR	21 14	
	4	UV-201A	1	69 WHR OR 67 WHR	22 16	
	4	1 UV-200 3 UV-201A	1 3/4	613 RHR OR 611 WHR	22 15	
	5	UV-201A	1 1/4	611 WHR OR 69 WHR	22 17	
	5	1 UV-200 4 UV-201A	2	613 RHR OR 611 WHR	19 13	
	6	UV-201A	1 1/2	611 RHR OR 69 WHR	21 14	
	8	UV-201A	2	69 KPR OR 67 KPR	21 15	
	For sets using current at a rate higher than 2 amperes.			2 1/4	69 KRL OR 67 KPR	22 13
				2 1/2	69 KRL OR 69 KPR	19 16

C-300 and UV-200 are interchangeable
C-301A, DV-2 and UV-201A are interchangeable

Copyright, 1925
The Prest-O-Lite Co., Inc.



How often should you charge radio batteries?

Don't wait until you've bought batteries and learn by bitter experience that they run down every few days. Let the Prest-O-Lite Radio Chart help select batteries that fit your set and guarantee you ample current and convenient intervals between chargings.

This section of the master chart shows how to select "A" Batteries for all 5-volt tube sets. Use either of the two sizes recommended for your set, depending on the days' service you want between chargings (based on the average use of your set of three hours a day). You will find the larger capacity battery more desirable unless facilities for frequent and easy recharging are provided. To select "B" Batteries, and "A" Batteries for peanut tubes, see the complete chart at your dealer's.

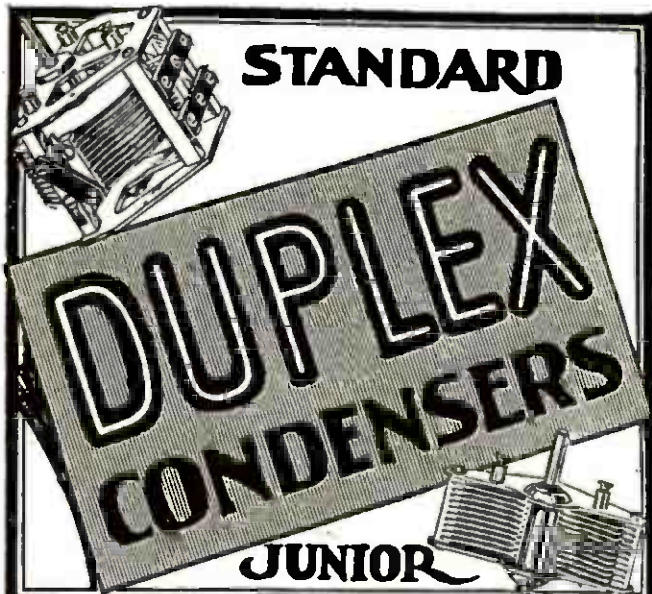
Prest-O-Lite Batteries are designed to supply the unvarying current that develops maximum distance, clarity and volume. Special structure plates and high porosity separators are features that help these splendid batteries get the most out of your set.

Prest-O-Lite Batteries offer you truly remarkable savings. Though standard in every respect, they are priced as low as \$4.75 and up. They last for years and are all easily rechargeable. See them at your dealer's or write to us at Indianapolis, Ind., for our booklet, "How to fit a storage battery to your set—and how to charge it."

THE PREST-O-LITE CO., INC.
INDIANAPOLIS, IND.

New York San Francisco
In Canada: Prest-O-Lite Company of Canada, Ltd.
Toronto, Ont.





Matched Condensers Are Necessary for Best Results!!!!

TO IMPROVE your set, replace its condensers with **DUPLIX Matched** condensers—the supreme achievement in the art of condenser building! Only one number to log, the simplicity of single dial tuning—or you can cut out logging and dial by call letters or wave lengths.

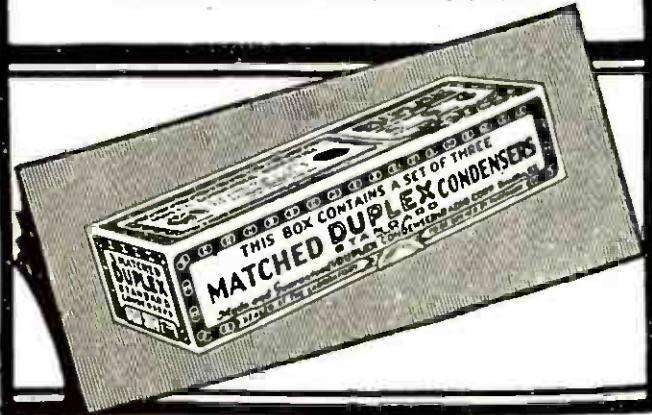
Each matched kit contains three **DUPLIX Standard** condensers, specially selected, matched, packed and sealed, to remain *unopened*, untouched, unchanged until ready to be placed in your set. **DUPLIX Standard** condensers are the accepted standard of condenser excellence. They are used in the famous Thermodyne, where matching is absolutely essential. They are made in strict accordance with Bureau of Standards specifications.

Insist on **DUPLIX Matched** condensers for better radio reception—stronger signals—greater distance.

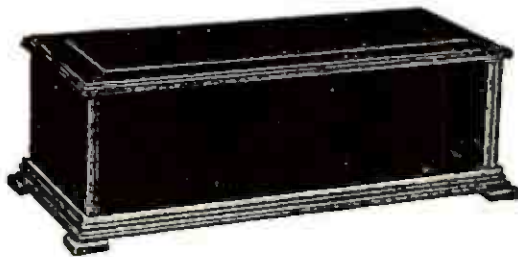
Write for instructive literature.

DUPLIX CONDENSER & RADIO CORP.

50 Flatbush Ave. Extension, Brooklyn, N. Y.



Our King Type Cabinet



Our cabinets are made of carefully selected lumber. They are beautifully finished and hand rubbed. The workmanship is of as high grade as in the best furniture. If not entirely satisfied with cabinets received from us, money will be refunded. Black walnut cabinets have piano hinges and lid holders. Imitation walnut cabinets have regular hinges, no lid holders. Send for circular showing our De Luxe Type, also our Beauty Type.

No.	For Panel	Deep, In.	Imitation Walnut	Genuine Walnut
King 621	6 x 21	7	\$4.60	\$6.80
King 714	7 x 14	7	4.20	6.70
King 718	7 x 18	7	4.35	6.80
King 721	7 x 21	7	4.90	7.40
King 724	7 x 24	7	5.35	8.00
King 726	7 x 26	7	5.80	8.50
King 728	7 x 28	7	6.60	10.00
King 730	7 x 30	7	7.00	11.00
King 71810	7 x 18	10	5.70	9.00
King 72110	7 x 21	10	6.25	9.50
King 72410	7 x 24	10	6.70	10.00
King 72610	7 x 26	10	7.25	10.50
King 72810	7 x 28	10	8.00	12.00
King 73010	7 x 30	10	8.20	12.50
King 836	8 x 36	10	8.75	12.00
King 840	8 x 40	10	9.25	12.50
King 921	9 x 21	10	7.50	9.25
King 924	9 x 24	10	8.50	10.50

F. O. B. WAUKESHA, WIS.

UTILITY CABINET COMPANY

Waukesha

Phone-721

Wisconsin

AMPLION

The World's Standard Loud Speaker

Alfred Graham & Company, London, England, Patentees.

Long tone travel with gradual amplification provided by the non-resonating, dragon-shaped tone conduit.

Rubber bushings insulate horn and unit from tone conduit.

Hinged base permits tilting horn to any desired angle.

"If it's natural and clear, 'tis the Amplion you hear"

Adjustment for "tuning" the Amplion "Floating Diaphragm" electro-magnetic unit to your set.

Created by the Originators and Oldest Makers of Loud Speakers

"Takes the place of an extra stage of amplification." That is the way many users describe the unequalled sensitivity of the Amplion. Prices \$13.50 and up. Write for literature and dealer's name.

THE AMPLION CORPORATION of AMERICA

Executive Offices: Suite X, 290 Madison Ave., New York
Canadian Distributors: Burndept of Canada, Ltd.
130 Richmond Street W., Toronto

Music Master
Resonant Wood
Insures
Natural
Tone
Quality



Connect Music Master
in place of headphones.
No batteries.
No adjustments.

Prices of all models
slightly higher
in Canada.

Music Master Makes any good set **BETTER**

Music Master transforms mere radio reproduction into artistic re-creation. Mere assertion? No! Plain fact—because:

THE piano's sound board, the violin and 'cello, and Music Master's amplifying bell are all of wood—because wood produces *natural* tones.

Heavy cast aluminum eliminates over-vibration, develops sound without distortion and imparts a *unique* tonal brilliance.

This balance of resonant wood and non-resonant metal preserves, reproduces and re-creates the natural qualities of instrument and voice—and makes

Music Master the Supreme Musical Instrument of Radio, for which there IS no substitute.

Buy Music Master and be safe—buy Music Master and improve your set—buy Music Master and exchange mere radio receiving for the artistic enjoyment of radio re-creation.

Music Master Corporation

Makers and Distributors of High-Grade Radio Apparatus
Tenth and Cherry Streets

Chicago

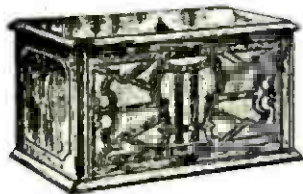
PHILADELPHIA

Pittsburgh

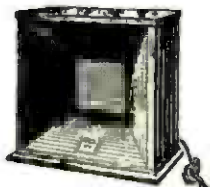
Canadian Factory: Kitchener, Ontario

Model VI, 14" Wood Bell \$30

Model VII, 21" Wood Bell \$35



Model VIII, Mahogany Cabinet with full-floating Wood Bell \$35



Model V, Metal Cabinet, Mahogany Finish, Wood Bell \$18

Music

RADIO

Master

REPRODUCER

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

Summer Care of Batteries

WHETHER you use your radio much or little, test your batteries frequently. Unless the solution is kept just right, batteries may wear out even quicker than when worked constantly. Use a

FREAS BATTERY TESTER

Known everywhere for its absolute precision. Made to U. S. Bureau of Standards specifications. Gauged to 1/5000 of an inch. Easy to read. Airtight joints. Acid-proof container prevents electrolyte damaging clothes or rugs.

Major J. S. Hatcher, U. S. A., well-known radio authority, tells how to care for batteries. Send postcard today.

FRANCIS L. FREAS GLASS WORKS

America's Largest Hydrometer Manufacturers
Conshohocken - Pennsylvania



*Free
Booklet*

Start now!

No other receiving set equals the Superheterodyne during Summer months

THE Superheterodyne alone maintains range and volume through warmest weather. If you start now to build your McLaughlin One-Control you will have real radio satisfaction all summer long. And when autumn comes you will be prepared with a set that is absolutely unequalled.

Full size working blue prints and complete constructional data are furnished in the booklet "Building the McLaughlin One-Control Superheterodyne." Price \$1.00. Get this booklet today and learn all about this amazing circuit. Coast to coast range—yet easier to build and operate than any other set ever designed. If your dealer cannot supply you, order direct from

PRECISE MANUFACTURING CORP.
Rochester, New York

"Take No Chances—Use Como" COMO DUPLEX

The World's Standard Push Pull Transformer



PRICE \$12.50 per pair

For maximum volume without distortion

What Prominent Writers on Radio Subjects say About Como.

Lewis B. Hagerman, Technical Editor, *Chicago Post*: "Actual Tests show this transformer to be far superior to any others of similar makes."

R. J. Robbins, *New York Sun*: "After consideration of several well-known makes of push pull transformers which are available 'COMO DUPLEX' was selected as most satisfactory."

C. White, *Radio World*: "'COMO DUPLEX' is infinitely superior—most other push pull transformers seem to be ordinary transformers with a center tap brought out as a makeshift."

E. P. Gordon, *Open Road*: "A system of audio-amplification which is becoming increasingly popular. Its use . . . will give surprising results in both quality and volume, and is thoroughly recommended by this department."

NEED WE SAY MORE?

COMO APPARATUS COMPANY

Manchester, New Hampshire
For Sale at Leading Dealers

Important Notice

Patent Litigation Pending

*Westinghouse Elec. & Mfg. Co. and
Radio Corporation of America,*
Plaintiffs

VS

Golden-Leutz, Inc. et al
Defendants

Will not stop the sale of the

PLIODYNE "6"
SUPER-PLIODYNE "9"
or PLIO-"6" Receivers

Sales will continue as before on these receivers

GOLDEN-LEUTZ, Inc.
C. R. Leutz, President

GOLDEN-LEUTZ, Inc.

476 BROADWAY

NEW YORK CITY

Speed and Safety with ULTRA HANDY CHARGER

No Acids to Spill
No Bulbs to Break

Charges all storage batteries "A" or "B"
—from 2 to 48 volts. Speedily—5 to 7
amperes per hour to a 6 volt battery.

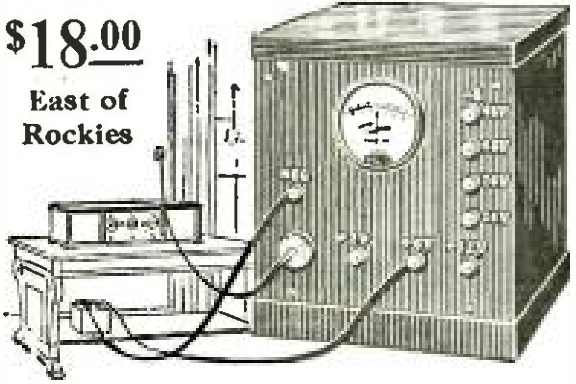
There are no acids to spill in the Ultra
Handy Charger to ruin expensive rugs—
no bulbs to burn out causing annoyance
and inconvenience. The Ultra Handy
Charger will not dirty or harm the home
in any way—there is absolutely no dan-
ger of fire.

REQUIRES NO CARE

No auxiliaries necessary. Simple to use—
connect the sturdy clips to the battery—
plug the cord into a light socket and turn
on the current. No care required when
in or out of use. Will not overcharge your
battery. Send for illustrated folder.

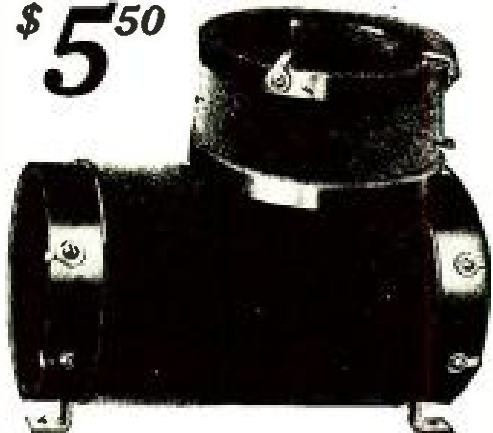
INTERSTATE ELECTRIC Co.
4339 Duncan Ave., St. Louis, Mo.

\$18.00
East of
Rockies



New and Improved

\$5⁵⁰



Authorized Cockaday Coil!

No more loose winding—special new feature holds
coil windings fast. Built throughout of moulded hard
rubber, not affected by atmospheric conditions.
Wound with No. 18 D. S. C. copper wire.
The only coil specified by I. M. Cockaday in his
New Four Circuit Tuner with Resistance Coupled
Amplification because it meets all his specifications.
Described in October POPULAR RADIO as Cockaday
Precision Coil. Hundreds have substituted this
quality coil for those of inferior make and are amazed
at the improved reception, selectivity and general
D-X results.

At your dealers, otherwise send purchase
price and you will be supplied postpaid
In Canada \$7.75. Canadian Distributor, Perkins, Ltd.
Montreal—Toronto—Winnipeg

PRECISION COIL CO., Inc.
209-B Centre St., New York City



THE ONLY PATENTED CABINET SPEAKER

The BEL-CANTO has exceptional volume and a mellow, bril-
liant tone quality. Our secret is a *flexible reed tone chamber*, an
exclusive BEL-CANTO feature. The BEL-CANTO Cabinet

Loud Speaker is a real musical instru-
ment—a truly "beautiful singer."
Workmanship is of the best—solid
wood throughout—beautifully fin-
ished.



Gooseneck Fibre
Horn with Adjust-
able Unit, \$15.00

Bel-Canto

Price only \$17.50



The original Bel-
Canto Fibre Horn
with Adjustable
Unit, \$10.00

Your dealer can get it for you, or we will ship prepaid
on receipt of price

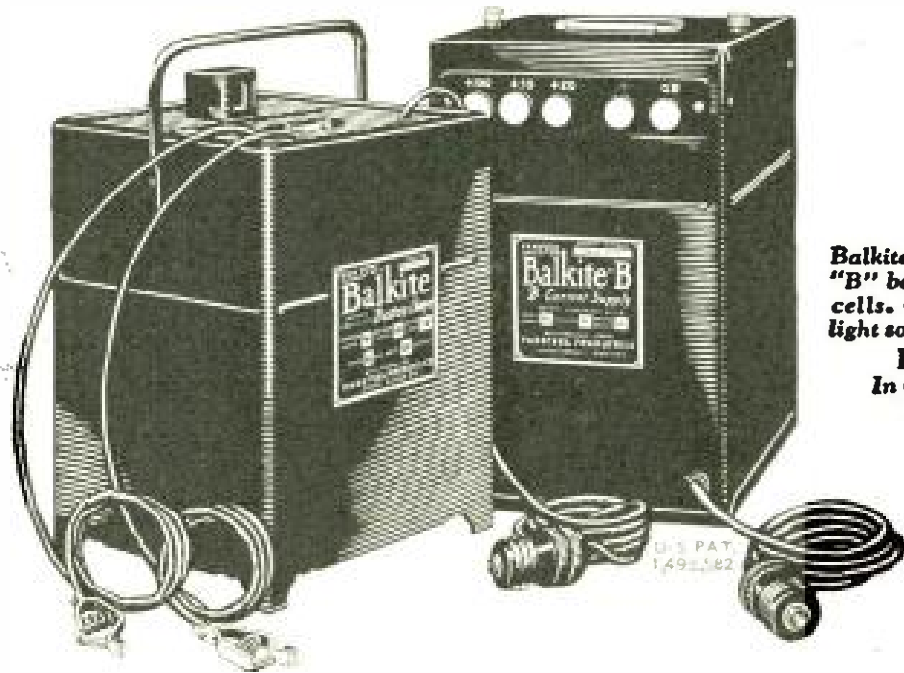
JOBBERS—Write us today about out-of-town territory
West of Rockies—Prices are \$18.00, \$15.50, \$10.50

**BEL-CANTO RADIO AND TELEPHONE EQUIPMENT
CO., Inc.**

872 Broadway, New York

Balkite Battery Charger.
Charges 6 volt "A" storage batteries.

Price \$19.50
West of Rockies \$20
In Canada \$27.50



Balkite "B"—replaces "B" batteries and dry cells. Operates from light socket.

Price \$55
In Canada \$75

A uniform, constant power supply for both "A" and "B" circuits

Here at last is a convenient and unfailing power supply for your radio set. Balkite Radio Power Units furnish constant uniform voltage to both circuits, and will give your radio set greater clarity, power and range. The Balkite Battery Charger keeps your "A" storage battery charged. Balkite "B" replaces "B" batteries entirely and supplies plate current from the light socket.

Based on the same principle, both the Balkite Battery Charger and Balkite "B" are entirely noiseless. They have no bulbs or moving parts, and nothing to break, adjust or get out of order. They have a very low current consumption, are simple and efficient in operation, and can be put in use at any time by merely connecting to a light socket. Both are guaranteed to give satisfaction.

Sold by leading radio dealers everywhere

FAN STEEL
Balkite *Radio Power Units*

BALKITE BATTERY CHARGER — BALKITE "B" PLATE CURRENT SUPPLY

Manufactured by FANSTEEL PRODUCTS COMPANY, Inc., North Chicago, Illinois

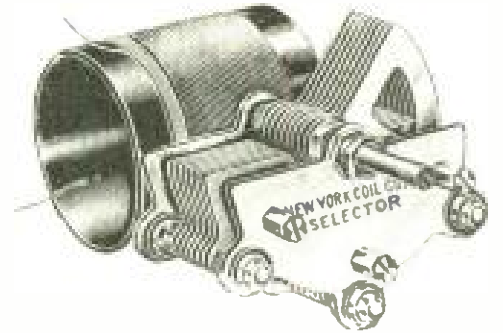
All apparatus advertised in this magazine has been tested and approved by POPULAR RADIO LABORATORY

ATTENTION, SET MANUFACTURERS!!

Our special "Selector" Variable Condenser with self-balanced coils attached is the equipment you have been waiting for—at a price you can afford to pay.

To enable you to successfully manufacture a five-tube, popular-priced radio receiver consisting of two stages of tuned radio frequency, detector and two stages audio, combining selectivity, volume, true tone, distant reception and simplicity.

Our "Selector" Low Loss Grounded Rotor Variable Condenser, "The Manufacturer's Special," answers the demand for a ruggedly constructed efficiency instrument at an exceptionally low price.



Condenser and Transformer as shown, List Price \$3.75
Get manufacturers price and descriptive literature

LIST PRICE: \$2.75 .0005 (23 plate) \$2.50 .00035 (17 plate)



New York Precision Mica Fixed Condensers

Choice of Leading Manufacturers and Radio Engineers

All Capacities

PRICE: 35c to 75c

NEW YORK COIL COMPANY 338 PEARL STREET
New York City, N. Y.

PACIFIC COAST—Marshank Sales Co., 926 Insurance Exchange Building, Los Angeles Calif.,
also San Francisco, Portland.

The Red Stripe
A Radio Guide Line

For your protection, throughout the center of every Dilecto radio panel is a Red Stripe. You can see it along the edge of every panel.

If you buy or build a set Look for the Red Stripe—and you'll be sure of the finest, strongest radio panel that can be made. Dilecto is a Phenolic condensation material.

THE CONTINENTAL FIBRE COMPANY
Factory: Newark, Delaware

Service on Dilecto, Conite, Contex and Vulcanized Fibre from:

New York, 250 Park Ave.	Chicago, Wrigley Bldg.
San Francisco, 75 Fremont St.	Los Angeles, 307 S. Hill St.
Seattle, 1041 Sixth Ave. South	Pittsburgh, Farmers Bank Bldg.

Dilecto

JOS. W. JONES

TRADE MARK



JOS. W. JONES J-85 SET

5-Tube Tuned Radio Frequency Receiver; handsome gold dials and trimmings; Vernier adjustment on condensers. Price, without tubes, batteries, headphones or aerial equipment.....\$85

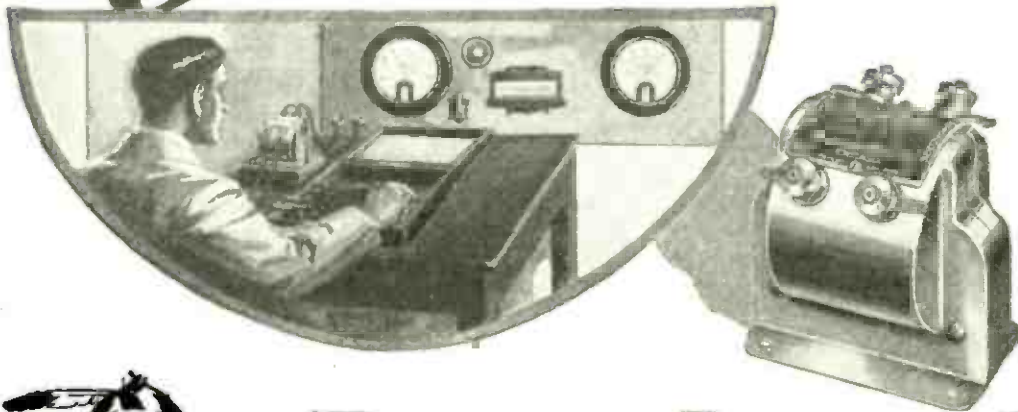
Dependability!

Tune in local or distant stations, loud and clear. No interference. No distortion. That's what it means to own a Jos. W. Jones Receiver.

Built of the Famous Jones Precision Parts
Write NOW for literature and full particulars

Jos. W. Jones Radio Mfg. Co., Inc.
40-46 West 25th St., New York City
Branch Offices: Philadelphia—Boston—Chicago

Vigilance



Leadership

Every All-American transformer has stamped upon it a serial number which identifies the record of its individual test at the factory. The manufacturer stands behind it absolutely provided this serial number is not effaced. Look for the number, and for the famous red guarantee tag with the inspector's punch marks.



MEMBER
RMA

Of what importance is it to you as a user of radio transformers, to know that any particular brand, such as ALL-AMERICAN, has held continuously for a number of years the position of *proven leadership in quantity of sales?*

Simply this: that such an achievement is the best possible proof of *continued satisfaction* given to other ALL-AMERICAN

users. The average purchaser of a transformer chooses, above all, an instrument which has been *recommended* to him by a person whose judgment he respects.

Only by the most thorough accuracy and care in manufacturing, and unusual care in testing, is it possible for ALL-AMERICAN to maintain this position. Let it be your protection!

A new edition of the Radio Key Book, just off the press, illustrates an eight-tube set which is the sensation of the year. Send 10 cents for it now, coin or stamps.

ALL-AMERICAN RADIO CORPORATION, 2686 Coyne St., Chicago
E. N. Rauland, President

ALL-AMERICAN

Largest Selling Transformers in the World

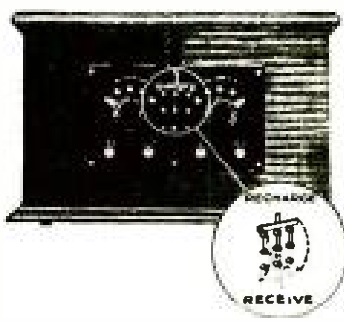


KIC-O
"B" ELIMINATOR
SIMPLICITY
PERMANENT
ALKALINE STORAGE
BATTERY RECEPTION

KIC-O MULTI-POWER UNITS operate from your lighting line and eliminate the replacing of dry cell "B" batteries usually saving their cost in the first six to twelve months of service on Neutrodyne and Super Heterodyne sets.

Its RECHARGER is attached to back.

We have a
 100 volt
Multi-Power
 Unit
 Complete at
\$32.50



To receive simply throw switch down.
 To recharge throw switch up—disconnect no wires—no fuss—no worry.
 Leave it plugged into any 110 volt lamp socket.

PRICES
 Multi-Power Units
 (No Recharger required)

130 volt Type P. U.	\$43.50
100 volt Type P. U.	35.00
100 volt Type C. U.	32.50

BATTERIES

P. Z. indicates panel type with switches.
 C. Z. is plain type without switches.

Voltage	Type PZ	Type CZ
130	\$36.00	\$33.00
100	27.50	24.50
70	21.50	18.50
45	16.00	14.50
22½	—	7.50

CHARGERS

Type K-1 Single Unmounted.....	\$1.50
Type K-2 Single Mounted.....	3.50
Type K-3 Multi-Polar Mounted.....	5.00
KIC-O Special Charger Chemicals (One Cell).....	.50

Dealers! Everybody!
 Write for complete details

Kimley Electric Company, Inc.
 2667 Main Street. Buffalo, N. Y.

"WINDHAM" WIRE FORMER

(Patent Pending)








A complete and handy tool for electricians, radio set builders and mechanics. It will accurately form loops or eyes for No. 4, 6, 8 and 10 screws, make easy radius and sharp right angle bends, has flat jaws and wire cutters. This tool is made of the best quality steel, dropped forged and carefully tempered in oil.

Price \$1.25 Each

Manufactured by
THE GOYER COMPANY
 Willimantic Connecticut

How about your Jobber ?

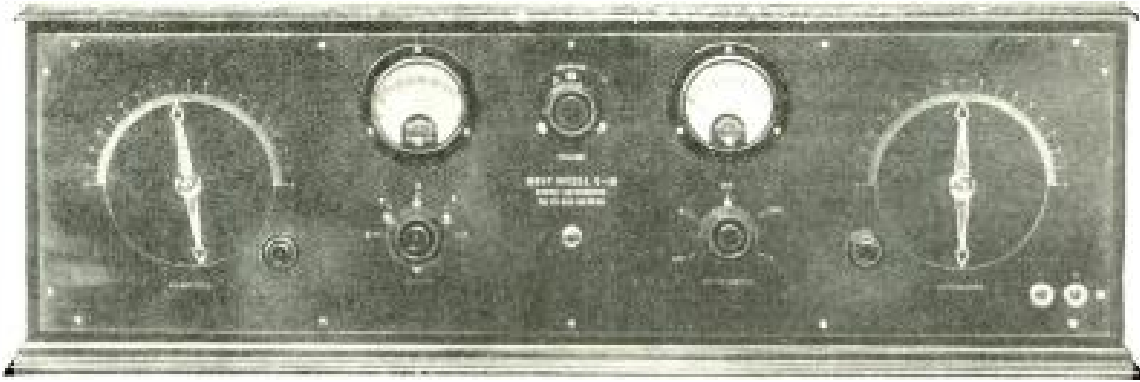
- Does he wholesale exclusively ? 
- Does he refer all customers inquiries to his dealers ? 
- Does he carry reputable apparatus that is nationally advertised and in demand ? 
- Does he carry ample stock to insure prompt delivery ? 
- Does he sell all his stock to dealers - even when material is scarce ? 

Hommel does ! 

Write for Hommels' Encyclopedia of Radio Apparatus No. 266-P

LUDWIG HOMMEL & CO
 629 PENN AVENUE PITTSBURGH, PA.

The New NAVY MODEL C-10 SUPER-HETERODYNE



Only 2 Main Tuning Adjustments for 10 Tubes
Panel Size Only 28 3/16" x 8"

A POWERFUL 10 TUBE BROADCAST RECEIVER

Total Amplification 1,500,000 Times
Wave Length Range 50 to 600 Meters

We believe this new design by Charles R. Leutz has a range and degree of selectivity far in advance of any receiver, and represents final superiority over any receiver, now being manufactured, or even contemplated, for broadcast reception.

Descriptive Literature Mailed on Request

A Patent Suit between the Westinghouse Electric & Manufacturing Co. and Radio Corporation of America vs. Experimenters Information Service, Inc., is now in progress. Regardless of the outcome, our Blue Print designs of the Models C-7 and C-10 will still be sold.

Experimenters Information Service, Inc.

476 Broadway

New York City, N. Y.

*Designers of the Highest
Class Radio Apparatus
in the World*

**Experimenters
Information Service, Inc.
476 Broadway, New York, N. Y.**

Please forward literature on the New
Navy Model C-10. No charge.

Name.....

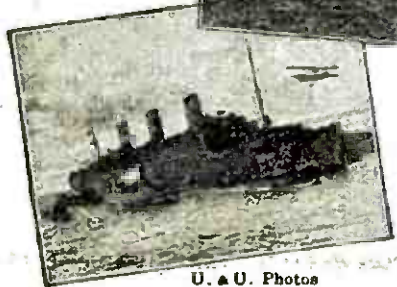
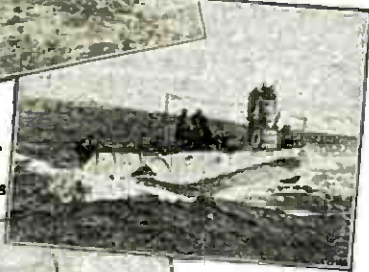
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The Adventures of BURGESS RADIO BATTERIES



The World Flyers
Carried Burgess

Standard Equip-
ment of United
States Submarines



They're in the
Wireless Room
of the Leviathan

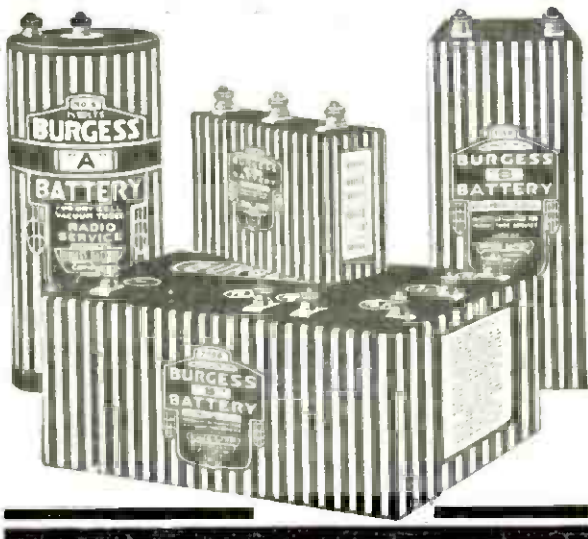
U. & U. Photos

Remarkable are the adventures of Burgess Radio Batteries. And where there's danger—upon, above, or below the earth, sky and sea, will be found Burgess Batteries—laboratory products.

"Ask Any Radio Engineer"

BURGESS BATTERY COMPANY
Engineers DRY BATTERIES Manufacturers
Flashlight - Radio - Ignition - Telephone
General Sales Office: Harris Trust Bldg., Chicago
Laboratories and Works: Madison, Wisc.

In Canada: Niagara Falls and Winnipeg



Another Achievement!



\$5.00 per set

Precision R. F. Coupling Unit

May be used as a transformer for coupling two tubes in a circuit as a radio frequency amplifier. Designed for present broadcast range in conjunction with a standard .0005 mfd. variable condenser. The coupler consists of a compact primary winding to be connected to plate circuit of one tube and a split secondary winding, half on each side of the primary, to be shunted with the tuning condenser and connected in grid circuit of following tube.

The design is such that an amplifier built with this apparatus makes possible extremely sharp tuning with maximum signal strength and stability of operation.

Made by the makers of the famous Cockaday Coil.

At your dealers, otherwise send purchase price, and you will be supplied postpaid

Precision Coil Company, Inc.
209-B Centre St., New York City



The New "35-D" Super Radio Cabinet

Panel at top 7 x 26". Depth 10 1/2". Filler strips for panel 7 x 18, 7 x 21 or 7 x 24. Built-in spruce horn back of silk lined grille. Horn fits all standard units. Two compartments each side of horn, ample for complete dry cell set. Door in back. Built of genuine select mahogany—latest lacquer hand rubbed piano finish. Equipment includes extra 1/2" mounting board, full continuous piano hinge, two folding lid supports and rubber feet under bottom. Write for illustrated price list.

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BLANDIN PHONOGRAPH COMPANY, INC.
1500 16th ST. :: :: RACINE, WIS.

Thorola

LOW-LOSS DOUGHNUT COILS



The true basis of Selectivity, Clarity, Power

Most present radio receivers can now be made far more selective.

Exact response to tuning controls is now possible in most sets which have given only broadest reception.

"Pick-up" and scrambling of signals can now be avoided, along with intercoupling and power losses. Clarity and volume can now be amazingly increased, particularly on distant stations.

All this is done simply and quickly by going to the source of these difficulties with Thorola engineers. They sought and found the seat of most radio troubles. They cured them with Thorola Low-Loss Doughnut Coils.

This creation of Thorola laboratories so far betters radio as to rank with the vacuum tube itself as a radio fundamental.

You know what it means to have coils with the correct ratio of resistance to inductance. You will realize the advantage of the self-



contained field which gives *Isolated Power* in Thorola Low-Loss Doughnut Coils. You will at last be able to operate with just one aerial!

The meaning of these exclusive Thorola Low-Loss Doughnut effects is fully described in Thorola literature now ready. It details the one simple step that will jump most radio sets far ahead of any previous performance. It brings you diagrams of new circuits which take full advantage of the new properties of Thorola Low-Loss Doughnut Coils. See the Thorola dealer or send the coupon.

REICHMANN CO.

1725-39 W. 74th St., Chicago

Please send me complete description of your new discovery, Thorola Low-Loss Doughnut Coils, together with circuit diagrams illustrating the most effective use of these coils.

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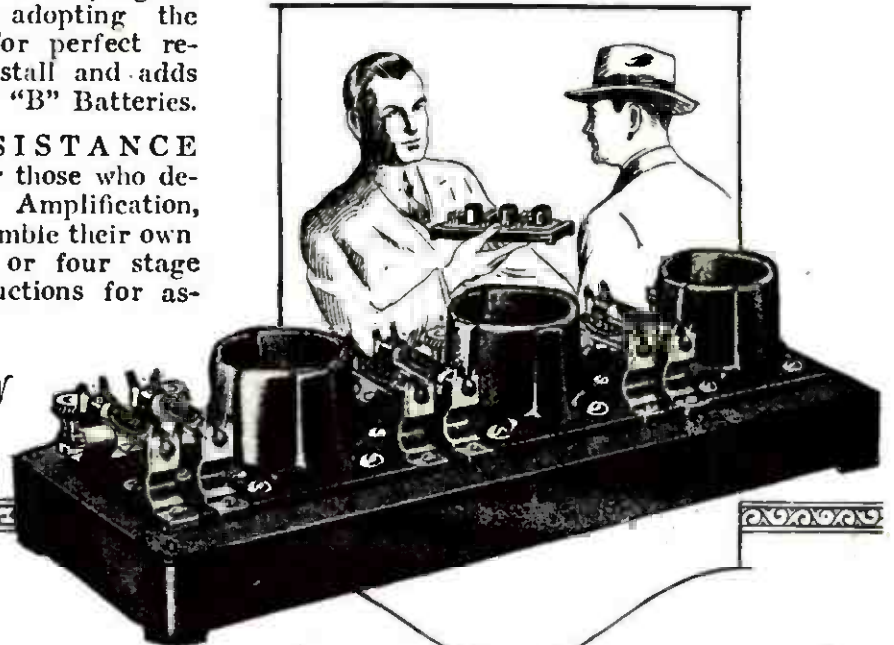
The DAVEN SUPER AMPLIFIER

A 3-stage RESISTANCE COUPLED UNIT which gives you that perfect tone-quality you are seeking. It is already wired and may be made a part of your set with a minimum of assembly labor. The merits of this modern form of amplification is so appreciated that progressive set builders are adopting the SUPER AMPLIFIER for perfect results. It costs less to install and adds greatly to the life of your "B" Batteries.

The DAVEN RESISTANCE COUPLED KITS are for those who desire Resistance Coupled Amplification, but who would rather assemble their own amplifier. Sold in three or four stage kits with complete instructions for assembly.

Obtain from your Dealer the "RESISTOR MANUAL," our complete handbook on Resistance Coupled Amplification. Price 25c. Postpaid 35c.

The Line of Merit
DAVEN RADIO CORPORATION
Resistor Specialist
 NEWARK, N. J.



Solid Rubber Case

You Save 50%

World 6-Volt Storage Batteries are famous for their guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 50% and get a

2-Year Guarantee Bond In Writing
 World Battery owners "tell their friends." That's our best proof of performance. Send your order in today.

RADIO BATTERIES	
6-Volt, 100-Amperes	\$12.25
6-Volt, 120-Amperes	14.25
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AUTO BATTERIES	
6-Volt, 11-Plate	\$12.25
6-Volt, 13-Plate	14.25
12-Volt, 7-Plate	17.00

SEND NO MONEY
 Just state battery wanted and we will ship day order is received, by Express C. O. D., subject to your examination on arrival.
Extra Offer: 5% discount for cash in full with order. Buy now and get a guaranteed battery at 50% saving to you.

WORLD BATTERY COMPANY
 1219 S. Wabash Ave., Dept. 3 Chicago, Ill.

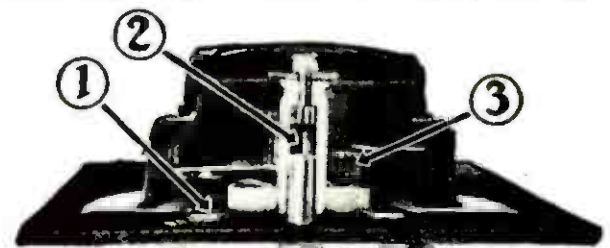


Approved and Listed as Standard by Leading Authorities

including Radio News Laboratories, Popular Science Institute of Standards, Popular Radio Laboratories, Radio Broadcast Laboratories and Lefax, Inc.

Solid Rubber Container

Now Standard equipment on all World Storage Batteries. No more leakage or breakage of jars or rotting of box.



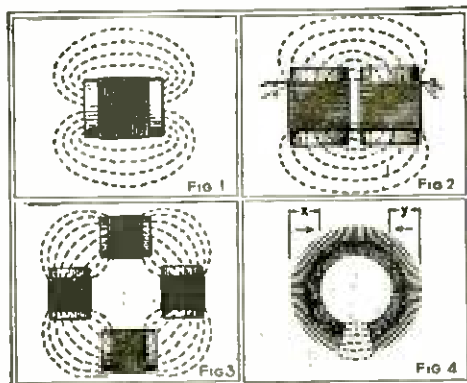
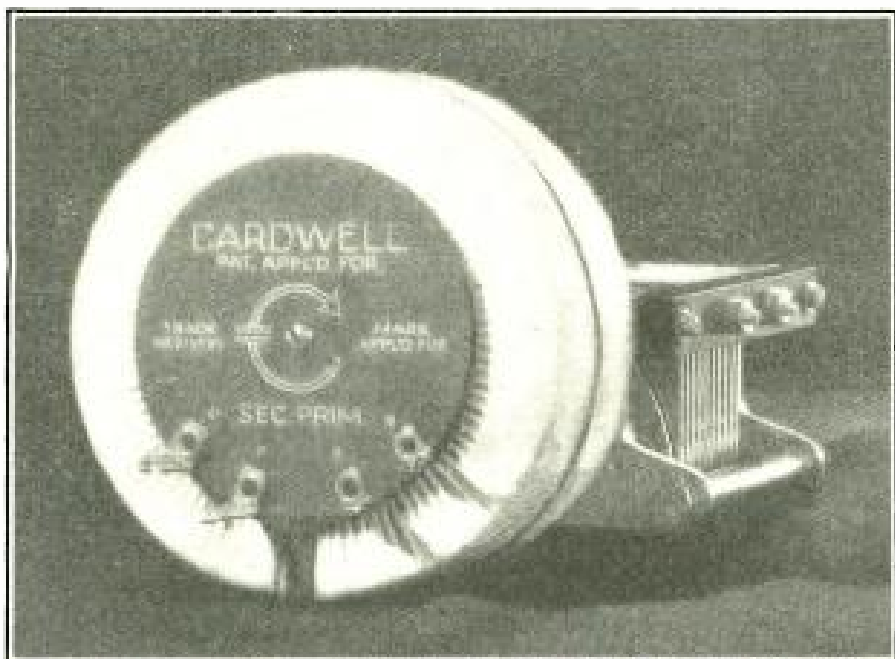
Geared 80 to 1



Another important development in ACCURATUNE construction—the use of a full brass gear train, built exceptionally rugged and designed for Accurate Tuning. Absolutely "essential for sensitive sets."
 1. Friction Clutch. 2. Long Center Bushing. 3. New Gear Mesh.
 At your dealers, otherwise send price (\$3.50) and you will be supplied postpaid.

Mydar Radio Company, 9-B Campbell St., Newark, N. Y.

ACCURATUNE
 REGISTERED GEARED 80/1 U.S. PAT. OFF.
 MICROMETER CONTROLS



General Theory of the Toro-Tran

Figure 1 shows how the field of the ordinary coil extends into space and increases losses due to stray field. Figure 2 shows a "double series" winding, which restricts the field somewhat. Figure 3 shows a "four series" winding and the field almost enclosed. In Figure 4 (the Toro-Tran) the field is entirely enclosed and the losses due to stray fields are eliminated. Note that a stray signal passing through the coil at "X"—not introduced from the aerial or the tube—is balanced out at "Y" by the reversed polarity of the winding. This rejects undesirable signals, while the concentrated internal field builds up the tuned signal. Hence maximum distance and selectivity.

—and now the TORO-TRAN!

CARDWELL, whose pioneer "low-loss" condenser established new standards of radio efficiency, is now introducing the Toro-Tran*—the ideal *balanced* coupling inductance for all radio frequency work.

*TRADE MARK
Registry applied for

The Toro-Tran eliminates signal energy picked up by ordinary coils from nearby stations. It eliminates magnetic feed-back in multi-stage radio frequency circuits, thus removing the most active factor in causing howling and distortion, and thereby increasing selectivity and distance. It rejects almost entirely the interference effects caused by electrical power

machinery, elevators, door-bells, arc stations, etc. The Toro-Tran winding confines the field to the inside of the coil, a small area, and thus avoids one of the greatest causes of loss known to radio receivers—that of stray magnetic fields, which result in the absorption of signal energy and reduce the efficiency of the receiver tremendously.

Note these unusual advantages in assembly and operation

1. Compactness. The coils do not require spacing or angular mounting. They occupy less space than your condensers.
2. Permit exact nullification for tube and stray capacity without guesswork or tedious testing.
3. Closed magnetic field eliminates magnetic feed-back in tuned radio frequency amplifiers.
4. Low distributed capacity, due to air spacing of each winding and to low voltage-drop per turn of small diameter wire.
5. Maximum coupling and high ratio of voltage increase due to concentrated field with zero leakage.
6. Absence of all supporting insulation in the field of the coil. This is one of

the greatest loss factors in the ordinary circuit and is not remedied by "skeleton" or so-called "low-loss" windings.

7. Ease of neutralizing oscillation due to tube capacity by means of rotating control, which anyone can "balance."

8. Low capacity between primary and secondary, affording maximum transfer of energy to succeeding grid circuit.

The Toro-Tran has a lower "circuit resistance" (i.e., effective resistance as assembled in a set and not as isolated in the laboratory for theoretical measurements) than any inter-stage tuned transformer made and has a correspondingly higher amplification factor, its ratio exceeding ten.

To appreciate the many remarkable advantages of the Toro-Tran, write for our two free booklets: "The Torodyne Circuit" and "The Most Interesting Radio Frequency Transformer Ever Invented."

Toro-Trans are ready to mount in any tuned radio frequency circuit. Replace your ordinary coils

with Toro-Trans. You will be astonished with the results. Most .00035 mfd. variable condensers will tune them, but by using Cardwell Condensers you get maximum efficiency.

Order from your dealer or direct

CARDWELL TORO-TRAN WITH BALANCING POTENTIODON	
Cardwell .00035 Condenser for tuning	\$ 4.00
Cardwell .00035 Vernier Condenser	4.75
Cardwell .00035 Dual Condenser (two-in-one)	8.00
Cardwell .00035 Triple Condenser (three-in-one)	12.00
Cardwell Audio-Tran (compound audio transformers)	10.00

The Allen D. Cardwell Manufacturing Corp.
81 Prospect Street, Brooklyn, N. Y.



**EARN
\$50 to \$200
A WEEK!**

Become a Radio Expert

This is the time to get into Radio—the new fast growing uncrowded profession. Stop working long hours for small pay at work that is drudgery. Men from all walks of life are taking advantage of the big opportunities now open in this wonderful new industry. Salaries of \$100 a week—and more—not at all uncommon!

Learn At Home

You can train for this "big money" field right in your own home—in spare time. You need know nothing about Radio or even electricity—the National Radio Institute—the largest and oldest home study Radio school in the world, established 1914—can quickly make you an expert through a marvelous method of practical instruction—which includes all the material for building the latest Radio apparatus.

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Almost every day we get urgent calls for our graduates. The big jobs hunt you when you are a Radio Expert. Radio offers you more money than you ever dreamed possible—a chance to travel or to take any one of the many Radio positions all around you at home. And Radio offers you a glorious future!

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Write today for free book "Rich Rewards in Radio." Tells all about this great new money-making field—and describes our amazing practical method which gets you the *bigger* paying jobs in Radio. No obligation mail postcard NOW. **National**

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I am interested in Radio as a profession. Send me, free and without obligation, your interesting book, "Rich Rewards in Radio," all information about your spare time, home-study plan and free employment service. Also, the details of your Special Offer.

Name.....Age.....

Street.....

City.....State.....

with the \$100 Guarantee



Absolutely warranted to protect your set from lightning, with a guarantee to pay you \$100 or repair your set, should it be damaged through any fault of the

FIL-KO-ARRESTER.

Listed as standard under the re-examination service of National Board of Fire Underwriters.

If your dealer has none, send his name with remittance to Dept. PR-685

**DX Instrument Co.
Harrisburg, Pa.**



SIMPLEX

Efficient devices bearing this name have made it one of the best known in radio. For instance—

Simplex SR-5 Receiver—a distance getter of full volume and clear tone.

Simplex 180° DX Tuner—much sharper than 90° coils. Spiral wound molded rotor.

Simplex 180° Variocoupler—especially well adapted to radio frequency circuits.

It's Lightning Arrester Time



\$1.50

The Simplex gives complete safety. Air gap sealed in glazed porcelain housing. Weather proof. Approved by National Board of Underwriters.

*At your
Dealer's*

**SIMPLEX RADIO CO., Mfrs.
1013-15 Ridge Ave., Philadelphia, Pa.**

"IT'S A Standardyne DEAR! NOW WE'LL GET EVERYTHING!"

Every day more and more people are coming to know that the purchase of a **Standardyne** Receiver means an end to their radio difficulties.

Dependable always, both **Standardyne** models assure their owners of **Selectivity, Clarity, Volume** and **Distance Reception** which brings a thrill of pride to their users.

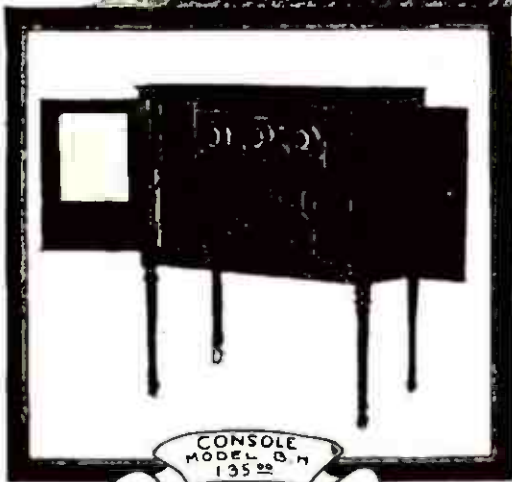


WITHOUT ACCESSORIES

Model B-5

The famous Biltmore Hotel, New York, has installed Console Model B-H in all guest suites.

Buy a 5-tube Tuned Radio Frequency **Standardyne** from your dealer or write us direct.



CONSOLE MODEL B-H 135.00

WITHOUT ACCESSORIES MANUFACTURED BY

The **Standard Radio Corporation** -
41 Jackson Street
Worcester Mass
U.S.A.

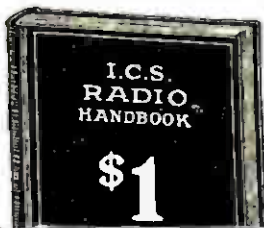


CANNON-BALL \$3.50

YOU want to hear voices that sound clear and natural, and music pure in tone and quality. For over eight years, Cannon and Miller have been producing quality headsets, used and approved by thousands of radio enthusiasts. Why not treat your ears to real radio reception with a Camco Cannon-Ball Headset at \$3.50, or a Camco Grand at \$4.75. Compare them at your dealer's. Choose the one you like best. Folder, "Radio As You Like It," gladly mailed on request.

CANNON & MILLER CO., Inc., SPRINGWATER, N. Y.

RADIO HANDBOOK



Only \$1

514 PAGES

Just off the press! The greatest book on Radio ever written. Price only \$1. Filled with sound, practical, tested information for every radio fan, from beginner to hard-boiled owl. Written, compiled, and edited by men of national reputation. Every page tells you something useful—and there are 514 pages. Mail \$1 to-day and get this I. C. S. Radio Handbook before you spend another cent on parts.

Money back if not satisfied

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I enclose One Dollar. Please send me—post-paid—the 514-page I. C. S. Radio Handbook. It is understood that if I am not entirely satisfied I may return this book within five days and you will refund my money.

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Check here and enclose \$1.50 if you wish the deluxe edition, bound in Leatheroid.

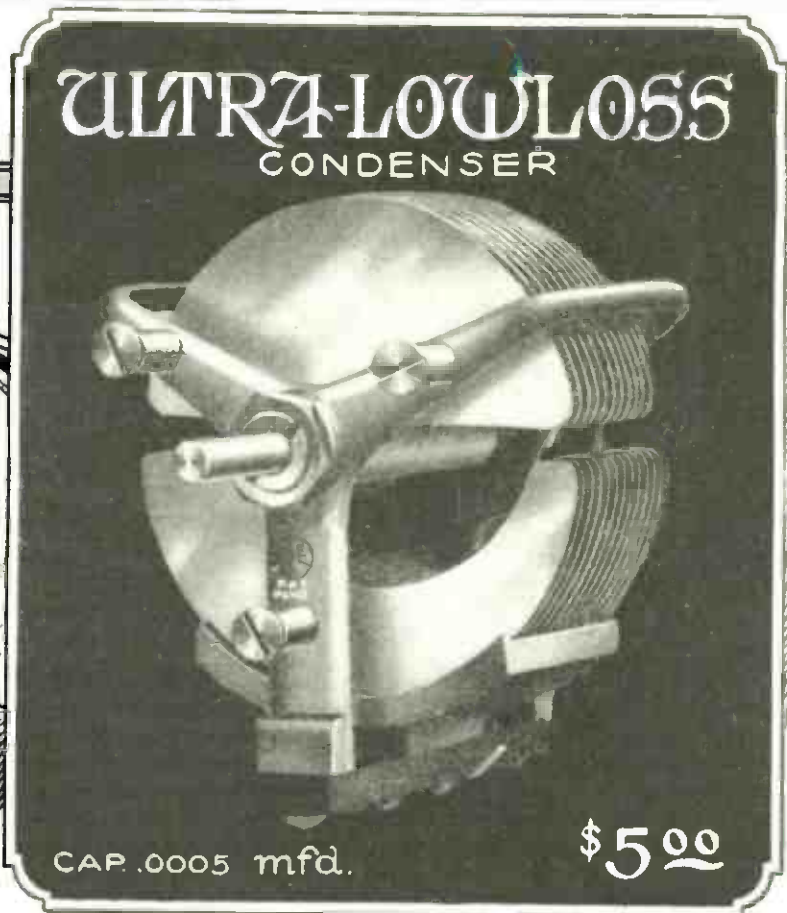
Actual Performance Is the real test Of any Condenser.

Judged On this basis The RATHBUN Is the equal Of any — and At any price.

There is No Better Value.

RATHBUN MANUFACTURING CO., Inc.
Jamestown New York





As positive as Big Ben

SET Big Ben at seven and at seven o'clock you're bound to get the alarm.

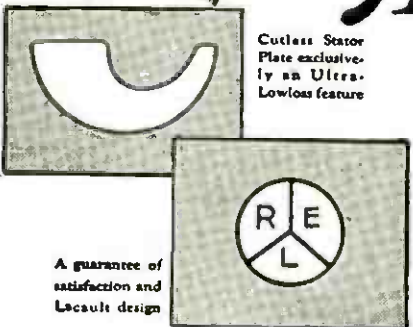
Just so, the Ultra-Lowloss condenser can be set at any wavelength—the corresponding station will come in clear and sharp. You know instantly where to turn, once a station of known wavelength is located. Makes tuning easy—direct—positive. Special Cutlass Stator Plates spread wavelengths evenly over a 100 degree scale dial so that each degree represents approximately $3\frac{1}{2}$ meters.

Ultra-Lowloss condensers are designed by R. E. Lacault, originator of the famous Ultradyne Receivers, and built upon scientific principles which overcome losses usually experienced in other condensers.

At your dealers, otherwise send purchase price and you will be supplied postpaid.

Design of lowloss coils furnished free with each condenser for amateur and broadcast wavelengths showing which will function most efficiently with the condenser.

To Manufacturers Who Wish to Improve Their Sets
Mr. Lacault will gladly consult with any manufacturer regarding the application of this condenser to his circuit for obtaining best possible efficiency.



Cutlass Stator Plate exclusively an Ultra-Lowloss feature

A guarantee of satisfaction and Lacault design



ULTRA-VERNIER TUNING CONTROL

Simplifies radio tuning. Pencil-record a station on the dial—thereafter, simply turn the finder to your pencil mark to get that station instantly. Easy—quick to mount. Eliminates fumbling, guessing. Furnished clockwise or anti-clockwise in gold or silver finish. Gear ratio 20 to 1.

Silver \$2.50 Gold \$3.50

ULTRA-LOWLOSS CONDENSER

PHENIX RADIO CORPORATION



116 East 25th Street



New York

Keep radio tubes like NEW!

JEFFERSON TUBE REJUVENATOR

doubles and trebles tube life

OWNERS of radio sets long have hoped for such a device as this — a "tube rejuvenator" for home use to keep radio tubes at full efficiency and greatly increase their length of life.

Weak tubes mar radio reception just as much as weak batteries. Keep your radio tubes like new with the Jefferson Tube Rejuvenator! Get from your radio the one thing you paid for — satisfactory reception at all times.

All radio tubes deteriorate with use; the Jefferson Tube Rejuvenator "brings them back" in 10 minutes! Attach it to a convenient electric light socket. Used once a month, it adds months, even years, to the life of every tube.

Improves Summer Reception

You cannot expect satisfactory warm-weather reception with "run-down" tubes. During spring and summer you will appreciate the Jefferson Tube Rejuvenator most of all. Get yours now.

At its small cost of \$7.50 the Jefferson Tube Rejuvenator soon pays for itself many times over in its saving of tubes and batteries. It's wasteful to be without one; it's economy to own one. Sold by leading dealers in radio supplies, and fully guaranteed. See it today.

If your dealer can't supply you, send \$7.50 to

JEFFERSON ELECTRIC MFG. CO.
501 South Green Street, Chicago, Ill.

Makers of Jefferson Radio, Bell Ringing and Toy Transformers; Jefferson Spark Coils for Automobile, Stationary and Marine Engines; Jefferson Oil Burner Ignition Coils and Transformers.

For
Home
Use



Patent Pending

\$7.50
\$10 in Canada



Takes Large or Small
Tubes—201-A, 301-A,
UV-199, C-299

the Tube that Eliminates "A" Batteries from Radio

Natural Tone Quality

A new *naturalness* is distinctly defined in McCULLOUGH A-C TUBE reception, the signal being *full and clear* in volume and *naturally true* in tone.

Constant Signal Strength

The assurance of *constant signal strength* in the operation of the set.

No "dying-off" of signal, as when "A" batteries are used and the battery strength diminishes.

No "sputtering" and "spitting," as after the re-charging of "A" batteries.

No matter what the frequency may be—25 to 60 cycles—it does not alter the operation of the McCULLOUGH A-C TUBE.

Simplified Tuning

No *rheostats* are required in sets in which McCULLOUGH A-C TUBES are used as no adjustment of the McCULLOUGH equal potential cathode is necessary.

Insignificant Expense of Operation

Its cost of operation is negligible—about two-tenths of a cent per hour on the basis of a 5-tube set. Current consumption, about the same as one 30-watt lamp.

List Price \$6

Radio Nuisances Eliminated—

Handling of "A" Batteries

Re-charging of "A" Batteries

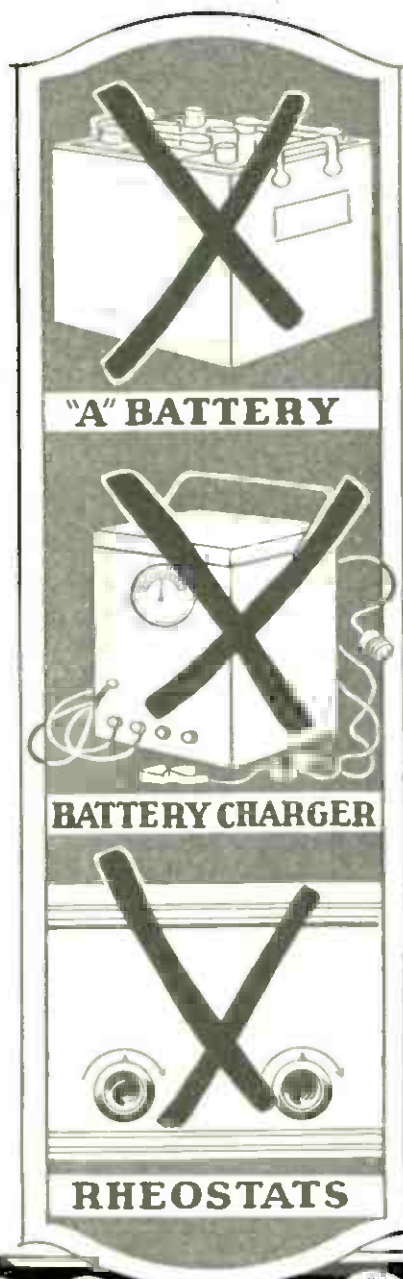
Loss of Signal Strength From Run Down "A" Batteries

Rheostat Tuning

Burning Out of Filaments

Microphonics

Filament Distortion



The McCULLOUGH A-C

RADIO TUBE



No Alternating Current Hum

A tube operating on alternating current with an absolute elimination of alternating current hum.

No "A" Batteries

It eliminates the "A" batteries:
*No "A" Batteries to buy—
 No "A" Batteries to run down—
 No "A" Batteries to recharge.
 No expense of battery-chargers.*

Longer Tube Life

It is the tube of longer life—no filament to burn out—ruggedly constructed—an assurance of at least *twice the life of the ordinary radio tube.*

Increased Signal Strength

It gives *much greater signal strength* as compared with the ordinary tube maintaining *clarity and tone quality* even with the exceptionally loud signals.

Greater Electron Emission

The McCULLOUGH A-C TUBE has *greater electron emission* and resultant lower impedance. As signal strength depends on efficiency of electron emission, the large emitting area of the McCULLOUGH A-C TUBE makes for notably greater strength of signal. This low impedance is due to the McCULLOUGH *equal potential cathode*—the cathode being used instead of a filament, as in ordinary tubes.



McCullough Sales Company

Distributors McCullough A-C Tubes

963 Liberty Avenue

Pittsburgh, Pa.

The Superspeaker

THROUGH the ether there will come to you sometime a Voice.

A Voice of Friendship—
A Voice of Romance.

Be ready with a Jewett Superspeaker to catch every revealing inflection of living, breathing, human Personality!

The Superspeaker horn is non-metallic, and is therefore absolutely free from discordant harmonic vibrations.

"THERE IS NO SUBSTITUTE
FOR THE BEST"



JEWETT RADIO & PHONOGRAPH COMPANY
5668 TELEGRAPH ROAD PONTIAC, MICHIGAN

Factories: Allegan, Michigan—Detroit, Michigan—Pontiac, Michigan

Canadian Sales Offices: Walkerville, Ontario

Export Sales Offices: 116 Broad Street, New York City

The Jewett Superspeaker—All that the name implies. Recommended by experts everywhere. Price \$30.00.

The Jewett Vemco Unit—Makes a loud speaker out of your phonograph. The Reproducer used in the Superspeaker. Price \$12.00.

The Jewett Micro-Dial—Makes tuning 50 times as accurate. Fits any set. Needs only a screwdriver to install. Price \$3.50.

The Jewett Parkay Cabinet—With parquetry top. Puts the amateur on a par with the most exclusive cabinet worker. All sizes, prices to correspond.

The Jewett Superspeaker Highboy—Houses Radio set and all batteries. Superspeaker built in. Takes Radio into the realm of fine furniture. Price \$130.00.

Jewett Quality Products

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

Eighty New Wave Allocations

REALLOCATIONS of radio wavelengths to broadcasting stations were announced recently by the Department of Commerce. The stations given allocations are those listed by the department as "B" grade, with modern mechanism, high power and stocks of spare parts which will reduce interruption of service.

WAVE-LENGTH	CALL LETTERS	LOCATION
379.5	WHAZ	Troy, N. Y.
384.4	WMBF	Miami Beach, Fla.
389.4	WTAM	Cleveland, Ohio
389.4	WEAR	Cleveland, Ohio
394.5	WFI	Philadelphia, Pa.
394.5	WDAR	Philadelphia, Pa.
394.5	WOAI	San Antonio, Tex.
399.8	WHAS	Louisville, Ky.
405.2	WOR	Newark, N. J.
405.2	WJY	New York, N. Y.
416.4	WCCO	Minneapolis, Minn.
422.3	WLW	Cincinnati, O.



Kadel & Herbert

THE LARGEST RECTIFIER EVER BUILT

The rectifying tube shown above was constructed by the Marconi Wireless Telegraph Company of Great Britain for changing alternating currents to direct currents that are used in the plate circuits of radio transmitters. This tube, which is designed to operate on voltages up to 150,000, is only twenty-two inches high and weighs about three pounds. It can also be used as a testing device in X-Ray and cable work.

WAVE-LENGTH	CALL LETTERS	LOCATION
422.3	WMH	Cincinnati, O.
428.3	WSB	Atlanta, Ga.
434.5	NAA	Arlington, Va.
440.9	WDWF	Cranston, R. I.
440.9	WOS	Jefferson City, Mo.
447.5	WQJ	Chicago, Ill.
447.5	WMAQ	Chicago, Ill.
454.3	WJZ	New York, N. Y.
461.3	WCAE	Pittsburgh, Pa.
468.5	WCAP	Washington, D. C.
468.5	WRC	Washington, D. C.
475.9	WEEI	Boston, Mass.
475.9	WBAP	Ft. Worth, Tex.
475.9	WFAA	Dallas, Tex.
483.6	WHAA	Iowa City, Ia.
483.6	WOC	Davenport, Ia.
491.5	WEAF	New York, N. Y.
499.7	WMC	Memphis, Tenn.
508.2	WOO	Philadelphia, Pa.
508.2	WIP	Philadelphia, Pa.
516.9	WCXH	Detroit, Mich.
526.0	WNYC	New York, N. Y.
526.0	WHO	Des Moines, Ia.
526.0	WOAW	Omaha, Neb.
535.4	KYW	Chicago, Ill.
535.4	WHA	Madison, Wis.
545.1	KSD	St. Louis, Mo.
545.1	KFUO	St. Louis, Mo.
280.2	WNAC	Boston, Mass.
282.8	WOAN	Lawrenceburg, Tenn.
285.5	WREO	Lansing, Mich.
285.5	WEMC	Berrien Springs, Mich.
285.5	WKAR	East Lansing, Mich.
288.3	KFKX	Hastings, Neb.
293.9	WEAO	Columbus, O.
293.9	WBAV	Columbus, O.
296.9	KFRU	Bristow, Okla.
299.8	WPG	Atlantic City, N. J.
302.8	WTAS	Elgin, Ill.
302.8	WJJD	Mooseheart, Ill.
305.9	WJAR	Providence, R. I.
309.1	KDKA	East Pittsburgh, Pa.
315.6	WAHG	New York, N. Y.
315.6	WGBS	New York, N. Y.
315.6	KFDM	Beaumont, Tex.
319.0	WGR	Buffalo, N. Y.
322.4	KOA	Denver, Colo.
325.9	WMH	Cincinnati, O.
325.9	WSAI	Cincinnati, O.
333.1	WBZ	Springfield, Mass.
336.9	WSAC	Clemson College, S. C.
336.9	KFM	Northfield, Minn.
336.9	WCAL	Northfield, Minn.
340.7	WKAQ	San Juan, Porto Rico
340.7	KSAC	Manhattan, Kan.
344.6	WLS	Chicago, Ill.
344.6	WCBD	Zion, Ill.
348.6	KOB	State College, N. M.
348.6	WTIC	Hartford, Conn.
352.7	WWJ	Detroit, Mich.
352.7	WJAD	Waco, Tex.
361.2	WHN	New York, N. Y.
365.6	WHB	Kansas City, Mo.
365.6	WDAF	Kansas City, Mo.
370.2	WEBH	Chicago, Ill.
370.2	WGN	Chicago, Ill.
374.8	KTHS	Hot Springs, Ark.
379.5	WGY	Schenectady, N. Y.



F. M. Delano

A RADIO STATION 8,500 FEET ABOVE THE SEA

One of the highest broadcasting stations in the world is situated in the French Pyrenées alongside the observatory shown in the picture. Weather forecasts and other information that are obtained at the observatory are broadcast from this station for the benefit of the government bureaus and the French farmers.

The New "Radio Rash"

A PECULIAR skin eruption is the newest disease to puzzle medical circles in Vienna. It is caused by hard rubber receiver cases pressing against the ear for long periods of time. Dr. Marcus of Vienna, who discusses the disease in the *Clinical Review*, recommends the use of soft rubber ear muffs fitted over receivers to prevent the irritation.

* * *

Religious Superstitions Hurt Radio

ALTHOUGH the ban on receiving sets in Morocco has been lifted, the natives take no interest in their use. Only Europeans who are resident there hail the new ruling. Religious conservatism is a large factor which has impeded the advance of radio in the Orient even among the wealthier non-Christians.

* * *

How Radio Served in the Alaska Epidemic

THE Nome radio station worked twenty-four hours a day for the first time in its history

during the diphtheria epidemic that raged there recently. Great dependence had to be placed upon radio communication from Nome on account of weather conditions that interfered with other means of transmitting intelligence—but which did not affect radio stations.

* * *

Germans Hear American Programs

GERMAN radio fans for the first time are listening in on American stations. The powerful Stuttgart receiving center transmits music played at Pittsburgh, Pa. by an automatic amplifying process to individual receivers throughout the whole of the German Republic. Even the weakest German apparatus now is able to hear American broadcasting.

* * *

Radio Artists Organize

THE radio artists of America have banded together "for the purpose of putting radio on a paying basis." The new organization is known as the Radio Artists Association of America and is national in scope, with temporary headquarters in New York.

Navy Forms a Radio Reserve

THE Naval Communication Service has enrolled six thousand qualified radio operators in its Reserve Force as a result of a recent campaign. In the Chicago district alone about 2,100 men have signed up. All of them are radio operators, although many have not attained the speed requisite for classification as naval radiomen. The Director of Naval Communication will undertake the instruction of all the recruits, who are not expected to drill or cruise but who may upon application, if the radio quotas are not filled.

* * *

German Composers Demand Broadcasting Royalties

GERHART HAUPTMANN, Germany's most famous writer, and Hugo von Hoffmannsthal, renowned as the librettist of Richard Strauss's operas, are at loggerheads with the radio concerns which broadcast their writings. Hauptmann has entered objection to broadcasting of his words by radio concerns at Leipsic and Munster, while von Hoffmannsthal demands from a Berlin concern a royalty on its broadcasting of one of his works.

* * *

Government Wavemeter Check-ups

THE Bureau of Standards transmits twice a month radio signals of definitely announced frequencies for use by the public in standardizing wavemeters and transmitting and receiving apparatus. The signals are transmitted from the Bureau's station WWV, at Washington, D. C. and from station 6XBM at Stanford University, California. The schedule of signals from both the Bureau of Standards and Stanford University is as follows:

SCHEDULE OF FREQUENCIES IN KILOCYCLES

(Approximate wavelength in meters in parentheses)

Time *	June 5	July 20
10.00 to 10.08 P.M.	550 (545)	1,500 (200)
10.12 to 10.20 P.M.	630 (476)	1,650— (182)
10.24 to 10.32 P.M.	730 (411)	1,800 (167)
10.36 to 10.44 P.M.	850 (353)	2,000 (150)
10.48 to 10.56 P.M.	980 (306)	2,200 (136)
11.00 to 11.08 P.M.	1,130 (265)	2,450 (122)
11.12 to 11.20 P.M.	1,300 (231)	2,700 (111)
11.24 to 11.32 P.M.	1,500 (200)	3,000 (100)

* Eastern standard time for WWV, Washington, D. C. Pacific standard time for 6XBM, California.

Radio Motion Pictures in the Home?

C. FRANCIS JENKINS, the inventor who is known for his radio photographic transmission invention, is planning to conduct tests in the near future of radio transmission of motion pictures; he believes this will be one of the next stages in the development of radio. The experiments are to be conducted in what he designates as "radio vision," which he first described in POPULAR RADIO. A small studio has been rigged up in his laboratory in which will be staged pantomimes and other entertainment for sending over the air. Receiving sets will be installed in a few homes to ascertain if the transmission is successful; these sets will consist of boxlike affairs which, when the lid is raised, will reveal a screen with the motion pictures cast thereon. The instrument will be turned on in somewhat the same fashion as a radio program is now tuned in.

* * *

A New Operator's License

THE Department of Commerce has authorized a new form of operator's license to be known as Broadcasting Station Operator's License. Commercial Second-class License blanks will be used, with an inscription stating "valid only for the operation of a broadcasting station." In the code test a speed of only twelve words a minute in transmission and reception of Continental Morse is required, instead of twenty words a minute. The theoretical examination consists of a number of questions on transmitting apparatus such as is used in broadcasting, on receiving equipment, storage batteries, motors, generators and the radio communication laws. The passing mark required is 75 percent. Examination papers are now being prepared and will soon be sent to radio supervisors.

* * *

A Beam System Between Canada and Australia

WITH the completion of the Marconi Station at Drummondville, Quebec, it is expected that connection with Australia will be made possible by the new beam system of radio transmission. The new beam circuit which will be operated by the Marconi organization in conjunction with the British Post Office, will permit messages being sent from England to Drummondville and thence relayed to Australia.

* * *

Selective Police Broadcasts

A NEW installation at the New York City radio broadcasting station, WNYC, is expected to prove a valuable adjunct to the work of the police. Engineers have successfully demonstrated a "selective" call to a single police station, followed by police instructions exclusively to that precinct. It also was demonstrated that the receiving set under test would not respond when other stations were called unless a borough call or a general call was issued.

Schools Debate by Radio

DEBATING by radio is an innovation that promises to become popular in the Southwest if plans now being considered by the schools of higher education are realized. A debating club in a Texas high school conference recently staged a successful debate by radio and prizes were awarded by judges who listened in other cities. The two clubs were separated by about two hundred miles. Because of poor railway connections and severe weather the clubs decided to debate over the air. After the arguments and rebuttals were broadcast the judges, who were scattered throughout the district, wired their decisions to the president of the board and the president in turn announced through another broadcasting station the winner of the debate.

* * *

Broadcasting May Make Prague the World's Opera Center

CZECHO-SLOVAKIANS see in radio the means of building up Prague as one of the outstanding musical and cultural centers of the world. As the center of national opera, which will probably be broadcast, Prague will also play a new part in the national spirit and advancement of the country on cultural lines. The

government will control broadcasting and plans to erect stations for operation on a rental basis by a broadcasting company. The national opera of Czecho-Slovakia from Prague may be only one of many national musical programs that will be broadcast regularly over Europe. The time seems not far away when a listener may choose between the best musical genius of a half-dozen countries which have enriched the world with music.

* * *

Propose Radio College Course

THE founding of a privately-endowed radio university in New York which would broadcast college educations to millions who have not had the opportunities offered by a formal education was proposed recently. College professors would be engaged, according to the proposed plan, and the students would be able to remain at home; the only expense to them would be for textbooks.

* * *

Fog Signals Exploded by Radio

ACCORDING to *La Nature* (Paris) there has been installed on the coast of Scotland a fog signal which gives a loud bang at regular intervals, the noise being produced by a small acetylene cannon fired from shore by radio impulses.



International

LISTENING IN BESIDE A VOLCANO

At 4,000 feet above the Bay of Naples the men shown above set up a radio receiver and a loop antenna beside the crater of Vesuvius. These "fans" heard all the European stations and short-wave transmitters in the United States.



BROADCASTS

CONDUCTED BY DAVID LAY

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

A New Amateur Waveband

AMATEURS who operate wireless telegraph sets were recently authorized by Secretary Hoover to use a new wavelength band between .7477 and .7496 meter. Few people realize the immense number of possible operating channels that lie in the low wavelength, Secretary Hoover has pointed out. "If it ever becomes feasible to conduct broadcasting on these frequencies," the Secretary said, "it would be possible to place within the band mentioned one hundred broadcasting stations, and all the stations in the world at present could operate in the upper half of the one-meter band. The art has, of course, not developed to make it possible, but the amateurs now have an opportunity to see what they can do."

* * *

Radio and Insanity

DR. ISHAM G. HARRIS, superintendent of the Brooklyn State Hospital for the Insane said recently that because of the irritating effect that static has on mental cases, the radio has been eliminated from hospitals for the insane. Despite this belief, a number of medical psychologists here and abroad recommend radio receiving installations for their psychotherapeutic value in hospitals.

* * *

Where Applause Letters Come From

THE manager of a large western broadcasting station has found out that 25 percent of the station's correspondence is written by Canadians and Californians. The principal Canadian provinces from which applause letters have been sent are Saskatchewan, Manitoba and Alberta. In California the number of applause letters is divided equally over the state. Women are the least responsive, according to the data gathered at this station; a recent check of correspondence indicates that the station receives from men five letters to one from women. Of 100 letters an average of 80, or four-fifths are written by male listeners and the remainder are divided between

women, children of school age or are signed "Mr. and Mrs." These letters show that the question of women's ages has ceased to be a bugaboo for the women correspondents freely tell their ages especially when these are past the fifty-year mark. Children in their letters delight in telling family history and often the ages of their parents and neighborhood gossip.

* * *

City Charges Fee for Forced Antenna Inspection

A SMALL town near Atlantic City, N. J. has just passed an ordinance providing that all home radio antennas must be passed upon by the city electrician, who receives a fee of two dollars in each case. All who fail to undergo the inspection and pay the fee, under the ordinance, can be summoned to court and fined \$25 each day until the law is obeyed. Indignant citizens are protesting against the law on the ground that the city electrician pockets the fees, no part of which goes to the city.

* * *

Hard Labor for Radio Law Breakers

OWNERS of radio transmitting and receiving stations in Great Britain will have to get licenses under the new radio bill that was introduced recently in Parliament. All transmission station owners who might be convicted for not having licenses and breaking the proposed regulations would be subject to imprisonment for twelve months with or without hard labor, or a fine of 100 pounds. If the breaches of regulations should not cease at once an additional penalty of five pounds a day would be levied.

* * *

Radio Will Link the Philippines to America

PLANS have just been completed for the erection of a radio superstation in the Philippines. This station will give the islands immediate contact, twenty-four hours a day, with New York and other cities of the world.

A TUBE WITH UNIFORM CHARACTERISTICS

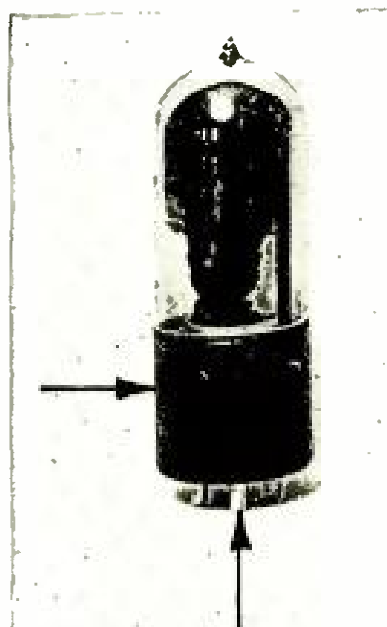
Name of instrument: Vacuum tube.

Description: A vacuum tube that is made in standard form with a glass bulb of a straight side variety that has rigid filament, grid and plate elements. The tube is equipped with a bakelite base and four terminals are brought out and covered with silver contact pieces. Of the number of tubes tested, they were found to have characteristics which varied very slightly one from the other.

Usage: In any radio receiving circuit as an amplifier at high or low frequencies and as a detector.

Outstanding features: Uniformity. Low capacity between elements. Good contacts. Neat appearance.

Maker: Brightson Laboratories, Inc.



Bakelite base and silver tipped contacts.

DIALS

"A. C. H." Sharp Tuner dials; A. C. Hayden Radio & Research Co.

"Heath" bakelite dial; Heath Radio & Electric Mfg. Co.

Dials; Henry Hyman & Co., Inc.

Micro dial; Jewett Radio & Phonograph Co.

HEADSETS

No. 2 Universal headphones; Holtzer-Cabot Electric Co.

No. 4 National headphones; Holtzer-Cabot Electric Co.

Headphones; Henry Hyman & Co., Inc.

CRYSTAL DETECTORS

Silver-Dome Fixed Crystal Detector; C. E. & H. T. Hargraves.

\$1.00 Crystal Detector; Chas. M. Hick. Crystal detector; Henry Hyman & Co., Inc.

PHONE PLUGS

"Harco" plugs; Harris & Birdseye, Inc.

Plug; Haynes-Griffin Radio Service, Inc.

Plug; Howard Mfg. Co., Inc.

Plug; Henry Hyman & Co., Inc.

"Jones" multi-plug; Howard B. Jones.

Plug; Jos. W. Jones Radio Mfg. Co., Inc.

TUBES

Airtron tubes; H. & H. Radio.

BATTERY CHARGERS AND RECTIFIERS

"Handy" battery charger; Interstate Electric Co.

"Simplex" battery charger; Interstate Electric Co.

"Ultra-handy" battery charger; Interstate Electric Co.

AUDIO-FREQUENCY TRANSFORMERS

Audio-frequency transformer; Henry Hyman & Co., Inc.

"Jefferson" audio-frequency transformer; Jefferson Electric Mfg. Co.

Audio-frequency transformer; Jos. W. Jones Radio Mfg. Co., Inc.

GRID-LEAKS AND RESISTANCES

Grid-leak; Horne Electric & Mfg. Co.

Grid-leak; Jos. W. Jones Radio Mfg. Co., Inc.

SETS IN KIT FORM

Super-Hilco-Dyne kit; A. E. Hill Mfg. Co.

Lo-Loss TRF Hilco Kit; A. E. Hill Mfg. Co.

Hilcoflex kit; A. E. Hill Mfg. Co.

4-tube Knockdown kit; Jos. W. Jones Radio Mfg. Co., Inc.

RHEOSTATS

Rheostat; Howard Mfg. Co., Inc.

Rheostat; Henry Hyman & Co., Inc.

Rheostat; Jos. W. Jones Radio Mfg. Co., Inc.

MICA FIXED CONDENSERS

"Hilco" fixed condensers; A. E. Hill Mfg. Co.

LIGHTNING ARRESTORS

"Sensory" lightning arrestor; Heineman Electric Co.

Lightning arrestor; Jewell Electrical Instrument Co.

POTENTIOMETERS

Potentiometer; Howard Mfg. Co., Inc.

Potentiometer; Henry Hyman & Co., Inc.

Potentiometer; Jos. W. Jones Radio Mfg. Co., Inc.

INSULATORS

Insulators; Henry Hyman & Co., Inc.

SWITCHES

Switch levers; Henry Hyman & Co., Inc.

"Improved" switches; Jos. W. Jones Radio Mfg. Co., Inc.

The Best 101 Hook-ups

THE Annual Hook-up Number of POPULAR RADIO—out next month—will contain the best of the radio circuit diagrams that have been developed up to the present time, together with data concerning costs of parts, reception range and other helpful information that will serve as a guide to every owner and prospective owner of a radio receiver.



Equipped with a single tuning control.

TUNING INDUCTANCE UNITS

"Hartman" variocoupler; Hartman Electric Co.
Bank-wound variocoupler; Haynes-Griffin Radio Service, Inc.
Special oscillator coupler; Haynes-Griffin Radio Service, Inc.
Acro coil tuning inductance; Henninger Radio Mfg. Co.
"Hilco" Three-circuit tuner; A. E. Hill Mfg. Co.
Verni-tuner; Horne Electric & Mfg. Co.
Tubular variometer; Horne Electric & Mfg. Co.
Variometer; Henry Hyman & Co., Inc.
Variocoupler; Henry Hyman & Co., Inc.
Variocoupler; Jos. W. Jones Radio Mfg. Co., Inc.

SOCKETS AND ADAPTERS

"Sure-Grip" socket; Hart & Hegemen Mfg. Co.
Bakelite Standard tube socket; Hart & Hegemen Mfg. Co.
Vacuum-tube socket for UV-199 tubes; Hart & Hegemen Mfg. Co.
Standard socket for UV-199 tubes; Hart & Hegemen Mfg. Co.
V. T. socket; Heath Radio & Electric Mfg. Co.
V. T. socket; Henry Hyman & Co., Inc.
Cushioned socket; Illinois Radio Co.
Socket cushion; Illinois Radio Co.
V. T. socket; Jos. W. Jones Radio Mfg. Co., Inc.

A FINELY MADE TRANSFORMER

Name of instrument: Audio-frequency, amplifying transformer.

Description: Here is a transformer which is really well-made. It contains a very large core of high-grade transformer steel and has carefully designed and manufactured coils of generous size to give the proper low-frequency transformer action that is so necessary for real good audio-frequency work. The connections are brought out to binding posts that are equipped with soldering lugs.

Usage: In an audio-frequency, amplifying circuit as a coupling unit.

Outstanding features: Large adequate core. Low-turns ratio. Low distributed capacity across the secondary coil. High primary impedance. Good volume. Clear reproduction.

Maker: Rauland Mfg. Corp.

A SIMPLE CRYSTAL RECEIVER

Name of instrument: Crystal set.

Description: An elementary receiving instrument with a coil that is mounted in a metal case, with a small tuning knob on the front and an adjustable crystal detector mounted on top.

Usage: For local reception with headphones.

Outstanding features: Simple to operate. Good volume for crystal set. Simple to tune.

Maker: Howe Auto Products Co.

VARIABLE CONDENSERS

Straitline Variable condenser; Haig & Haig Mfg. Co.
Vernier, variable condenser; Hammarlund Mfg. Co.
"Sexton" variable condenser; Hartford Instrument Co.
"Hico" variable condenser; Hartford Instrument Co.
"Low-loss" grounded, rotor condenser; Haynes-Griffin Radio Service.
Vernier, variable condenser; Horne Electric & Mfg. Co.
Variable condenser; Henry Hyman & Co., Inc.
Variable, vernier condenser; Jos. W. Jones Radio Mfg. Co., Inc.
Radiant condenser; Heath Radio & Electric Mfg. Co.
Non-dielectric condenser; Heath Radio & Electric Mfg. Co.

RECEIVING SETS

Nightingale Radio Set; Guthrie Co.
Hansen "Bobolink" receiver; Guthrie Co.
Hansen "Cardinal" receiver; Guthrie Co.
Hansen "Blue Bird" receiver; Guthrie Co.
American Crest receiver; Guthrie Co.
"A. C. H." receiver; A. C. Hayden Radio & Research Co.
Haynes receiver; Haynes-Griffin Radio Service, Inc.
Super-Hilco-Dyne receiver; A. E. Hill Mfg. Co.
Porto Set; Horne Electric & Mfg. Co.
"Howard" neutrodyne receiver; Howard Mfg. Co., Inc.
"Bestone" V-60 receiver; Henry Hyman & Co., Inc.
Symphony receiver; Jones Radio Co.



Shielded and equipped with soldering lugs.

PHONOGRAPH ATTACHMENTS

"Herald" phonograph attachment; Herald Electric Co., Inc.
 "Holtzer-Cabot" phonograph attachment; Holtzer-Cabot Electric Co.
 Vernico reproducing unit; Jewett Radio & Phonograph Co.

LOOP

Loop aerial; Hartman Electric Co.
 "Goldenrod" aerial; Imp Radio Corp.
 Inside aerial; Inter-State Signal.

A NOVEL COIL-WINDING MACHINE FOR THE EXPERIMENTER

Name of instrument: Coil winder.

Description: This apparatus may be mounted directly on the edge of a table or work bench by means of a small clamp that is attached to the bottom of the frame. The rotor shaft has two cones between which a form may be held when winding a coil. The apparatus is also equipped with a small vise, which holds a bent rod upon which the coil of wire may be mounted. A counter is provided for recording the number of turns of wire that are wound on each individual coil. Another attachment on the machine is a wire cutter that is operated from a short lever mounted directly on the vise of the winder.

Usage: In the radio experimenter's shop for winding home-made coils.

Outstanding features: Good workmanship. Equipped with all necessary accessories for coil winding. Easy to operate.

Maker: Specialty Automatic Machine Co.

MISCELLANEOUS ACCESSORIES

Radio tubes repaired; H. & H. Radio Co.
 Screw gauge; Han-Disc Co.
 Nu-way Snap Terminal; Hatheway Mfg. Co.
 "A. C. H." phone connectors; A. C. Hayden Radio & Research Co.
 Hines radio desk; Hines Radio Desk Co.
 Talking tape; Hope Webbing Co.
 "Hercules" aerial mast; S. W. Hull & Co.
 Coil winder; Ferd. Humphreys.
 "Ideal" radio cabinets; Ideal Radio Cabinet Co.
 "Ideal" loudspeaker console; Ideal Radio Cabinet Co.
 "I. C." radio handbook; International Correspondence Schools.
 "Mico" diaphragm; International Mica Co.
 "Snow White" fluid; J. W. Johnston.
 "Color-cap" connector; Howard B. Jones.

RADIO-FREQUENCY TRANSFORMERS

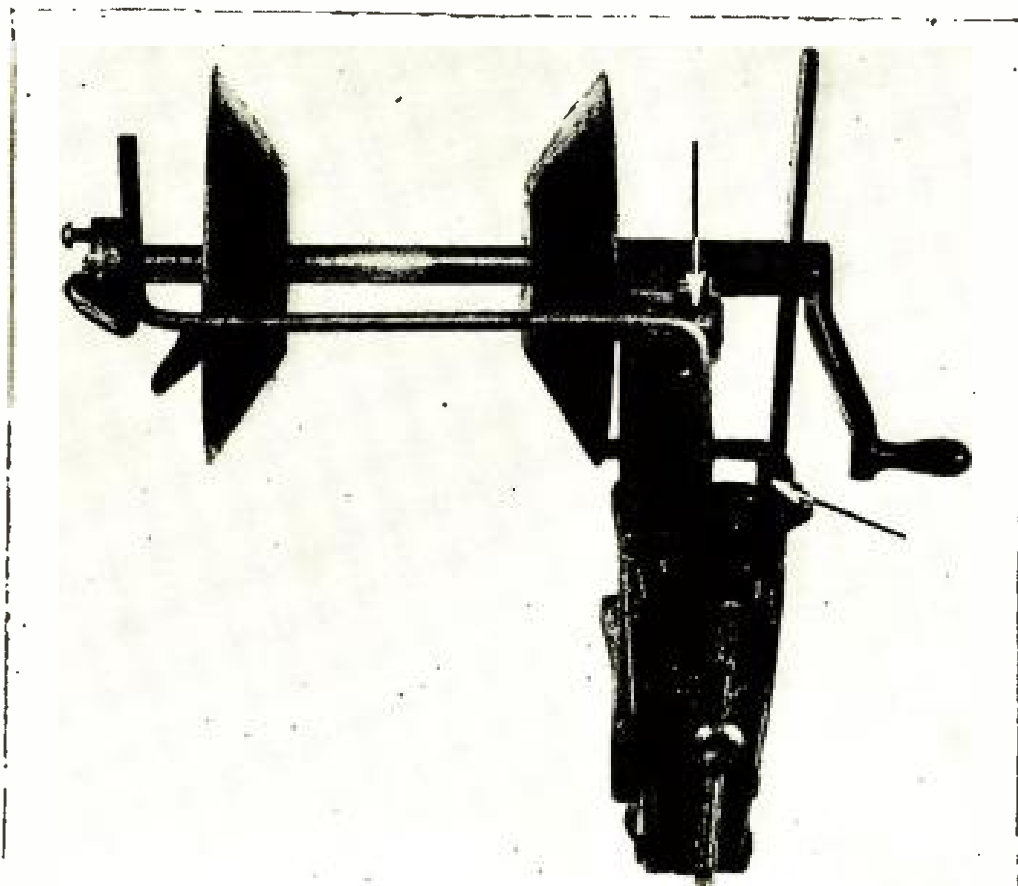
"H & H" transformer; Hart & Hegeman Mfg. Co.
 Intermediate-frequency transformer; Haynes-Griffin Radio Service, Inc.
 R. F. transformer; Henninger Radio Mfg. Co.
 "Hilco" multiformer; A. E. Hill Mfg. Co.
 "Jefferson" radio-frequency transformer; Jefferson Electric Mfg. Co.

LOUDSPEAKERS

J. Andrew White loudspeaker; Haynes-Griffin Radio Service, Inc.
 "Herald" loudspeaker; Herald Electric Co., Inc.
 "Holtzer-Cabot" loudspeaker; Holtzer-Cabot Electric Co.
 Super-speaker; Jewett Radio & Phonograph Co.

TESTING INSTRUMENTS

"Hoyt" tube tester; Hoyt Electrical Instrument Works
 Voltmeters; Hoyt Electrical Instrument Works.
 Voltmeter; International Supply Co.
 "A" and "B" battery voltmeter; Jewell Electrical Instrument Co.
 Multiple reading, panel voltmeter; Jewell Electrical Instrument Co.



A handy coil winder, completely equipped with turns-counter and wire cutters.



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

A WELL-MADE TUNING UNIT

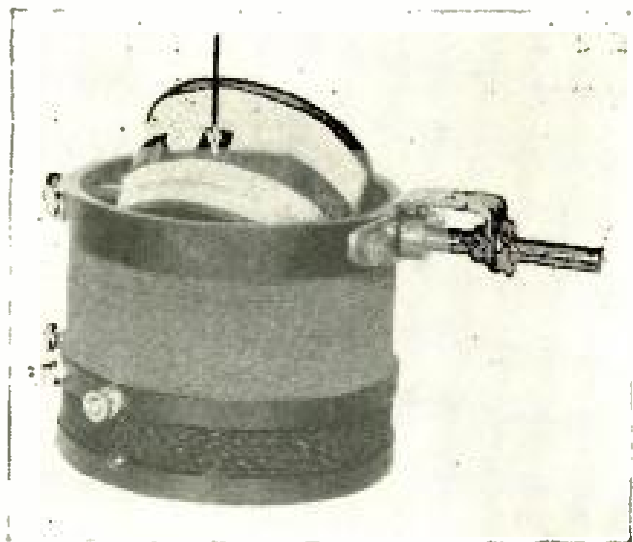
Name of instrument: Three-circuit coil.

Description: This tuner contains three sets of windings, a primary, a secondary and a tickler winding which are wound on two forms. The primary and secondary windings are made on a stationary form with the tickler winding wound on a rotor form. Both sets of forms are of the cut-away variety, which leaves the wire supported on rods. The wire used consists of a four-strand type of Litz wire. The kind of bearing used is satisfactory for close regenerative adjustments. All the connections are brought out to binding posts.

Usage: In a regenerative circuit for tuning with a single variable condenser.

Outstanding features: Neat appearance. Efficient. Easy to operate.

Maker: Uncle Sam Electric Co.



Coil windings are air spaced.

JACKS

Jacks: Henry Hyman & Co., Inc.
"Improved" jacks, Jos. W. Jones Radio Mfg. Co., Inc.

A CONDENSER WITH NOVEL PLATE FORMATION

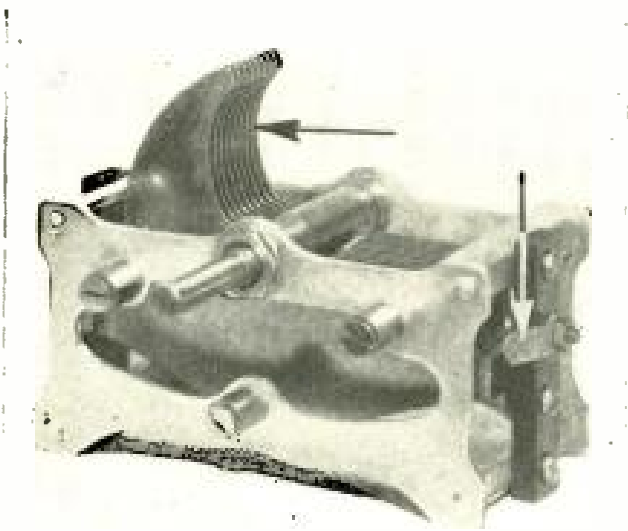
Name of instrument: Variable condenser.

Description: This instrument is unique in design because of the formation of one side of the rotor plates. They are cut away so as to give an approximation of straight line wavelength characteristics. The method of mounting the rotor with an adjustable bearing is well carried out and the stationary plates are well shielded, so that body capacity effects will be greatly reduced.

Usage: In any radio-frequency circuit for tuning.

Outstanding features: High efficiency. Compact. Simple to mount on panel.

Maker: Chelton Electric Co.



Straight-line plates. Equipped with soldering lugs.

Put Your Storage Batteries in the Cellar

WHILE most instruction books direct that the storage "A" battery be placed within five or six feet of the receiving set, there is really no reason why the battery should not be placed in the cellar or the next room if this arrangement is more convenient. The only precaution to be taken when the battery is some distance from the receiver is to use extra heavy wire so that there will be little if any loss in voltage. If No. 12 wire is used, the battery may be as much as thirty or forty feet from the receiver.

Do Your Dials Read Alike?

SOMETIMES the owner of a receiver which includes several stages of radio-frequency amplification, finds that one tuning dial consistently reads several degrees higher or lower than the others, regardless of the wavelength. The chances are that the dial has shifted on the shaft. The remedy for this condition is to loosen up the set-screw and reset the dial so it reads maximum when the plates of the condenser are fully engaged.

Overloaded Tubes Cause Distortion

IF you insist on getting the loudest possible signals from your amplifier, it is desirable to use a power tube in the last stage. Frequently, the cause of poor quality music and speech, when the amplifier is working to top capacity, is due to the overloading of the tube rather than to any defect in the audio transformers.

Wipe Your Soldering Iron

KEEP an old woolen rag handy while you are soldering. Wipe the end of the soldering iron every few minutes. It will help to make the solder flow more readily.

A Substitute for Soldering Outside Joints

IT is often difficult, if not entirely impossible, for the radio fan to solder the joint between the antenna and the lead-in. Soldering is best for this purpose, of course. But, if there is no connection for the electric soldering iron on the roof and if you have no means of heating an ordinary iron on the roof, the next best thing to do is to carefully twist the ends of the antenna wires together, put a coat of shellac over the joint and wind it with tape to protect the shellac. If you do not protect the joint in this manner, it will corrode so that the points of wire which were originally in good contact will cause weak signals.

Accuracy Is Essential in Making Screw Holes

IN any ordinary panel arrangement, it makes practically no difference if the holes for the shafts of the instruments are a small fraction of an inch out of the position you had figured on. The holes for the mounting screws of most instruments which are held to the panel in this way, however, do require considerable accuracy in location. That is why the manufacturers usually supply a paper templet.

How to Arrange the Instruments on the Baseboard

IN designing a radio receiver, the radio fan is up against the problem of getting efficiency without sacrificing the appearance of the panel layout. Frequently, the best arrangement of the coils, condensers and other parts, when judged from a strictly low-loss point of view, results in an awkward layout for the front panel. It may be necessary to compromise between efficiency and good looks but don't sacrifice everything for looks.



CONDUCTED BY ALBERT G. CRAIG

How to Increase Selectivity

WITH the gradual increase in the number of broadcasting stations and the high power now used by many of them, the problem of increased selectivity is becoming more and more acute. Generally speaking, there are two easy ways to increase the selectivity of almost any receiver. The first is to cut down the length of the antenna; the other is to reduce the number of turns in the coil to which the antenna is connected or to increase the spacing between the primary and secondary coils. These methods result in a reduction in the sensitiveness of the receiver which means a choice between two evils. Perhaps the best compromise is to have two antennas, a long one for use after the local stations have gone off the air and a short one to which you can switch when interference is particularly bad.

Avoid Soldering to Binding Posts

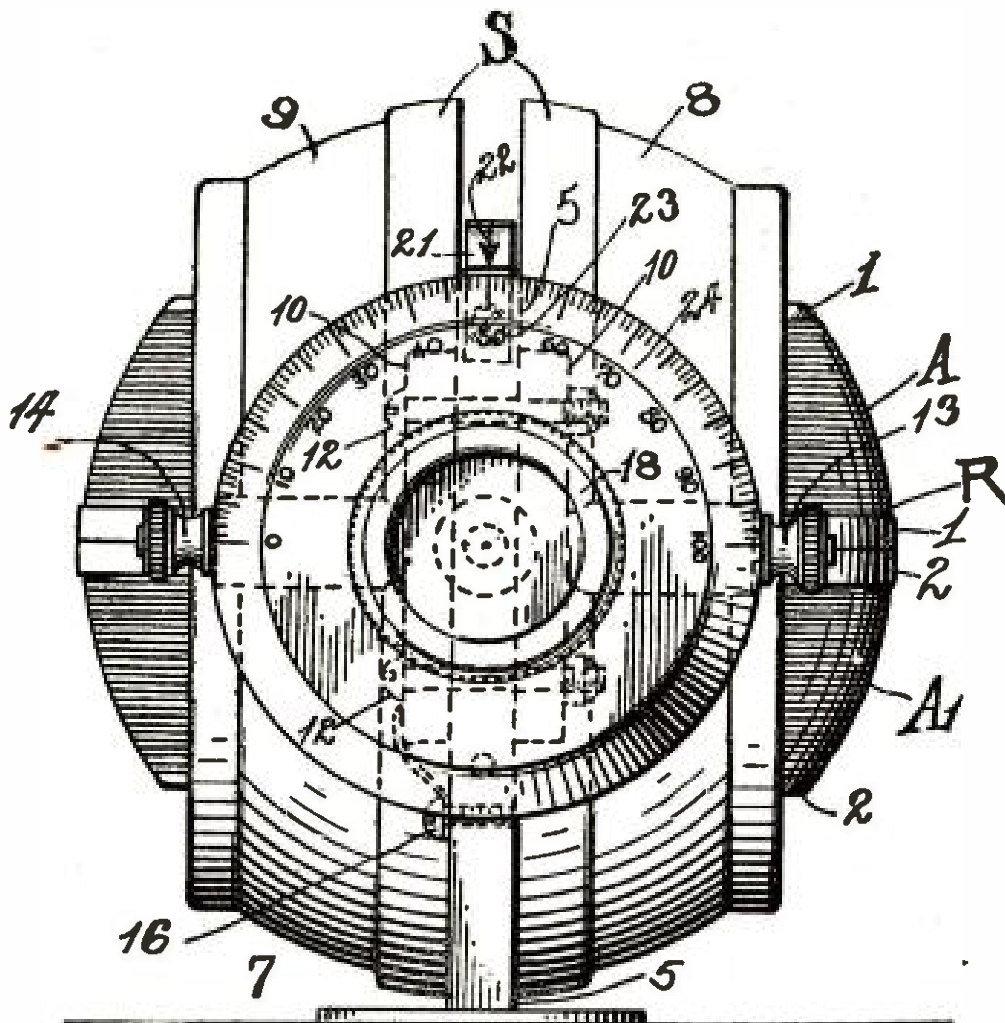
It is much better to use soldering lugs in connecting wires to the binding posts of radio instruments. The inside wires connected with the binding posts are often soldered to them and in many cases the heat applied to the outside end of the screw has resulted in spoiling the inside connection. The same advice applies to the binding posts that you mount on a small panel for the battery connections. The heat of the soldering iron often softens the material of the panel and a loose binding post results.

How to Mount Voltmeters

AMATEUR builders of elaborate receiving sets are often confronted by the problem of cutting a large round hole in the panel in order to fit a voltmeter or an oblong hole for an anti-capacity switch. Of course the easiest way to cut a large round hole is to use one of the special tools designed for this purpose, but if your dealer has none in stock, you can do a good job with an ordinary jig saw. Square or oblong holes may be filed out, starting with the largest drilled or reamed hole you can make. A jig saw will make such a job much more simple. Be careful in using a jig saw; if the blade breaks, you are likely to scratch the panel with the broken end of the blade.

How to Add Water to the Storage "B" Battery

BECAUSE of the large number of cells in the storage "B" battery, it is a tedious job to bring the level of the electrolyte up to the proper point, even with a large medicine dropper. The quickest way to do this work is to set the bottle containing distilled water on a shelf above the battery and use a long rubber tube. After the end of the tube is inserted in the bottle, a siphon action may be started by sucking on the open end of the tube. The flow of water may be regulated by pinching the tube. By this method, the level may be increased in forty-eight or more cells in just a few minutes.



A MODIFICATION OF VARIOMETER CONSTRUCTION

FIGURE 7: The general arrangement for constructing the new variometer is shown in this drawing. The coil resembles the conventional type of variometer that has been in vogue for some time.

Schenectady, N. Y. shows a simple but effective method of shielding receiver or loudspeaker cords from electrostatic, electromagnetic and coupling which sometimes exists between the telephone-receiver circuit and other circuits, particularly in radio receivers of high sensitivity that usually employ radio and audio-frequency, multi-stage amplifiers.

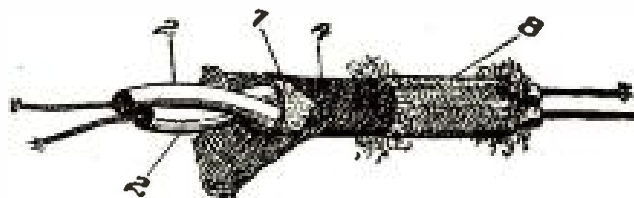
This coupling in some instances is responsible for producing an audio-frequency in the receiver circuit which oscillations are commonly known as "whistling" or "howling." In other instances it results in detuning the circuit.

The drawing in Figure 8 is a detail view of a portion of the cord showing the arrangement of the wire conductors and shield.

This invention contemplates the provision of an extremely flexible metallic tinsel braid woven over the telephone cords on the headset. The tinsel braid may be formed from fine copper wires each of which has a textile core in the well-known manner of standard, stranded electrical conductors. The several textile cores and wound wires are braided to form a substantially closed, flexible housing throughout the length of the cords. The ends of the

shield may also serve as a stay cord to prevent any undue strain upon the conductor itself.

While the shielding of conductors, by cutting magnetic or electrostatic fields to prevent transient current from being set up in them, is well known to the art, the particular type of shield construction disclosed in this patent is quite novel and should find wide application.



A NEW SHIELDED PAIR OF CONDUCTORS

FIGURE 8: The new loudspeaker cord is shown above with the covering stripped back. This arrangement overcomes troublesome electrostatic and electromagnetic coupling effects and besides makes a sturdy extension cord.

tically causes no disturbance of the detected signal currents. This is accomplished by means of filters 11 and 13 and resistance 8 to which the grid and plate circuits of the tubes will be connected, as shown in Figure 5 to the mid-point of the resistance, so that the grids and plates will be neutral with respect to the alternating current source 6.

Those of our readers who may wish to experiment with this circuit are advised to obtain a copy of this patent.

A Form of Construction for a Variometer

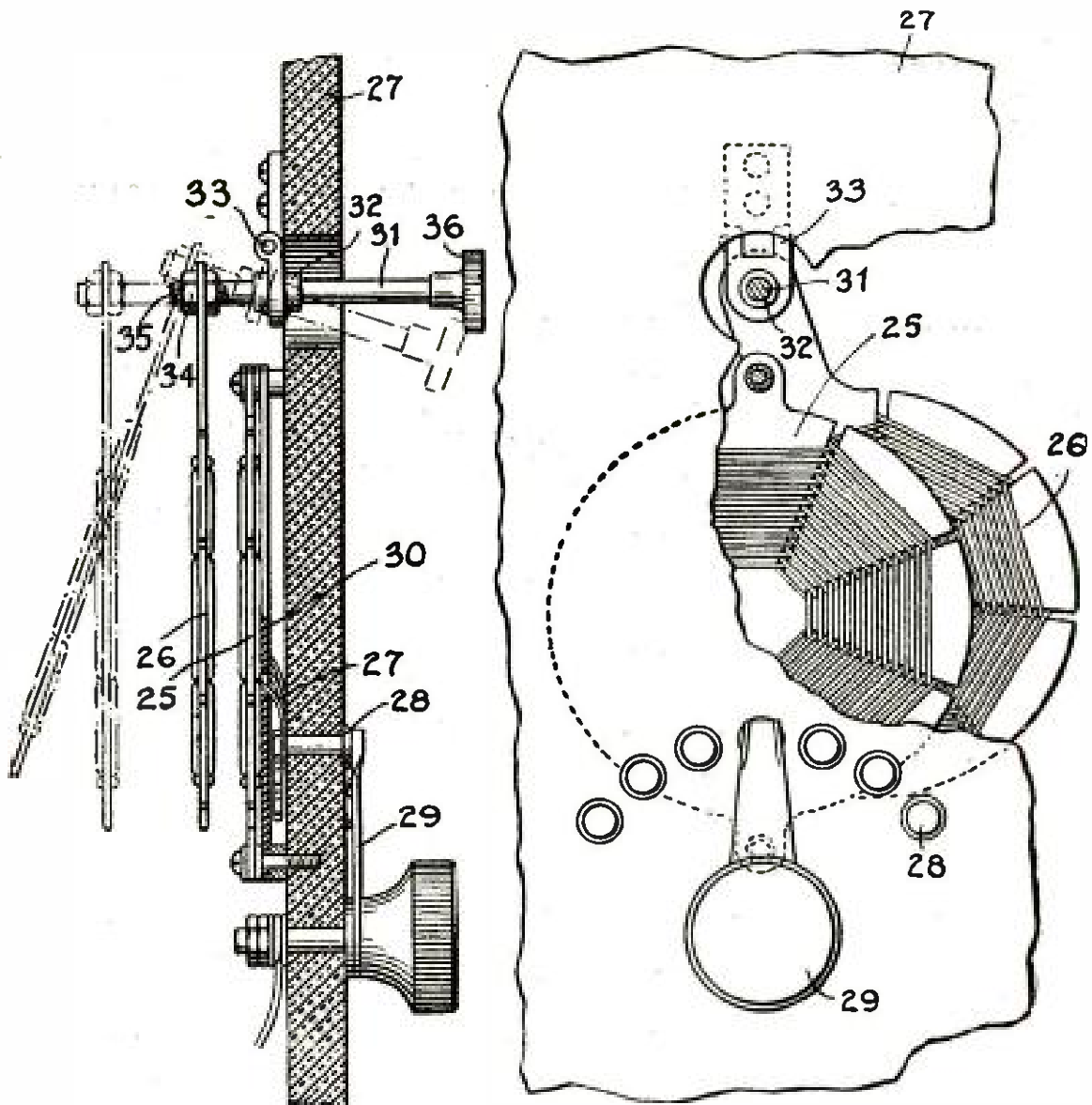
A PATENT that covers a particular type of construction of variometers and variocouplers was granted to A. Atwater Kent of Ardmore, Pa. under the Patent Office Number 1,523,832. Figure 7 discloses the fact that it is of the popular, conventional type.

A New Inductance-coil Mounting

C. A. BIRCH-FIELD, of Larchmont, N. Y. in his patent No. 1,488,310 discloses an efficient method of mounting receiving inductances, particularly of the pancake type, as shown immediately below in the drawing Figure 6 in which the coupling inductance or coil is so mounted as to enable one to quickly change its inductive relation to the fixed or primary inductance or coil in an angular variation there between in a plurality of planes. This practically affords a relative, universal movement of the coupling coil or inductance whereby one quickly gets sharp tuning of the oscillatory circuit—a desirable thing to obtain.

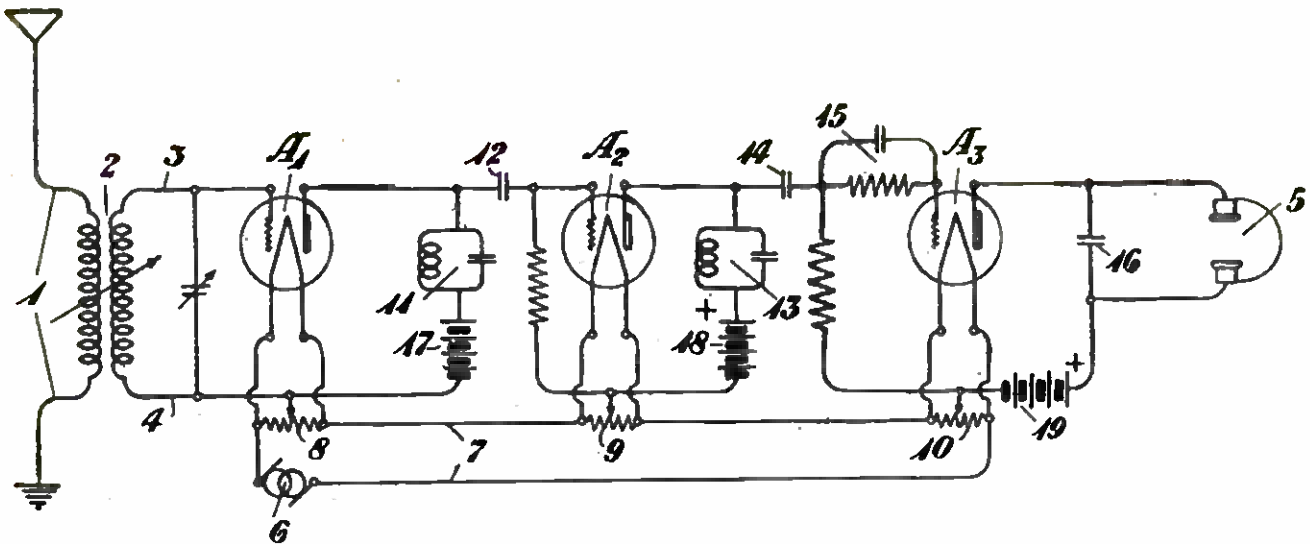
A New Telephone Receiver or Loudspeaker Cord Shield

A RECENT patent, No. 1,521,275, granted to G. W. Carpenter and W. I. Carlson of



THE NEW METHOD FOR MOUNTING PANCAKE COILS

FIGURE 6: These two views show how inductance coils may be mounted to enable quick changes in the inductive relation of coils.



ONE HOOK-UP FOR THE NEW A.C. FILAMENT SUPPLY

FIGURE 4: This wiring diagram shows how the filaments are connected in series to an alternating current source for heating the filaments.

frequency from a multiple of the filament frequency of the received energy. The multiple system used in this invention appears in Figure 3. (Patent No. 1,520,835.)

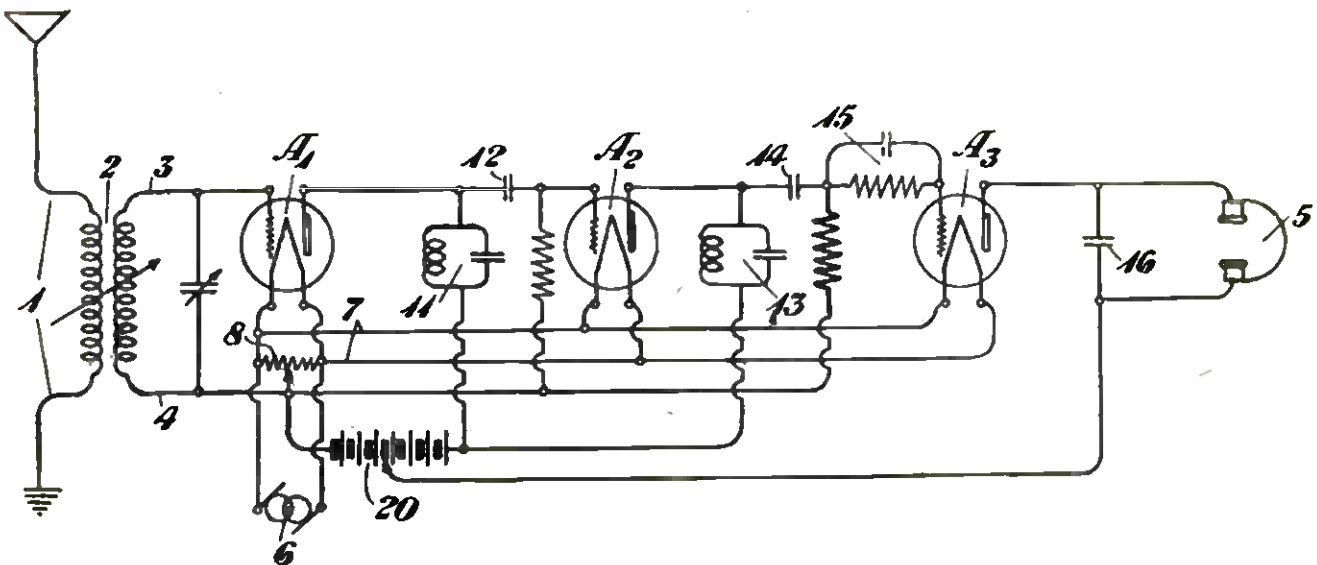
A Receiving Circuit for A. C. Filament Supply

DAVID GRIMES of Tompkinsville, N. Y. had recently issued to him patent No. 1,509,139 for a means for heating the filaments of vacuum tubes that are employed in a radio receiving circuit from an alternating current such as is available in many homes.

The circuits shown in Figures 4 and 5 are for a radio receiver that has two stages of

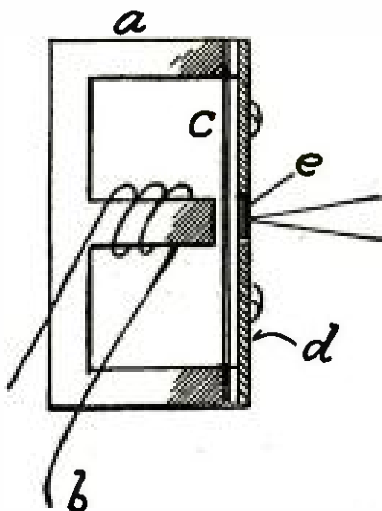
radio-frequency amplification and the third or last tube that is used as a detector. The difference between the two circuits is that in the first the filaments of all tubes are connected in series, and in the latter they are connected in parallel, which is the common practice among set builders today. Also this circuit would have the most value as it would not necessitate the changing of filament connections in a set.

When alternating current is used to heat the filament of vacuum tubes the alternating heating and cooling of the filaments, which is due to the quickly changing polarity of the current, creates a disturbing current that makes a hum which interferes with reception. With the arrangements provided for in this invention, this disturbing current or low-frequency hum is reduced to a minimum degree which prac-



ANOTHER CIRCUIT WITH MULTIPLE FILAMENT CONNECTIONS

FIGURE 5: Here is the hook-up for the parallel connection of the filaments that are heated from the alternator at 6.



THE JENKINS MAGNETIC CONTROL
 FIGURE 3: This shows how a magnetic field controls the movement of the light beam at the receiving end.

ing element so long as it is common to both circuits.

"Figure 2 shows a preferred form of circuits for use of the invention. Neglecting the coils I and J which may or may not be used, and whose use does not change the matter; the antenna circuit A to G includes inductance L_2 and variable capacity C_2 , and this is inductively connected to the resonant circuit including inductance L_3 similar to L_2 and variable capacity C_3 similar to C_2 , in addition to inductances L_4 , and L_5 and capacity C_4 . The coil L_5 may be used as the primary of a transformer connecting to another circuit, or to any detector circuit as for example B, C, R, having the receiver R therein.

"Again supposing the independent inductance and capacity of the antenna to be respectively L_1 and C_1 , the condition for resonance is:

$$\left(\frac{C_1}{C_1+C_2}\right)(L_1+L_2) = \left(\frac{C_3}{C_3+C_4}\right)(L_3+L_4+L_5)$$

"If we make $C_4 = C_1$ and $L_1+L_2 = L_3+L_4+L_5$ then the circuits will be in resonance whenever $C_2 = C_3$ and therefore varying the latter similarly and simultaneously will change the periods of both circuits alike without destroying resonance. The component parts of capacities C_2 and C_3 can be mounted on the same movable support.

"My invention is not limited to any particular embodiment of the tuning elements but comprises broadly tuning apparatus in which at least one tuning element is common to several circuits, but arranged and adjusted so that the variation of this one element will similarly alter the period of several circuits while still preserving resonance."

It may be of interest to our readers to know that the Patent Office records disclose only two references made by the Patent Examiner before allowing Mr. Hogan's patent and they were patent No. 932,913 issued to Shoemaker and No. 931,586 issued to Eisenstein, both of which were easily met by Hogan, as neither contained the essence of the Hogan invention.

Pictures by Radio

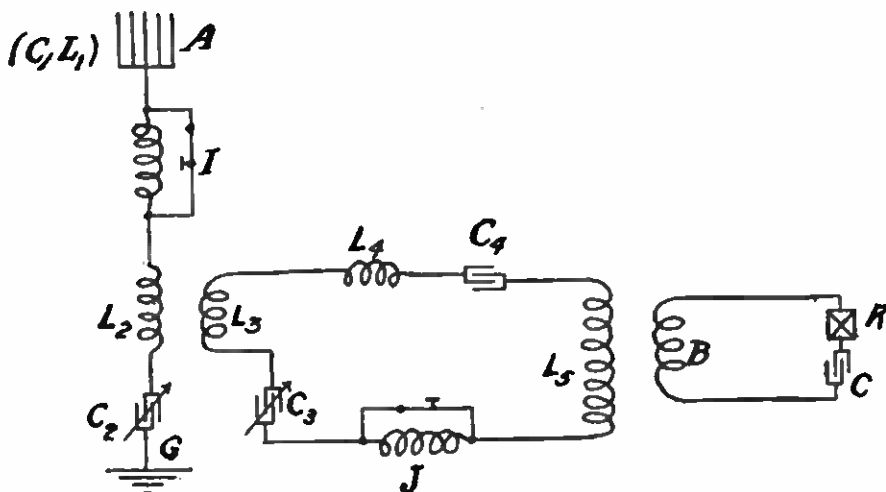
C. FRANCIS JENKINS of picture-transmission fame recently was granted eleven patents on apparatus and circuit details covering his method of transmitting photographs by wire and radio.* See Figure 3.

Patent numbers are: 1,521,188, 1,521,189, 1,521,190, 1,521,191, 1,521,192, 1,525,548, 1,525,549, 1,525,550, 1,525,551, 1,525,552, and 1,525,553.

A New Heterodyning Receiving System

A GERMAN inventor, Alexander Meissner of Berlin, Germany has developed a system for receiving electrical oscillations which includes heterodyning the received energy by current and the frequency of which differs by an audio-

* See POPULAR RADIO for April 1923, page 266, December 1923, page 437 and January 1925, page 11.



THE SINGLE-CONTROL SYSTEM ADAPTED TO AN INDUCTIVELY-COUPLED RECEIVING CIRCUIT

FIGURE 2: In this hook-up condensers C_2 and C_3 may be operated by a single knob that moves the condensers equally without destroying the resonance of the circuits.



CONDUCTED BY WILLIAM G. H. FINCH.

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

Hogan's Single-control Receiver

DUE to the increasing popularity of single-control receivers, John V. L. Hogan's patent No. 1,014,002, which was issued on January 9, 1912, is of peculiar interest to broadcast listeners. For Mr. Hogan at that early date clearly conceived and recognized the importance of controlling several high-frequency radio circuits simultaneously by the use of a variable inductance or a multi-capacity condenser.

Some of the new sets now on the market particularly of the radio-frequency type employ one of these multi-capacity condensers to tune several radio-frequency circuits. Radio manufacturers have begun to realize the value of Hogan's patent just twelve years after it was issued, and they are putting upon the market sets that incorporate single-control features. Thus we may soon expect to see sets, which employ a number of tubes, with a single-tuning control. This should be a relief to the average broadcast listener.

The following quotation is from his patent specifications:

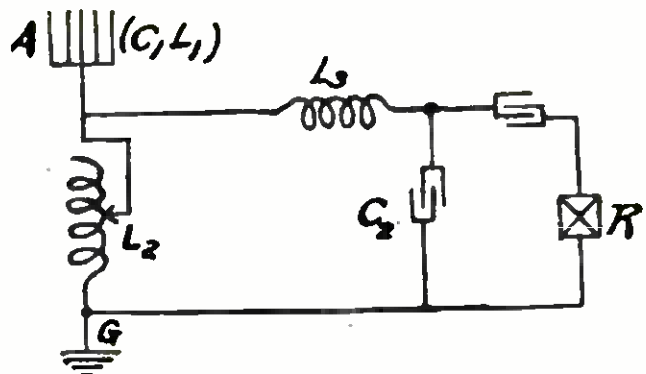
"Heretofore the associated electrical circuits employed in wireless telegraphy have been independently tuned by varying the tuning elements such as capacity and inductance, in each circuit separately, whereby to give the several associated circuits the same natural electrical period. The necessity of moving several indicating devices and making several adjustments has introduced errors and also has required considerable skill in the user of the instruments. By my invention I avoid this difficulty, and incidentally make it possible to more delicately adjust the apparatus, as well as reduce the liability of error.

"Referring first to the diagram Figure 1 it will be understood that when the circuit A, L_2 , G, has the same electrical period as (i. e. is in resonance with), the circuit L_2 , L_3 , C_2 , the electrical condition is, that the product of the effective capacity multiplied by the effective inductance, is the same in each of the circuits. Otherwise expressed, if we let "L" stand for

inductance, and "C" for the capacity, as usual, the condition is $C_1 (L_1 + L_2) = C_2 (L_2 + L_3)$, where L_1 and C_1 represent the capacity and inductance of the antenna independent of the inductance L_2 .

"If now the product $C_2 L_2 = C_1 L_1$ (C_1 being equal to C_2) then the above condition is fulfilled, since L_2 is common to both circuits. Therefore if in Figure 1, after having found the product of the effective capacity and inductance of the antenna circuit independent of L_2 , we adjust the elements L_2 and C_2 in the second circuit so that their product has the same value, then by simply varying the element L_2 which is common to both circuits, we may change the electrical period of both circuits simultaneously and similarly without destroying the condition of perfect resonance between them.

"In practice I construct the tuning box containing the elements L_2 , L_3 and C_2 with leads arranged to connect the antenna and ground in circuit with L_2 , and use but a single variable pointer, or indicator, that is, the slide of the coil represented by L_2 in this particular figure. Of course, I may thus vary any kind of tun-



WHAT THE SINGLE-CONTROL IDEA IS BASED ON

FIGURE 1: When circuit A, L_2 , G is in resonance with circuit L_2 , L_3 , C_2 , in this hook-up, the products of their effective capacities and their effective inductances are equal.

not with his voice but with his accompanying gymnastics. As a matter of fact, he was flatter than a deflated balloon tire when he got before the microphone. To put it bluntly, he was just about as bad as he could be and still be Al Jolson.

Eddie Cantor, who does not depend so much upon calisthenics in putting his stuff over as does the very nifty Jolson, is still a very funny man before the microphone. At least he is still a 75 percent edition of the true Eddie.

Radio is in bad need of more wholesome humor. A good laugh is a devilish hard thing to get out of broadcasting although a lot of our very smart announcers lie awake nights designing wisecracks.

* * *

Too Much of Jazz Is Plenty

SOME day when we have more time we are going to write a very long and a very insulting critique on the broadcasting of jazz. After all, broadcasting is largely a matter of jazz and sopranos. If it isn't one of these, you face a lot of not-too-cold air from a long-winded gent talking one of the 7,987,811 totally uninteresting things that we have to talk about in this old world.

Take the jazz and the sopranos from the studio managers' lists of entertainers and you would leave him in nothing less than a full-fledged panic. That would be just like telling a dealer in second-hand cars that he couldn't handle Fords, Chevrolets and Stars.

The makers of jazz are numerous and anything that is numerous usually has a pretty good chance of being pesteriferous. You don't begin to appreciate this philosophy until you have heard each one of seven different jazz hands play "Red Hot Mama" every night for eleven nights hand running. With so asinine a program and with no effort to establish co-operation, it was bound to happen that the public should eventually become filled-up with jazz and that its murmur of disapproval should eventually be heard above the moaning of the saxophones. That, thank God, has come to pass and we find a very definite opposition growing to the unreasonable use of syncopated music. The classics, once doomed to the sarcophagus of art by the shiny-haired masters of America's new folk music (tee-hee, America's now folk music!) are now supplying the basic stuff of broadcasting.

Broadcasting made jazz and broadcasting killed jazz—or let jazz kill itself, if you prefer. Give anything enough watts and it will kill itself. Of course, if you talk to any of the young men who write "pretty baby" or "mammy" songs on their cuffs while dining out, they will

tell you that jazz made broadcasting, but you don't need to believe that unless you are especially adept at believing. Jazz might have helped radio a little in the beginning, but our statistical department now reports that it is hurting radio and that must be so.

* * *

A "Society for the Suppression of Radio Sopranos"

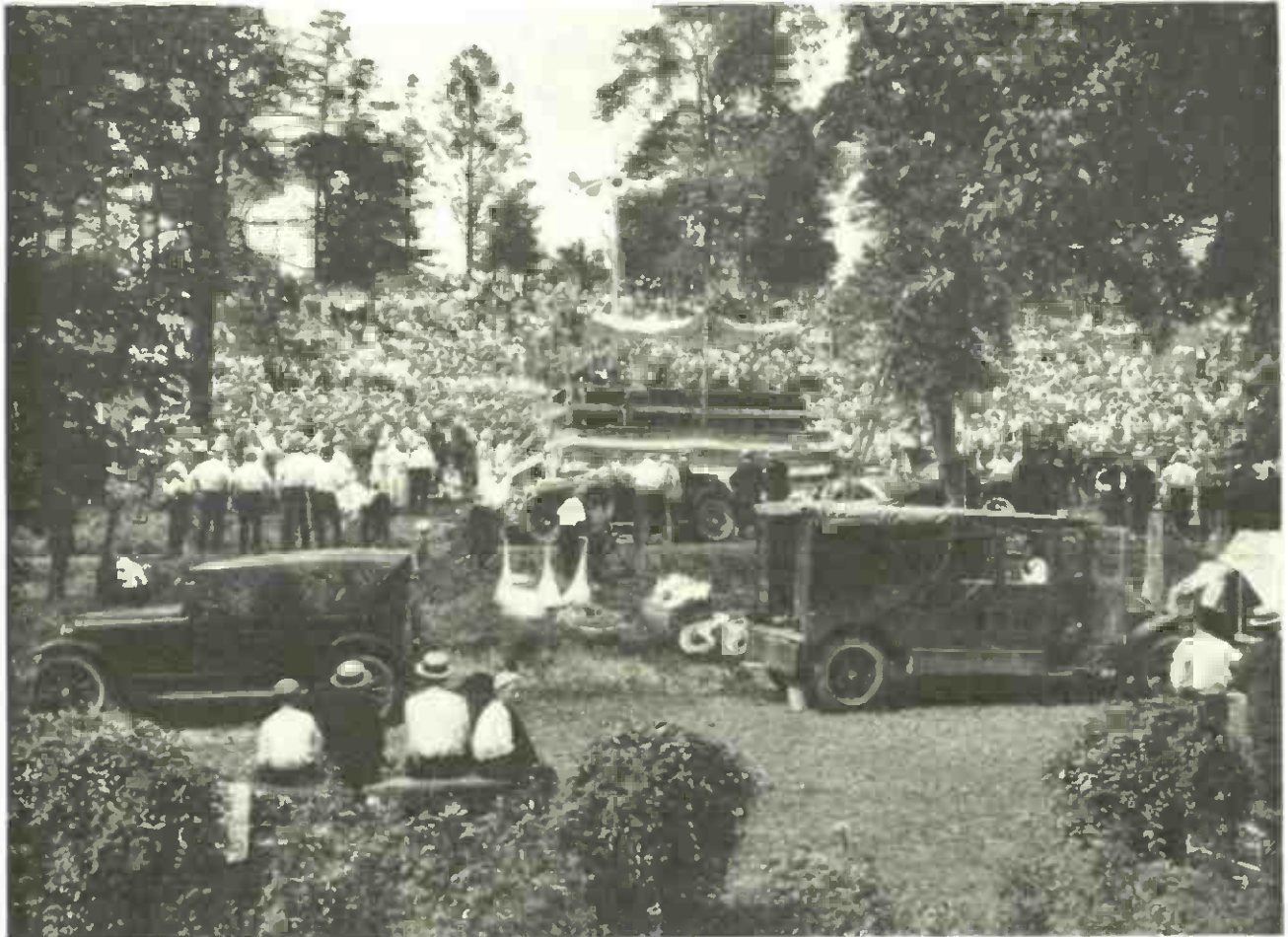
THE average soprano registers just nothing with the crabby old staff of this department. As a matter of fact, the average soprano is something less than terrible and yet our great, big capable studio managers (ha-ha-ha-ha-ha) are pretty sure that a program without a soprano is like a shore dinner without baked clams and oyster stew. Sopranos (we are still talking about the average) are about as plentiful as seven-year locusts and just about as entertaining. The difference between a locust and a radio soprano lies in the fact that a locust does not have sufficient faculty to know that he is a pest and may therefore be excused.

Sopranos are seldom "made"; they are just encouraged. Mabel invades the living room after dinner and "Marchetas" all the way to heaven and back. Her folks are usually ambitious people and they want her to continue with music just as they want little Willie to study electricity. Mabel may not think much of herself at first, but if her friends and family flatter her enough she invariably weakens and sets right out for a broadcasting studio. It was not so bad in the old days when sopranos had to be satisfied with spellbinding the people in the local M. E. choir. Now, thanks to radio, they can, with one unmerciful sweep, disturb the peace and tranquillity of hundreds of thousands of homes.

We are now forming the Society for the Suppression of Radio Sopranos and an invitation to join is offered to every owner of a radio who has exhausted his profanity for these reasons. Fourteen dollars initiation fee is required and this will be used, every red penny of it, to start a "soprano farm" outside of Cody, Ariz. Any soprano who looks as though she might convince a studio manager will be offered a free musical education down on the farm with a special audience paid to do nothing but applaud boisterously at her debut. The Society will also establish an Intelligence Department who, upon finding out that any studio manager in the United States, or its possessions, has engaged more than three sopranos for the week, will deliver to that manager, at the first opportunity, one large crack on the skull.

What Are Your Opinions of Broadcast Programs?

This department is dedicated to more intelligent program presentation and to better service from the studios. Its function as a forum will be facilitated if you will jot down your own thoughts about broadcasting features and send them to this department for comment.



A JOHNNY-ON-THE-SPOT RECEIVING STATION

Receiving apparatus—as shown above—mounted on motor trucks and equipped with a public address loudspeaker system, is maintained by some of the big stations so that broadcast programs can be received and made audible to large gatherings of people. This use of radio is becoming increasingly popular for the reception at public gatherings of events of national interest—ranging from sporting events to politics.

ing telegrams that have no possible interest except to the senders:

Last night I heard KFI, Los Angeles, announce that at 11 o'clock every night they would read into the "mike" all telegrams received the previous night; this to enable those who had sent them to tune in the following night and hear them on the air.

KFI is progressive. They know that the senders of applause telegrams wish and expect to hear them broadcast but, apparently, they are going to minimize the evil as much as possible by bunching the "junk" and getting it all out of their system at once after the regular program has been completed.

I believe that KFI is blazing the right trail.
Sincerely yours,

A. NEAL

Although we feel pretty strongly about answering telegram senders in any fashion save by the postal routes, we feel constrained to admit that KFI is probably doing the next best thing. If we owned a broadcasting station (we are going to write a book about that some day) we would not ask for telegrams in the first place.

Wanted—Some Real Radio Humor

It's funny, isn't it, how many people think they are funny on the air—and how many are actually funny? Of course, 100 percent of those who try their tongues at humor before the microphone have visions of hundreds of thousands of people all over the country rolling over the floor when, instead of rolling over the floor and acting foolish, they may be saying very nasty things. The chances in 99.987 cases out of every hundred are that they are saying nasty things and that they feel like translating these nasty thoughts into still nastier action.

Humor is pretty hard to get away with on the air. A man may be a perfect scream on the stage and he may immediately become the equivalent of a four-hour-old glass of beer when he is placed before the microphone. We remember the time we listened to Al Jolson. In the theater Jolson has always been able to practically lift us right out of our seat with one of his very banal and yet very sentimental songs. When we heard this young man on the air, we decided that he lifted us out of our seat

much they can be like each other and the remarkable part of it is that they have succeeded to an amazing degree. This success would be something to admire if each studio were doing something better than a very smelly piece of broadcasting. The programs, taken as a whole, are thin and vapid. The writer has it on good authority that even the Coolidge inaugural address was an outlandish *faux faux* because four stubborn managers decided to handle it instead of permitting one to do the job. Hoochie-coochie entertainment on the air from a place with the economic importance of Chicago is very bad for radio.

* * *

Wit and Near-wit of Announcers

WHILE discoursing on the banality of the Chicago air-shows, we feel constrained to drop a few pieces of chopped ice down the backs of the very fresh and very roosterish young men who do the announcing. We shake in the throes of a crying-laugh every time we expose ourself to the arid hokum of the Charlie Erbstein school of wit. Of course, to be frank, the wit of the Chicago announcers is no worse than the wit of the announcers of other cities, but it is practiced more assiduously.

There is a prevailing notion in the middle-west (and other places) that if you cultivate a few idiosyncrasies of speech and learn to pour a little of the whitewash type of humor into the microphone each evening, you may eventually become a very great character. At least you can win over a few provincial admirers who will kid you along with blue-lined

paper and watery ink. What Chicago needs is a new crop of announcers who will think more of the programs and their gentle presentation and less about themselves.

* * *

A Pair of Kings Among Broadcast Cards

FOR over a year now we have been patiently watching Ernest Hare and Billy Jones (WEAF New York) and only recently we called a conference at which it was decided that the staff of this department would anoint these young men as two of the most capable entertainers in all airdom. While the humor of the Jones-Hare combination does not always allow you to forget your appointment with the dentist or the third installment on the income tax, it at least respects your intelligence.

Although we have combed this country from California to Maine, nowhere have we found better singing of popular songs. Jones and Hare can sing the most asinine little ditty imaginable and still leave you in a tolerant frame of mind. And let us tell you that when this old snapping turtle makes an admission of this sort, it's a pretty fair wager that we are not wandering about with a spell of amnesia.

* * *

More About Reading Telegrams by Radio

DEAR MR. YATES:

Following my letter of the 20th, in which I commented on the practice of announcers read-



A. T. & T. Co.

A PAIR OF RADIO KINGS—AND A JOKER

Few singers of popular songs—or any songs—have ever been able to boast of as vast an audience as the "Happiness Boys." That is because they sing popular songs just a little better than any other pair of broadcasting artists. Their accompanist, Larry Briers, is shown here between them.



NO UP-TO-DATE HOTEL BEDROOM IS COMPLETE WITHOUT ONE
"The radio receiver will become as much of a feature of our everyday life as the telephone and the electric light," was the prediction made three years ago. The installation of receivers in the rooms of some of the newest hotels indicates that this prophecy is in process of fulfillment.

The BROADCAST LISTENER

*Comments on radio programs, methods and technique
—from the point of view of the average fan*

By RAYMOND FRANCIS YATES

What Is the Matter with Middle-west Broadcasting?

DURING the past month this department has tapped the best sources of Chicago broadcasting almost nightly with, we are sorry to report, very sad results. Chicago, it seems, is faced with three serious economic, social and sanitary problems, i.e., the taming of its very bad criminals, the disposal of its sewage and the improvement of its broadcasting.

Broadcasting in Chicago is something akin to the execution of drama in the remote provinces of South Dakota and to the practices of the yokel cawarets in the grape-producing sections of New York State. It may tickle the members of the Dairymen's League and the various Grange consistories east and west of the Missis-

sippi, but it will, unless greatly and intelligently improved, always remain something less than a Punch and Judy show to those of us (and, thank Allah, there are a few left) who can resist the intriguing placards of the penny arcades.

The trouble with the Chicago studios is that they are still squirting into the ether the Hungarian-goulash programs of three years ago. The announcing and the whole general atmosphere is the atmosphere of the riotous barnyard dance multiplied by 47.5. Focus your receiver on Chicago for a few hours and 79 percent of the material emitted by the loud-speaker will be the musical equivalent of old mattresses, tomato cans, Ford mud guards and broken pickle bottles.

Chicago broadcasters are trying to see how

The Four-circuit Receiver

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

SEVERAL readers have suggested connecting a wire from the antenna inductance D to some part of the condenser in the stabilizer circuit E. This, or any other added connections between circuits will help only in cases where the antenna is too small. These expedients may increase volume, but at the same time selectivity will decrease. For that reason it is much better to obtain good volume by increasing the size of the antenna, as suggested in this department in the May issue, because then selectivity will not be sacrificed, and may be improved.

Antennas Over Open Ground

When an antenna is erected over open ground, with no buildings, trees or other obstructions between it and the ground, it must be larger than one erected over a roof, if best results are to be obtained. Tests recently made show that with the Four-circuit Receiver, a

single wire 100 feet long with a 70-foot lead-in (total 170 feet), erected on an apartment house roof gives results approximately equal to those obtained with an antenna that is erected over open ground, and containing three parallel wires spaced three feet apart and each 135 feet long, including lead-in.

The Four-circuit Tuner with the Distortionless Amplifier

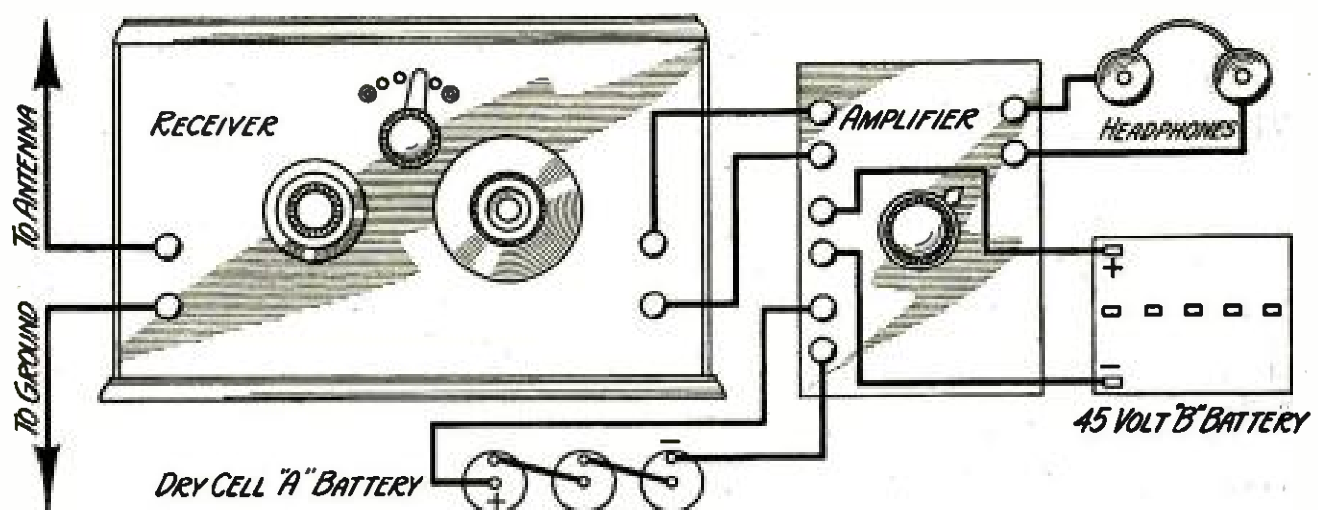
In this department in the February, 1925 issue, a hook-up of the aforementioned combination appeared. One of the connections was incorrectly shown. The wire running from the mid-tap of the secondary of the transformer J to the minus side of the "C" battery was shown joined to the wire running from the jack L1 to the plus 90-volt tap of the "B" battery. These wires should not be joined and in the diagram one of them should have been "arched" over the other.

Combining the Crystal Receiver with a One-tube Amplifier

ELSEWHERE in this issue Mr. Cockaday has described a simple crystal receiver, in his series of "Simple How-to-build Articles for Beginners." This crystal receiver is so good that undoubtedly many who build it may wish to add to it a small amplifier. The illustrations in Figures 1 and 2 show how this addition is made. The amplifier shown uses a UV-199 or C-299 vacuum tube, which obtains its filament current from dry-cells. It was described on pages 141 and 142 of the February, 1925 issue.

To connect these two units together, they are placed side by side with the amplifier on the right. The antenna and ground are con-

nected to the usual binding posts at the left-hand end of the receiver, but the two binding posts at the right-hand end of the crystal set are connected to the two upper left-hand terminals of the amplifier. The four other binding posts at the left-hand side of the amplifier panel are then connected to the "A" and "B" batteries, as shown in the photographs. Finally the headphones are connected to the right-hand terminals of the amplifier, and the combination is ready for operation. Simply turn the rheostat knob about a half turn in a clockwise direction, then tune the crystal receiver in the usual way.



COMPLETE CONNECTIONS SHOWN

FIGURE 2: The complete connections for the combination shown in Figure 1. The "A" battery consists of three standard 1½-volt dry cells, connected in series as shown. The "B" battery is a standard large size 45-volt "B" battery unit.

struction. However, the old type will give generally satisfactory results.

If signals are weak, and if turning the dial of the oscillator condenser B has little or no effect on the signals, it is safe to conclude that the oscillator circuit is not performing its proper function. Perhaps the most simple way to test for this trouble is to remove the oscillator tube while signals are being received. If the oscillator tube has not been functioning, signals will still be heard. Sometimes, in such a case, the five tubes to the right can be removed without interfering with reception in any way.

If the oscillator is not working, the first place to look for the trouble is in the oscillator tube itself. Try shifting other tubes to this

socket. If this fails to help, the wiring should be carefully checked, to see that it is correct and that all connections are tight. If the trouble still persists, it is probable that it exists in the autodyne coupler and its connections.

Trouble in the coupler usually results from reversed connections. Therefore it can be remedied, as a rule, simply by reversing the two connections to the top coil. If this does not do the trick it is likely that a short circuit exists between two of the turns on one of the coils. To remedy this replace the coupler with a new one, or else rewind the coupler that is in use. In rewinding, new wire of the same size as that used originally should be obtained, and the same number of turns should also be made.

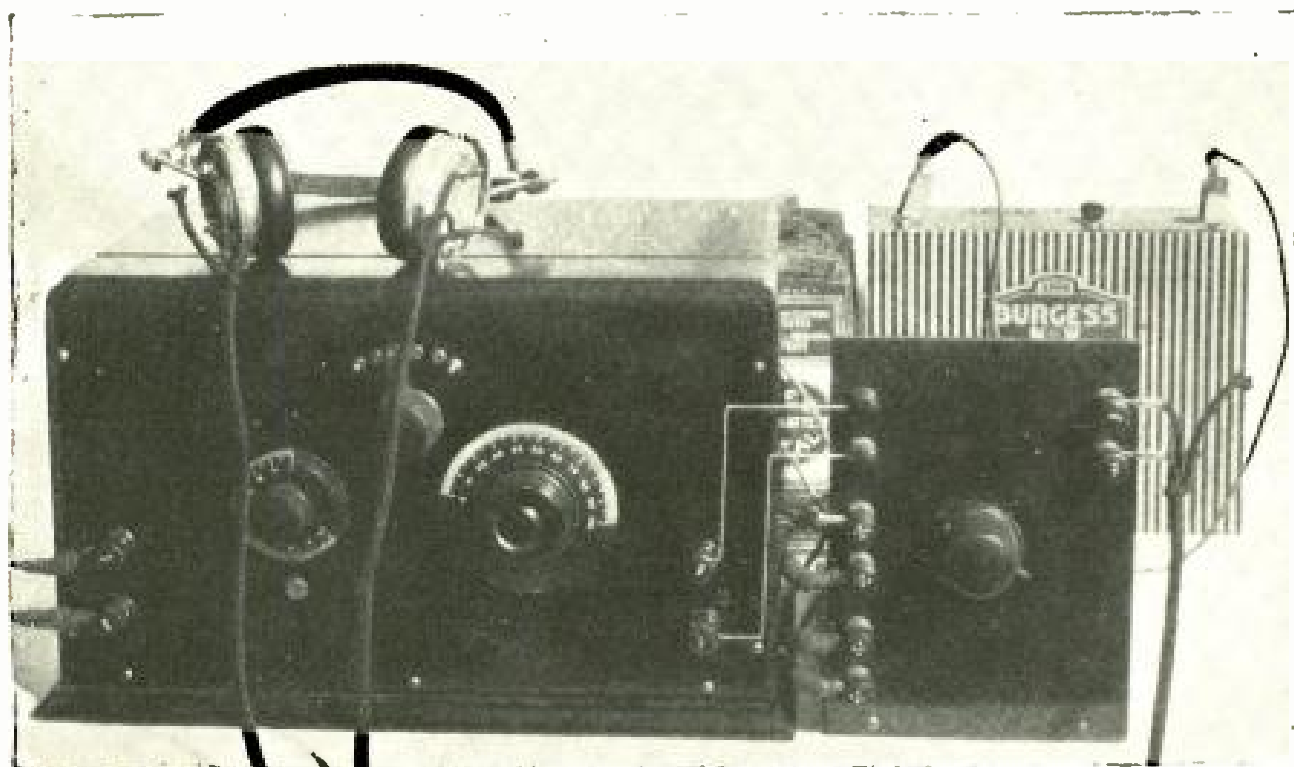
The Seven-tube, Non-radiating Superheterodyne

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

THE rheostat specified for use in connection with the first five tubes of this receiver is suitable only when WD-12 tubes are used. Its current carrying capacity is one ampere, and, of course, the current drain of the five WD-12 tubes when connected in series is only $\frac{1}{4}$ ampere. If UV-201-a type tubes are used in place of the WD-12's, however, the circumstances are altered. These tubes, connected in parallel, draw approximately $1\frac{1}{4}$ amperes; therefore the rheostat is forced to carry an

overload of approximately 25 percent. Usually no harm will result from this change in current, although the rheostat winding will become quite warm.

Under these conditions it is therefore advisable to use a rheostat having a higher current carrying capacity. The resistance need not be higher than 6 ohms, but the capacity should be not less than $1\frac{1}{2}$ amperes. The 10 ohm rheostat specified for controlling the current flow to the filaments of the last two tubes is entirely suitable for this purpose because there the current flow is only $\frac{1}{2}$ ampere.



From a photograph made for POPULAR RADIO

AMPLIFIER AND CRYSTAL RECEIVER

FIGURE 1: Here is the set-up of the one stage amplifier added to the crystal receiver. Here the batteries are shown behind the receiver but in actual use they may be placed under the table or in some other inconspicuous place if desired. The addition of this amplifier provides considerable increase in the volume of received signals, and somewhat increases the distance range.



“TROUBLE SHOOTING”

CONDUCTED BY S. GORDON TAYLOR

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

The Eight-tube Reflex Superheterodyne

(This set was described in POPULAR RADIO for January, 1925)

SOME readers have inquired about the wavelength range of the Eight-tube Reflex Superheterodyne receiver. The tuning chart given on page 50 of the January issue shows that the oscillator dial K2 covers a range from 220 up to over 600 meters. However, the wavelength tuning dial K1 is shown with a wavelength of 266 meters as the lowest to which it can be tuned. It is this latter fact that has mislead some readers.

Actually the range of dial K1 is limited only by the size of the loop antenna that is used. The curve for this dial, as given in the January issue, was made up with the switch of the Korach loop set on point 5, which is the center point of the loop. By moving the loop switch one or two points to the right, the dial K1 may be tuned down to 200 meters or thereabouts. Thus, by means of the switch on the loop, dial K1 may be made to tune down below 200 meters and up to approximately 900 meters.

The wavelength range of this receiver, when used with a Korach or similar loop is therefore limited only by the oscillator range (Dial K2). This range is from 220 meters up to more than 600; so it is evident that this receiver more than covers the entire broadcast waveband.

Many experimenters have on hand intermediate-frequency transformers which have been used with other superheterodyne receivers, and which they desire to use in building up the Cockaday superheterodyne. In some cases

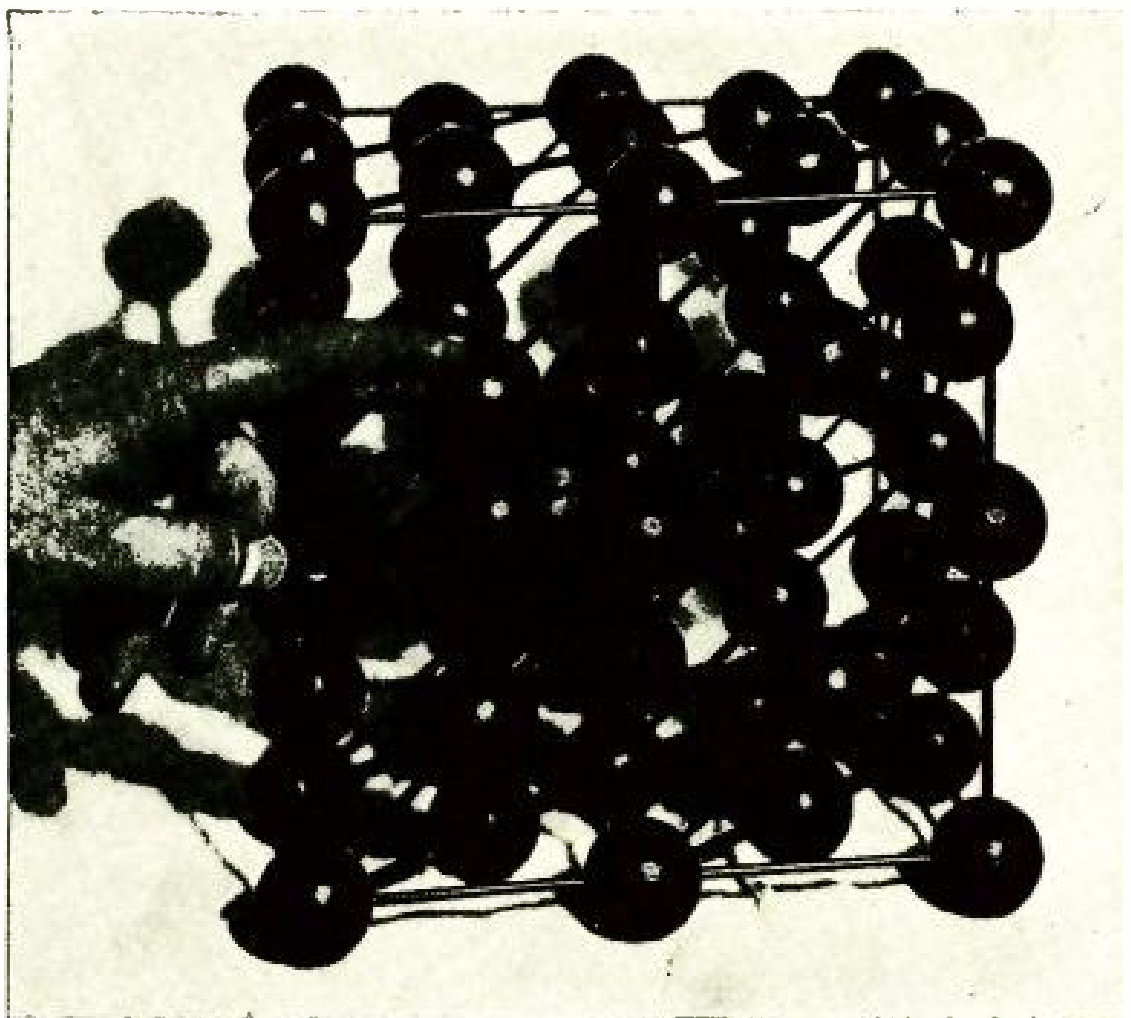
these may be rated at 5,000 or 10,000 meters instead of at 2,200 meters, such as those that were mentioned in the description of the superheterodyne receiver.

Such transformers may be used, provided they are in good condition. They will in many cases not provide as good results as those used in the model receiver, but it is worth while to give them a trial before going to the expense of purchasing a new set. No change is required in the circuit to use transformers of another type or make except that the “input” transformer must be of the same make as the intermediate transformers. The oscillator covers a sufficiently broad band of frequencies to permit the use of an intermediate amplifier that should be tuned to anywhere from 2,000 to 10,000 meters.

The Haynes-Griffin “input” and intermediate-frequency transformers (mentioned in the list of parts in the January issue) were of the new type. The top of the case of each transformer of this type is marked with a designating letter—C on the “input” transformer and D on the intermediate transformers. The old type “input” transformer was marked A but the old type intermediate transformers bore no marks.

The old type may be used in the Cockaday superheterodyne, but in that event it is important that both the “input” and intermediate transformers be of the old type. If the new type is used, both should be new.

Somewhat better results may be expected with the new type inasmuch as they incorporate several improvements in winding and con-



American Chemical Society

THE ATOMS INSIDE A COPPER CRYSTAL

This model shows how the individual atoms of copper are believed to be arranged inside a metal crystal, whether it be large or small. The electric conductivity of the copper varies in different directions through the atomic network that the model demonstrates. Chemists have discovered that this atomic arrangement can be altered by treatment of copper that increases its conductivity or provides an easier path for the passage of an electric current.

many substances, for example of natural mineral crystals like galena, may be different in different directions through the crystal. This is due, of course, to the different arrangement of the atoms and to the fact that the stream of electrons which constitutes an electric current may move through the atom-network more easily in one direction than in directions at angles to this one. Dr. Davey tested these matters with his large single crystals of copper. As expected, he found that the conductivity for electricity was greater in one direction than in others. More surprisingly, he found that in the most favorable direction the conductivity was greater than any previously found for copper.

In one particular crystal six inches long the conductivity along the best direction was .662 by 10^9 mhos per cubic centimeter, at 70 degrees Fahrenheit. This same crystal, hammered and annealed so that it was broken up into numerous small crystals instead of a single large one, gave a conductivity of only .584 by 10^9 mhos per cubic centimeter.

Just how this discovery is to be applied prac-

tically, if at all, is not yet apparent. It is possible, however, that ways may be found for constructing electric apparatus in part of these large single crystals of copper so that the increase of conductivity may be made of advantage in the partial avoidance of electric losses.

An Introduction to Modern Views on Atomic Structure

THE foundations of physical science have been rebuilt within the past decade. The radio fan who wishes to know what these foundations look like now, who is curious about the broad facts and theories which underlie radio, will find nothing better on this subject than a new work by Sir Oliver Lodge,* one of the regular contributors to POPULAR RADIO. An especially commendable feature is the inclusion of much quantitative data; sizes, velocities, masses, wavelengths and the like.

* "Atoms and Rays," by Sir Oliver Lodge. Published by George H. Doran Company, New York, 1925, 201 pages. Manuscript dated June, 1924.

Large Copper Crystal Is Best Electric Conductor

In this department have been described the large crystals of copper, three or four inches long, which have been produced recently in the laboratories of the General Electric Company.* At the meeting of the American Association for the Advancement of Science, held in Washington during the last week of 1924, Mr. Davey of that company described some remarkable results obtained in measuring the electric conductivity of these large single crystals of the red metal.† Under certain conditions the con-

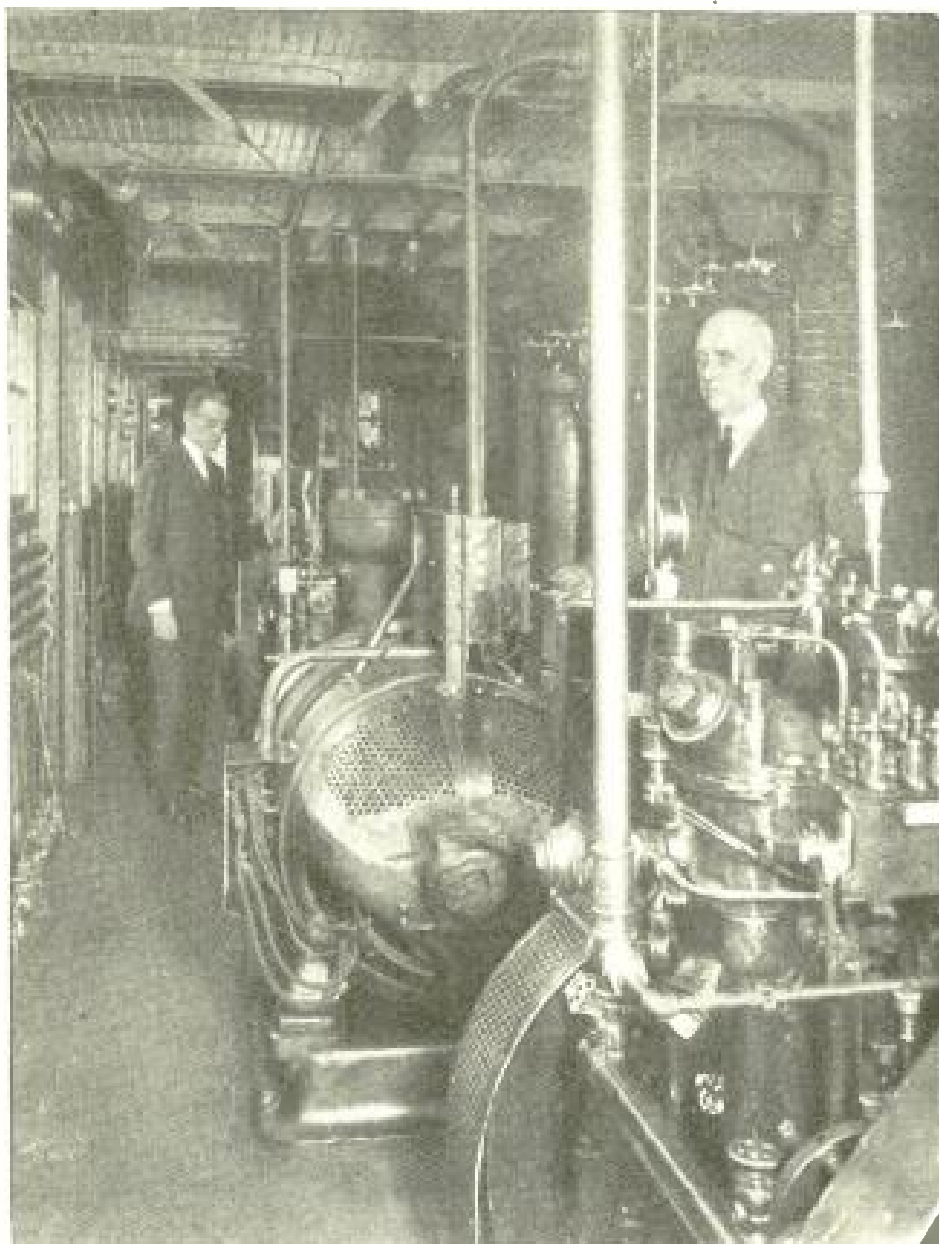
* "The Electrons Inside Crystals," POPULAR RADIO for January, 1925, page 82.

† "Preliminary Report on a Super-Conducting State of Copper," by Wheeler P. Davey. Paper presented to the meeting of the American Association for the Advancement of Science, Washington, D. C., December 31, 1924.

ductivity found was thirteen percent greater than that of ordinary copper, which means that it was greater even than the usual quality of metallic silver, hitherto supposed to be the best of all metallic conductors of electricity.

In ordinary copper the metal is really crystalline but the individual crystals are exceedingly tiny. They can be seen, as crystals, only under a powerful microscope. It was found, however, by Professor Bridgeman of Harvard, that when a bar of copper is treated in a certain way, mainly by very slow and uniform cooling, the tiny crystals in it rearrange themselves so that the entire bar became a single crystal. This applies, of course, only to its internal structure—to the mutual arrangement of the atoms. The external form of the bar remains the same.

It has been known for a number of years that the electric conductivity of crystals of



U. S. Bureau of Mines

AN AMERICAN EXPERT IN TWO TEMPERATURE EXPERIMENTS

Dr. R. B. Moore (at the right) is shown in the helium-purification car of the United States Bureau of Mines. In this car the helium is cooled to hundreds of degrees below zero in order to freeze out impurities.

Sound frequencies, the frequencies of light waves and, indeed, any frequencies whatsoever, will fit into this system. Visible light rays, for example, will lie in the 41st and 42nd octaves.

It is pointed out by Colonel Edgeworth and Mr. Cobbold that many modern calculations of radio waves, as, for example, those dealing with the interference of two broadcasting stations with each other, depend on the proportional difference in their frequencies. This proportional difference is indicated immediately and directly by the octave number, or "pitch." This is not true—as we know all too well—with the wavelength numbers now in use.

No Promise of Cancer Cure in French Radio Experiments

THERE is a group of diseases of plants known as the galls, these diseases being characterized by the growth on the plant stem of rounded, tumor-like masses looking not unlike some of the fungi that grow at times on the dead trunks and stumps of trees. These galls are really true plant tumors, similar in many ways to the tumors that grow in the human body. They have been studied in great detail by the scientists of the United States Department of Agriculture and elsewhere and they are believed to be produced by tiny microscopic organisms, probably of bacterial type, which invade the plant tissue and set up an irritation resulting in the growth of the gall.

A group of scientists in Paris has now reported some remarkable results of exposing plant galls of this type to the action of very high-frequency radio waves.* The waves used were of approximately 150,000 kilocycles, corresponding to a two-meter wavelength, but it does not appear that the radiation was especially well controlled as to frequency, so it is probable that the waves employed were actually much mixed and consisted merely of a "mushy" series of radiations all being, however, very short as radio waves go.

The plant galls used were obtained experimentally by injecting into the stems of healthy plants (for example, of the common geranium) cultures of micro-organisms known to produce galls, this being a well-known method of gall production worked out originally by Dr. Erwin F. Smith of the United States De-

partment of Agriculture. Galls were produced. If the infected plants were left alone these galls grew until the plant was killed.

Some of these experimental plant tumors were then exposed to the short-wave radiation. In a few days the galls began to decrease in size. After a few days more the gall dropped off altogether, leaving the plant apparently as healthy as before the injection of the gall-forming micro-organisms.

These results are extremely interesting and there seems no doubt that they are real as far as they go. The short-wave radiation did result, one may conclude, in some damage to the invading micro-organisms so that they died and ceased to trouble the plant, or else in some stimulation to the plant so that its tissues were able to repel the microscopic invaders and throw off the gall. In any case the plant was "cured."

There is necessary, however, a very important caution. Although these plant galls have been called, with some justice, plant "cancers" and although it is true that they do resemble in certain superficial ways the cancerous growths that constitute such a scourge to mankind, it emphatically does not follow that the plant cancers and the human cancers are the same or that the French experiments with high-frequency radiation imply any immediate hope of treating human cancers in a similar way.

Among the victims of human diseases none have been more a prey for quack and charlatan than those unfortunates who are attacked by cancer. The new French investigations have been instantly seized upon, as was inevitable, by these unscrupulous vultures of misfortune. We hear of a score of "radio cures" for cancer and related diseases in support of some of which the French work has been cited. All this is pure moonshine.

It is probable that cancer will be conquered some day. Vast resources from the medical professions are being focused on the disease. It is possible, too, that the work of M. Lakhovsky and his collaborators will prove to be important scientifically and even practically. But this work offers, so far as anyone can see at present, no hope of a cancer cure, by radio or by anything else.

Let us see to it that advances in radio—however important and useful they may be—are not used to mislead and despoil the public nor to arouse false hopes which can do nothing but harm. There are two treatments for cancer; radium and the surgeon's knife. Both must be used by expert specialists. Either may cure in favorable cases. That, at present, is all that science can do for the cancer victim. "Radio cancer cures" are a despicable form of fraud.

* "Therapeutic Trials with Experimental Cancer of Plants," by A. Gosset, A. Gutmann, G. Lakhovsky and J. Magrou. *Radio-Revue* (Paris), vol. 3, page 135 (August, 1924); "Microbial Radiations and Cellular Oscillations," by Georges Lakhovsky. *Radio-Electricité* (Paris), vol. 5, pages 397-399 (October 25, 1924); "High-Frequency Radiations and Living Beings," by Georges Lakhovsky. *Radio-Revue* (Paris), vol. 3, pages 210-214 (November, 1924).

How to Build an Amplifier

IN POPULAR RADIO for July will appear a complete description of a two-stage resistance-coupled amplifier, for use with any of the receivers described in the series "Simple How-to-Build Articles for Beginners."

an interesting fact opposing any idea that these piezo-electric effects may be important.

It is desirable, of course, that one additional group of investigators be heard from. This is the group of scientists who keep continuous records of the magnetic constants of the earth and of related characteristics of the earth's electricity. There has been no report as yet of any earthquake effect observed on these records but it does not appear that anyone has looked for it very carefully.

Designating Radio Waves by Octaves

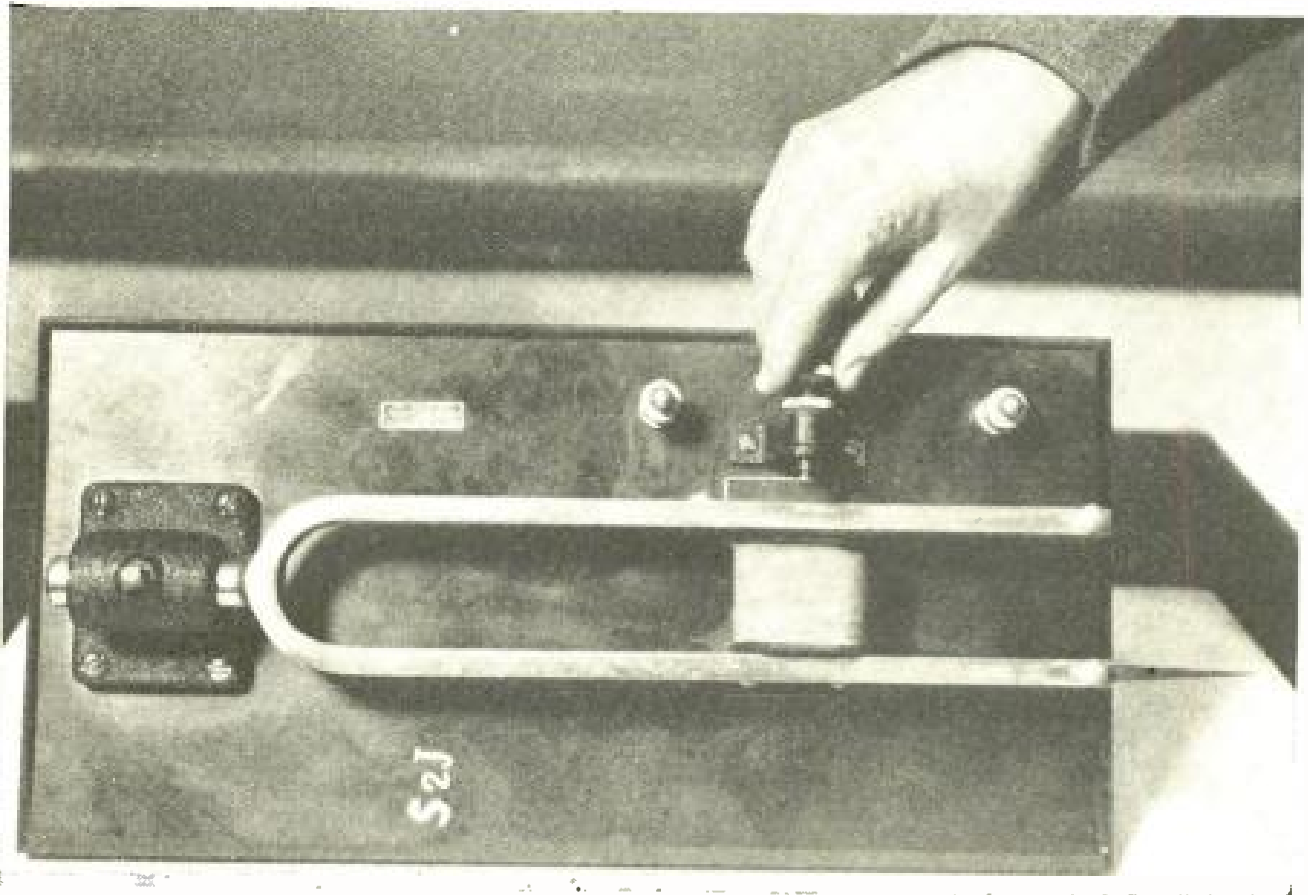
THE designation of radio waves by wavelength has so many disadvantages from the viewpoint of the scientist that there is continual effort to alter the system, as, for example, the recent attempt—which seems largely to have failed—to persuade the fans to talk in cycles or in kilocycles. Now comes a new plan pointed in the same direction, a plan which borrows its essential idea not from electrical engineering but from music.

Everyone knows that the notes in modern musical notation are divided into successive

series of eight notes, or "octaves," one octave covering a frequency range equal to twice the frequency of its first note. One of the notes called "C" on the piano has, thus, a frequency of approximately 256 cycles a second. The octave above this is twice 256, or 512 cycles a second. The next octave is 1,024, the next is 2,048, and so on until the limit is reached.

In a recent paper submitted to the Institution of Electrical Engineers, in London, Lieutenant Colonel K. E. Edgeworth, late of the British Royal Signal Corps, and Mr. G. W. N. Cobbold, advocate the application of this same octave system to radio.* If the beginning of the series of octaves be set arbitrarily, at a frequency of one cycle a second and if each octave above this be numbered in succession, a radio-frequency of 500 kilocycles (600 meters) will lie almost at the beginning of the nineteenth octave and will be designated, in figures, as a "pitch" of 18.932 octaves. Very short radio waves (five meters or thereabouts) will range upward into the 26th octave.

* "The Measurement of Frequency and Allied Quantities in Wireless Telegraphy," by Lieut.-Col. K. E. Edgeworth and G. W. N. Cobbold. Advance proof from the Institution of Electrical Engineers (London), 1 page, 1925, to be published in the *Journal* of that Institution.



From a photograph made for POPULAR RADIO

A SCIENTIFIC STANDARD OF PITCH

Musical tones are designated in "octaves," each octave ending on a note just twice the frequency of the note with which it began. This tuning fork is driven by the electro-magnetic coil placed between its arms and has a definite "pitch" or frequency. This same method of "pitch" and "octaves" is now proposed for the designation of radio frequencies.



From a photograph made for POPULAR RADIO

AN APPLICATION OF PIEZO-ELECTRICITY IN RADIO

The property of quartz crystals, by virtue of which they become electrified under pressure or strain, has been applied in this piezo-electric oscillator, designed for use as a standard wavemeter and constructed by the General Radio Company. In the small case between the fingers is a tested quartz crystal. It will oscillate at one definite frequency only. Resonance of this definite frequency with that of any oscillation entering through the coupling coil at the right is indicated by the meter in the center.

the hotter and whiter stars, there is reason to believe that atoms are being made and re-made by transformations of the atomic structure. The distances of the great nebulas are so vast that the amount of light energy which they are sending out must be almost incomprehensibly enormous. Otherwise we would not see them at all. The source of this energy is not known surely, but there is much reason to believe that it comes mainly from the transformations of the atoms of matter.

The Earthquake Left Radio Alone

ON the evening of Saturday, February 28, 1925, the northeastern part of the United States was visited by a sharp but practically harmless earthquake. Millions of people felt the shock, buildings were shaken, minor damage was done here and there. Because of the time of the evening and the area covered by the shock it is certain that many thousands of persons were listening at radio receivers at the time. Nevertheless, there has been no report of any unusual crash of static or other disturbance accompanying the tremblor.

In at least one instance an experienced radio engineer (Mr. Greenleaf W. Pickard) was actually engaged in measuring the field strength of a distant station at the instant of the shock. No disturbance was observed.

This negative result is more important than it might seem. It has been claimed, notably by several French scientists, that earthquakes are accompanied and preceded by unusual displays of static. It is not impossible that this be true. The rocks of the earth are composed in large part of the mineral called quartz. This mineral has the property, you remember, of generating an electric impulse when subjected to stress—the so-called piezo-electric property.* It would be by no means surprising, therefore, if the vast forces released by an earthquake and the tremendous rock masses which it sets into vibration caused a considerable release of piezo-electric forces, with a resultant effect on radio reception or on the production of static.

That no such effect was observed at the instant of the earthquake of February 28 is

* On the piezo-electric properties of quartz see the article by Professor Walter G. Cady in POPULAR RADIO for April, 1925, pages 357-365.

Wilson Observatory.* Dr. Hubble has succeeded in obtaining, by a rather complicated astronomical method, a measure of the distance of two of these nebulas from the earth. The figures are staggering. They come out as nearly a million light-years, approximately 5,500,000,000,000,000 miles.

This distance reaches far beyond any previous estimate for the size of the visible universe and far beyond any possible figure for the dimensions of the group of stars to which we belong, this group including all the stars that we can see with the unaided eye. It is probable, therefore, that the spiral nebulas are really not parts of our own particular universe at all but are other "island universes" set off at vast distances in the depths of space.

To the person endowed with even the least bit of philosophic imagination the most interesting feature of this new and remarkable discovery is the way in which it expands the limits of our knowledge on the upper end of

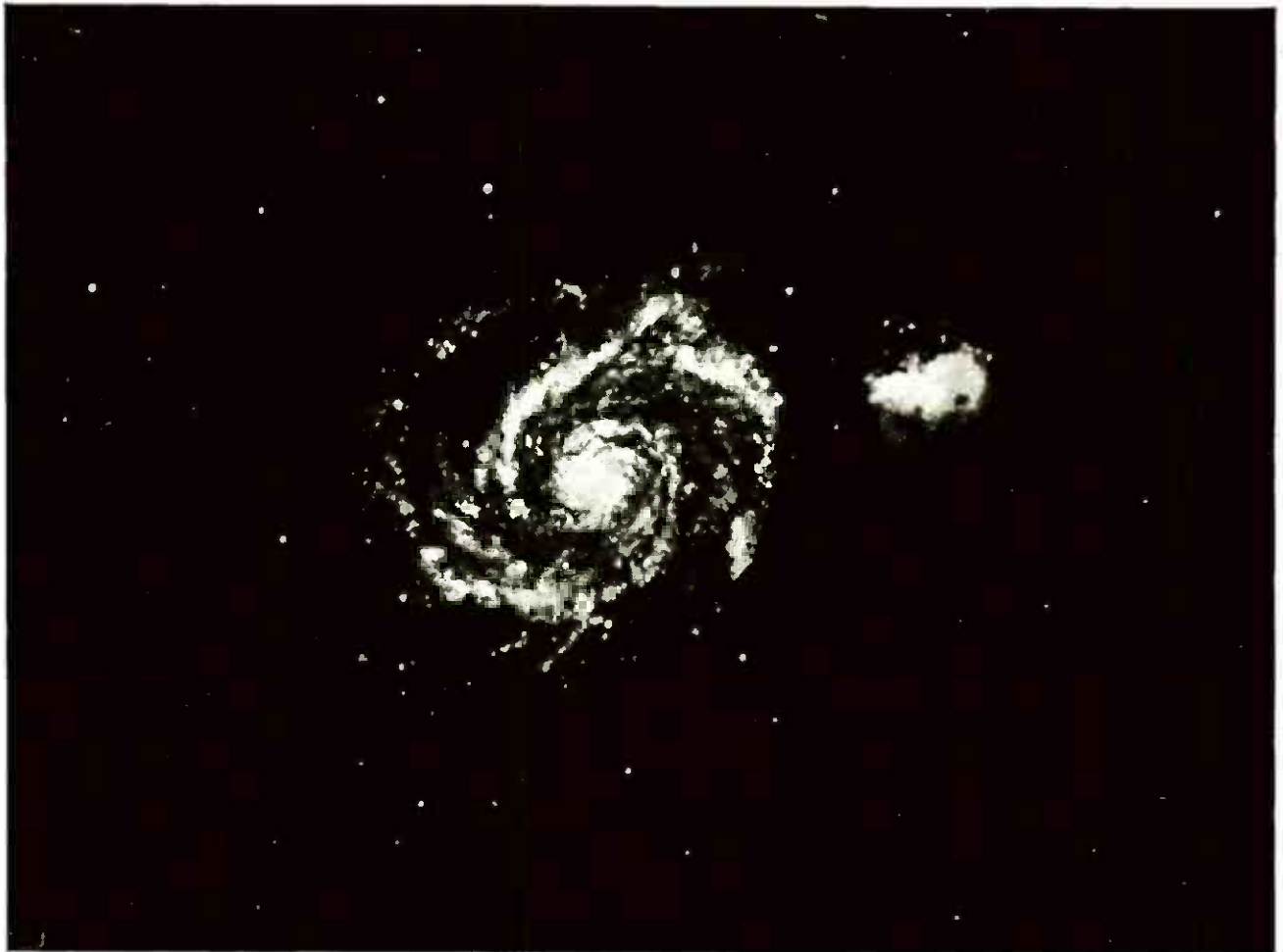
* Dr. Russell reports this paper in the *Scientific American* (New York), vol. 132, page 165 (March, 1925). There is a brief report by Science Service, Washington, D. C., in *Science* (Lancaster, Pa.), vol. 61, number 1573, page x (February 20, 1925).

the size-scale, much as increasing knowledge of the atom has expanded it on the lower end.

In the realm of the very tiny we now know the minute universe of the atom. Above this in size comes the realm of ordinary things such as we touch and see and taste here on earth. Next is the solar system; vast when compared to ordinary objects, tiny when compared with the spaces between the suns of our particular universe, the suns which we call the stars. And now, if Dr. Hubble is right, we must add a still larger unit to our picture. There are other complete universes off in space, universes as large or larger than our own. Each of them possesses, no doubt, its millions or billions of stars. Each may have its solar systems, its planets like the earth, possibly its creatures who touch and see and taste things as do we.

And each of them has, we know, its atoms like our own atoms, for the spectral lines of these far off atoms of hydrogen and helium and other elements come to us from Dr. Hubble's most distant nebulas exactly as they do from atoms of these same chemical elements here on earth.

In some of the nebulas, in fact, as well as in



Brown Brothers

ANOTHER UNIVERSE FAR OFF IN SPACE

Recent measurements made by Dr. Hubble, of Mount Wilson Observatory, show that this great nebula is so far away from the earth that light, which moves at the same rate as radio waves (186,000 miles in a second) needs over a million years to reach us. We see the nebula not as it is, but as it was long before there were any men on earth.

went even farther. "It is impossible to emphasize too strongly," he said, "that nothing in this communication is to be taken as implying that any correlation . . . with pathological conditions has yet been shown, or *a fortiori* that any justification—physical, pathological, nosological or clinical—exists for the direct use of either the Abrams or Boyd apparatus in diagnosis or treatment." The notorious "Electronic Reactions of Abrams"—frequently called "E. R. A."—remain as completely discredited as they have always been since they were first subjected to scientific test.

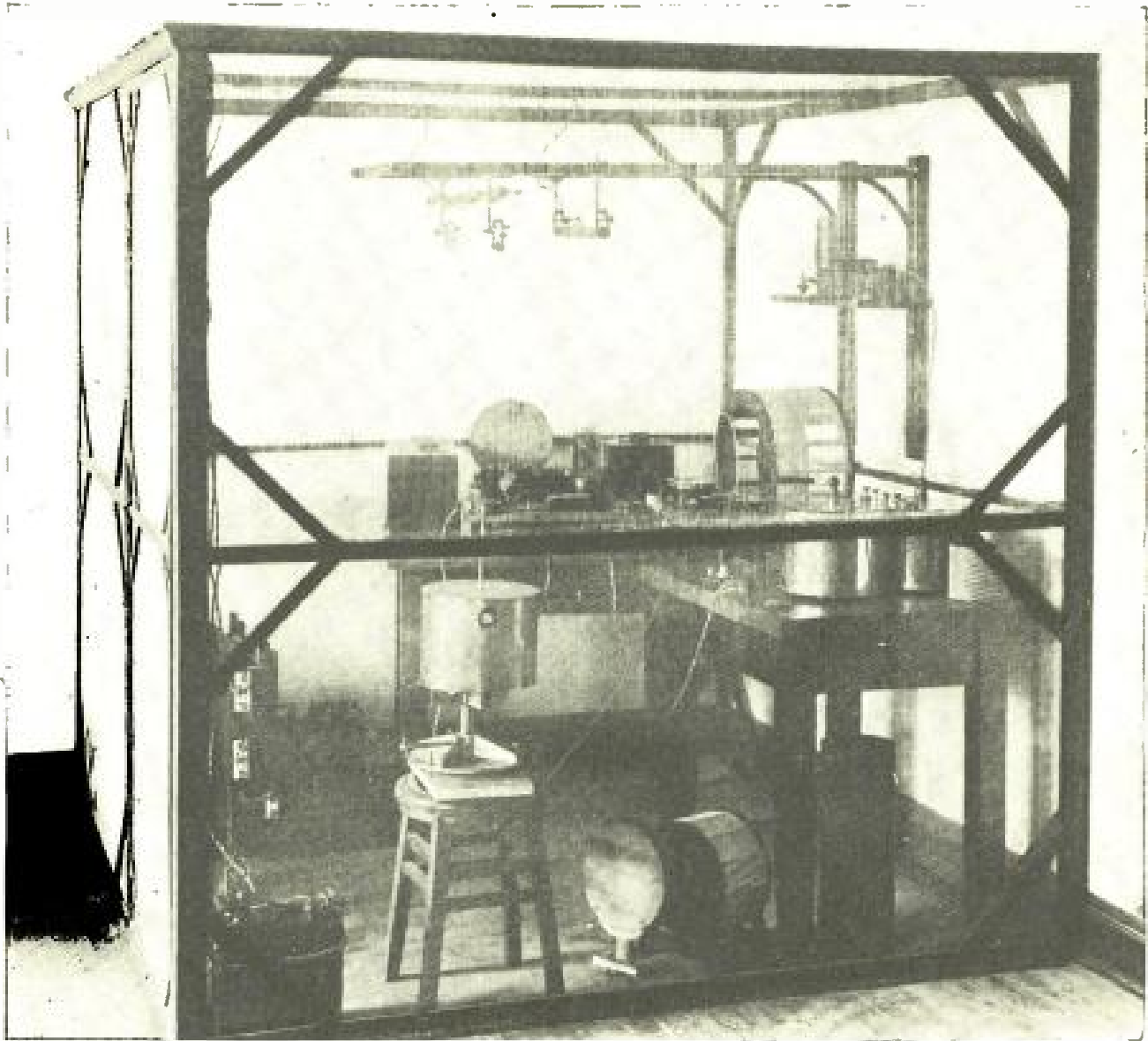
Discovering Another Universe

WHEN an earthly astronomer looks out into the depths of space he sees not only a vast assemblage of stars but also a considerable number of curious spiral-shaped clouds of

shining matter, the so-called spiral nebulas. Most of these are too small to be visible to the naked eye but a good telescope shows them very well.

Their exact nature has always been a good deal of a mystery. Some astronomers have believed them to be relatively small, indicating, perhaps, a solar system in course of formation, a stage similar to one that our own earth and sun and planets may have passed through a few billion years ago. Other astronomers have believed the nebulas to be much vaster objects; true universes, each one more or less like the cloud of stars of which our sun is one.

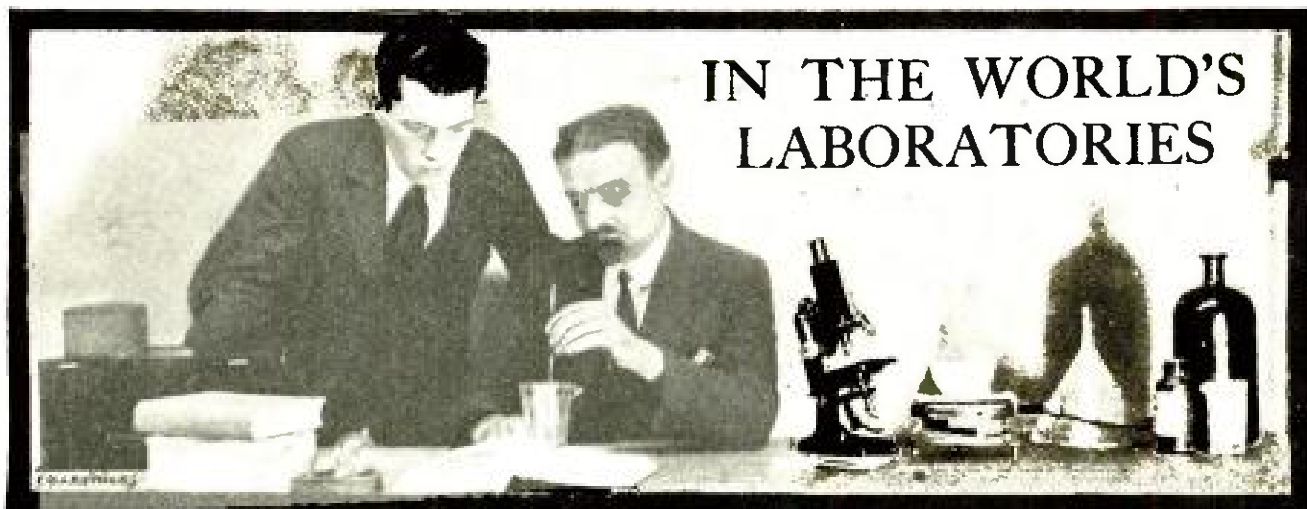
One of the most important papers presented at the recent meeting of the American Astronomical Society, in Washington, was a report, read by Professor Henry Norris Russell of Princeton, on some recent investigations on this subject by Dr. E. P. Hubble of Mount



Bureau of Standards

A CAGE THAT HELPS TO KEEP OUT STRAY WAVES

The United States Bureau of Standards has constructed this cage of copper-wire netting, inside which radio apparatus may be placed for the prevention of interference from outside sources. Dr. Boyd makes use of a similar shielding procedure in his experiments on the supposed "emanations" from chemical substances.



IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

Can Chemicals Be Distinguished by Radio Emanations?

A FEW weeks ago in London the Royal Society of Medicine listened to a report which has been widely interpreted in the British newspapers as supplying some scientific evidence in favor of the discredited and dwindling cult of Dr. Abrams.* This interpretation is entirely incorrect and before the incident is seized upon for the benefit of Abrams' practitioners in this country it is desirable to make the real facts as widely known as possible. Furthermore, the experiments newly reported have considerable interest, although they cannot yet be called really convincing.

The experiments have to do with the work of Dr. W. E. Boyd, of Glasgow, Scotland. Dr. Boyd began by experimenting with the Abrams apparatus and methods. He soon abandoned them. There survived, nevertheless, a conviction that some kind of radiation might be given off by living bodies and by chemicals and other substances and might be detected. The Abrams methods, although useless themselves and surrounded by a vast accretion of fraud and quackery, might contain, Dr. Boyd felt, the germ of some new and true idea.

After a time Dr. Boyd's experiments came to the attention of London physicians and scientists. A committee was sent to Glasgow to inspect the experiments. The test selected was the very simple one of distinguishing, by Dr. Boyd's methods, between two samples of medicine known to the inspecting scientists but unknown to the operators of the apparatus. The tests were prevailing successful; much more so, it is reported, than could be explained by the laws of chance. A report of these tests was then presented to the London Society by Sir Thomas Horder.

Dr. Boyd's apparatus resembles that of the

* For an account of the Abrams ideas and their failure to stand up under test see POPULAR RADIO, for November, 1924, page 506.

Abrams cult in that the mysterious "reactions" on the skin of a human "subject" are employed as the detector of what is going on.† It differs from the Abrams devices in consisting of standard units of resistance, inductance, capacity and the like. It is reported that an essential of success is the complete shielding of the apparatus against all forms of stray electromagnetic waves.

The explanation of the Glasgow successes remains in doubt. There is no reason whatsoever to impugn the complete good faith of Dr. Boyd. His interpretation is that radiations (he calls them "emanations") are given off by most substances and that these radiations enabled his apparatus to distinguish between the test specimens of medical chemicals. It may be so, but scientists as a whole remain unconvinced. A great deal more experimentation is necessary to establish so revolutionary a conclusion.

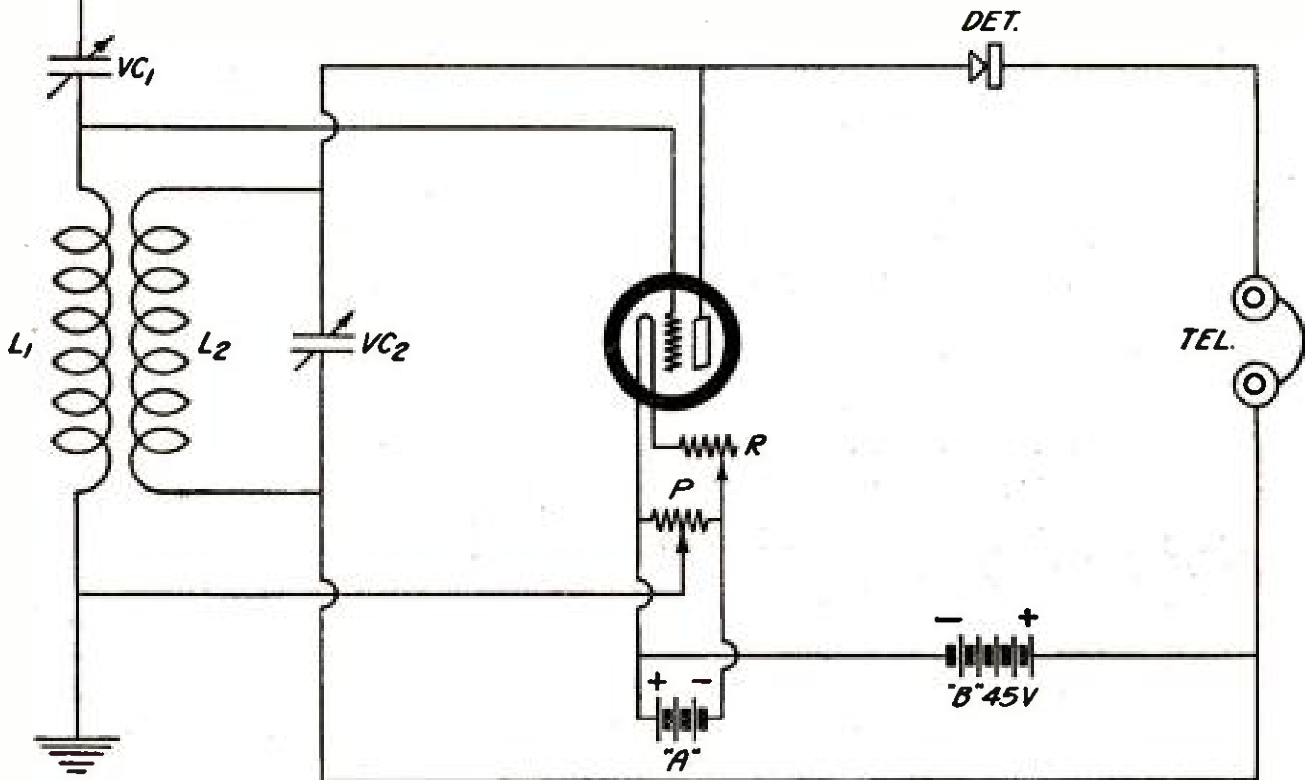
The necessary inclusion in the "circuit" of so variable and undependable an indicator as the body of a human subject is still—as it was with Abrams—a cause of extreme suspicion that the results are psychological rather than physical. Dr. Boyd is reported to be working toward the elimination of the human "subject" and the substitution of a vacuum-tube device. This would go a long way toward establishing his case.

Meanwhile there is small comfort for the Abramsites in the Glasgow results. Dr. Boyd specifically denies that his results confirm or support the Abrams methods. In his report to the London meeting Sir Thomas Horder

† "Electronic Reactions," a report of a communication made to the joint meeting of the Sections of Medicine and Electro-Therapeutics of the Royal Society of Medicine, on January 16, 1925, by Sir Thomas Horder, on behalf of himself, Dr. C. B. Hald, Colonel H. P. T. Lefroy, Mr. Whately Smith and Mr. M. D. Hart. Published in the *Lancet* (London), vol. 208, pages 177-181 (January 24, 1925). A more complete account of the Committee's investigations has been issued as a pamphlet entitled "A Preliminary Communication Concerning the 'Electronic Reactions' of Abrams with Special Reference to the 'Emanometer' Technique of Boyd," by Sir Thomas Horder. John Bale Sons and Danielson. London. 56 pages, 1925.

THE CIRCUIT DIAGRAM FOR THE CRYSTAL RECEIVER

FIGURE 4: A novel single-tube and crystal detector receiver, which should enable the experimenter to become familiar with regeneration and radio-frequency amplification. This circuit has quite a remarkable range on the headphones.



minimum limits. The problem in getting a low-loss condenser is to have the electrostatic field distributed throughout a very small area of dielectric, and also to use a dielectric substance which inherently possesses low dielectric loss, or in better terminology, one which possesses high efficiency as a dielectric.

A metal end-plate is, however, of use in a number of circuits as a shield for the rotor plates in eliminating body capacity from the operator's hand. The same thing can be done with a dielectric end-plate by placing a small shield on the panel.

The question of comparison of eddy-current losses in these two types of condensers is rather foolish, because if the tuning coils are placed so that currents are generated in the end-plates of the metal end-plate condenser, they will also be induced in the rotor plates of the dielectric end-plate condenser, and the difference in the losses of the two would be so small, that they would furnish no talking point whatsoever.

In fact, there is not much to choose between these two types, if they are both well-designed and well-made articles constructed of the best materials.

A Simple Radio-frequency Circuit

QUESTION: Please give me a hook-up for an experimental circuit that embraces one-stage of radio-frequency am-

plication with regeneration and a crystal detector. I am interested in simple experimental hook-ups, but I have not yet progressed far enough to conquer the complicated ones. Will you give me an easy one to start in on?

WILLIAM R. DUNN

ANSWER: You will find the diagram of a remarkable circuit shown in Figure 4. This circuit is marked for its simplicity of construction and operation and its capacity to pick up DX signals. The parts you will need are the following:

- L1 and L2—Honeycomb coils, size L-50;
- VC1 and VC2—variable condensers, .0005 mfd.;
- DET—crystal detector;
- R—filament rheostat, 20 ohms;
- P—potentiometer, 400 ohms;
- TEL—telephones.

Use one of the standard makes of hard amplifier tubes, such as the UV-201-a, C-301-a, De Forest DV-3 or Brightson "True Blue" tubes or others. Coils L1 and L2 should be mounted in a double coil mounting, so that the coupling between L2 and L1 may be varied to control the regeneration in co-operation with the condenser VC2. Practically all the tuning to wavelength is done with condenser VC1.

plains how to use these tubes. The most important fact to keep in mind when using the new A.C. tubes is that they operate best as audio-frequency amplifiers with 90 turns on the plate and $4\frac{1}{2}$ volts "C" battery. As detectors, they operate best with no "C" battery and with a direct return from the grid to the cathodes and with $67\frac{1}{2}$ volts on the plate. As radio-frequency amplifiers, their best operation is with $67\frac{1}{2}$ volts on the plate and with a $4\frac{1}{2}$ -volt "C" battery.

A Receiver for Short-wave Reception

QUESTION: Please give me a circuit design and constants for a regenerative receiver in which one-stage of audio-frequency amplification is employed. I want to use the receiver on short-wave transmitters. I would like to make coils for this receiver myself; please give me the proper sizes for them.

T. A. READY

ANSWER: The circuit you have requested is shown in Figure 3. You will need the following parts:

- L1—Honeycomb coil, size L-25 (with 12 turns removed from the outside);
- L2—Honeycomb coil, size L-25;
- L3—Honeycomb coil, size L-25 (with 10 turns removed from the outside);

- L4, L5 and L6—choke coils;
- VC1—variable condenser, .0005 mfd.;
- VC2—variable condenser, .0003 mfd.;
- GC—mica fixed condenser, .00025 mfd.;
- GL—variable grid-leak;
- R1—filament rheostat, 6 ohms;
- R2—filament rheostat, 20 ohms;
- AFT—audio-frequency amplifying transformer;
- TEL—telephones.

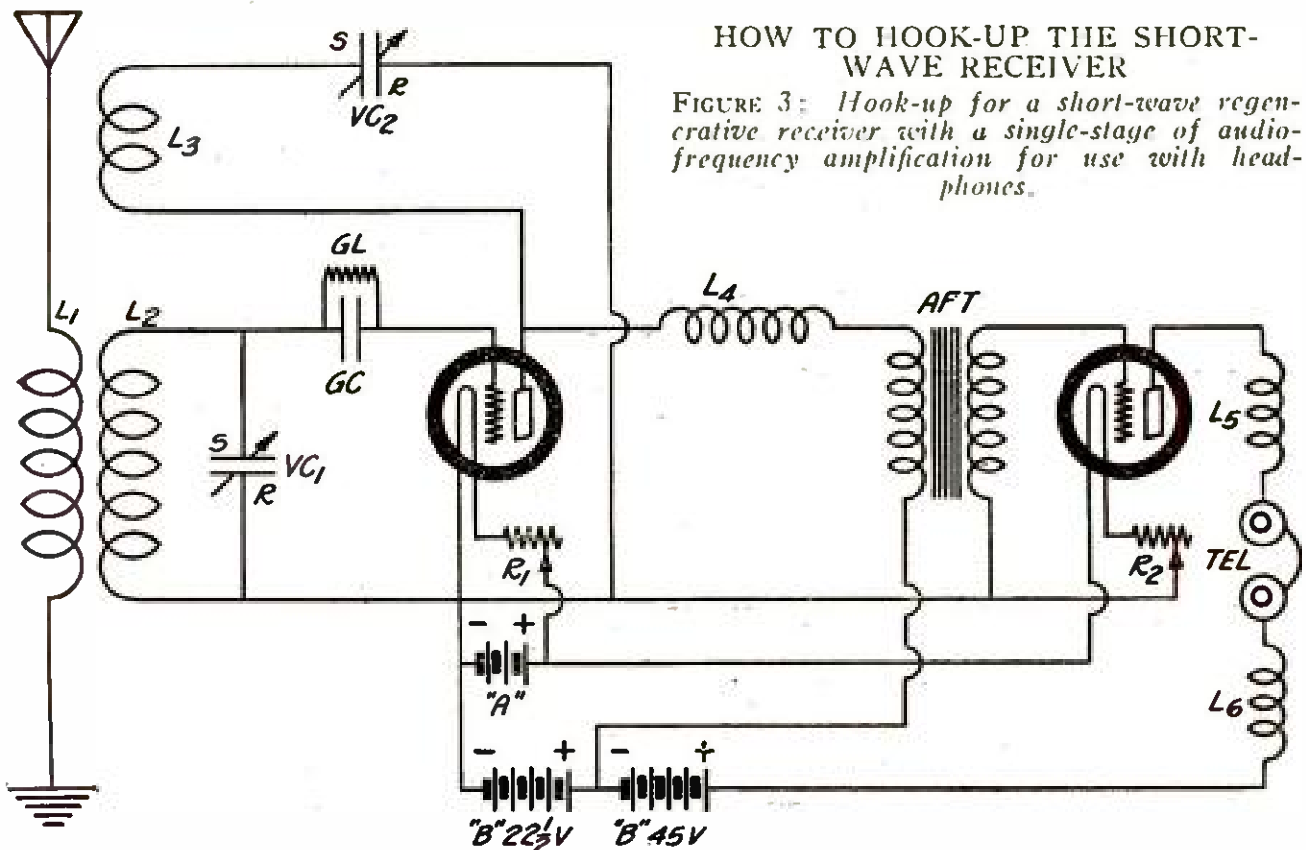
Coils L4, L5 and L6 should be made by winding 70 turns of No. 38 DSC wire on a bakelite tube that is 2 inches in diameter. It is recommended that a UV-200 tube or C-300 tube be used for the detector and any of the standard, hard, amplifying tubes for the amplifier.

Metal End-plates vs. Insulated End-plates

QUESTION: Which do you believe to be the lowest type of construction, the variable condenser employing metal end-plates or one employing end-plates of dielectric material?

T. HOLTEN

ANSWER: Your question has no bearing upon dielectric loss in a variable condenser. It is possible to make variable condensers by either of these two methods and reduce the dielectric loss in both types to about the same



HOW TO HOOK-UP THE SHORT-WAVE RECEIVER

FIGURE 3: Hook-up for a short-wave regenerative receiver with a single-stage of audio-frequency amplification for use with headphones.

Insulators for the Antenna

QUESTION: What type of insulator do you recommend as especially good for an outdoor receiving antenna?

F. MACDONALD

ANSWER: Use either a glass or porcelain insulator, moulded in one solid piece without any metal parts. The insulator should have a number of corrugations along its surface. If a porcelain insulator is used, it should be the glazed type.

Static Charges on an Antenna

QUESTION: I recently noticed a little ticking sound inside of my receiving set; upon lifting the lid and looking about, I noticed a little spark between the plates of my antenna, series condenser. The rate of discharge across these plates remained constant for a while and then slowed up until finally the sparks occurred about once in every three or four seconds. Finally they ceased altogether. I disconnected all the batteries from the set, but this did not affect the spark. Where was the electricity coming from?

C. A. HUNTER

ANSWER: This discharge from antenna to ground was due to an electrostatic condition by

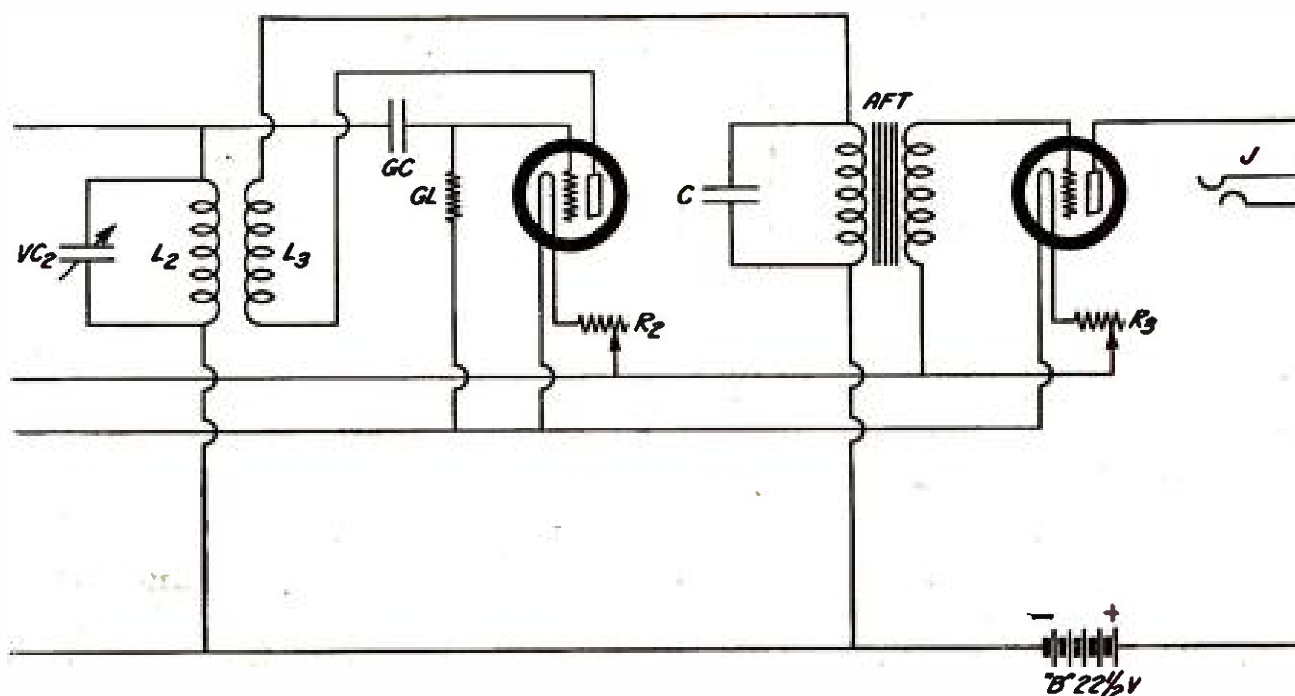
which the antenna (which is insulated from ground by the air space between the plates of your variable condenser) became charged. When the voltage of this charge became high enough to break down the gap between the plates of the condenser, a small spark jumped the gap and made the clicking sound. This charging of an antenna often occurs when there is a sudden change in temperature or when some other unexplained atmospheric condition prevails. It is quite harmless.

Circuit for the New A.C. Tubes

QUESTION: In the May issue of POPULAR RADIO is an announcement of a new A.C. tube called the "McCullough" tube. Can this tube be used in any regular receiving set, or does it need a special apparatus to go with it? Can I use the tube in the set I already have, or would I have to use a circuit of special design? I am interested in the possibilities that this tube offers, particularly if it can be incorporated in ordinary receivers.

F. A. REARDON

ANSWER: The new "McCullough" A.C. tubes can be used in a few of the ordinary tube circuits if they are modified slightly. However, it might be difficult for the unskilled man, who is not familiar with the special characteristics of these tubes, to incorporate them in his own set. In this number of POPULAR RADIO (see page 511) is an article that tells how to build a set using five of these tubes and that ex-



the variometer, VAR. The three tubes take about $\frac{3}{4}$ of an ampere on the filaments and about 5 milliamperes plate current.

What Is a Kilocycle?

QUESTION: Some of the broadcasting stations are recorded in kilocycles rather than in wavelength. Just what does the word "kilocycle" stand for?

M. HUNTER

ANSWER: A kilocycle means a thousand cycles ("kilo" meaning thousand). When you notice that the frequency of any broadcasting station is given in cycles or kilocycles instead of in wavelength, you should remember that this applies to the frequency of the wave that is being transmitted. In other words, if a station is designated as transmitting at a frequency of 86 kilocycles, it means that the oscillating current in the antenna of this station vibrates at the rate of 86,000 cycles a second. Of course, the frequency of this current determines the wavelength on which the station transmits as the velocity of the transmitted wave is constant.

The Ground Clamp

QUESTION: I have tried four or five times since I have obtained my new radio set to solder a wire on to the cold water pipe. At first I tried to do it with an ordinary tinsmith's soldering iron, but the iron became cold before the solder would

melt on the pipe. Since then I have made numerous attempts to do the same job with an electric soldering iron that I have purchased especially for doing this job. It also fails to heat the pipe enough to melt the solder. I have had to use just a wire wrapped around the pipe. Is there not a way to make a more satisfactory connection?

G. S. KINNEY

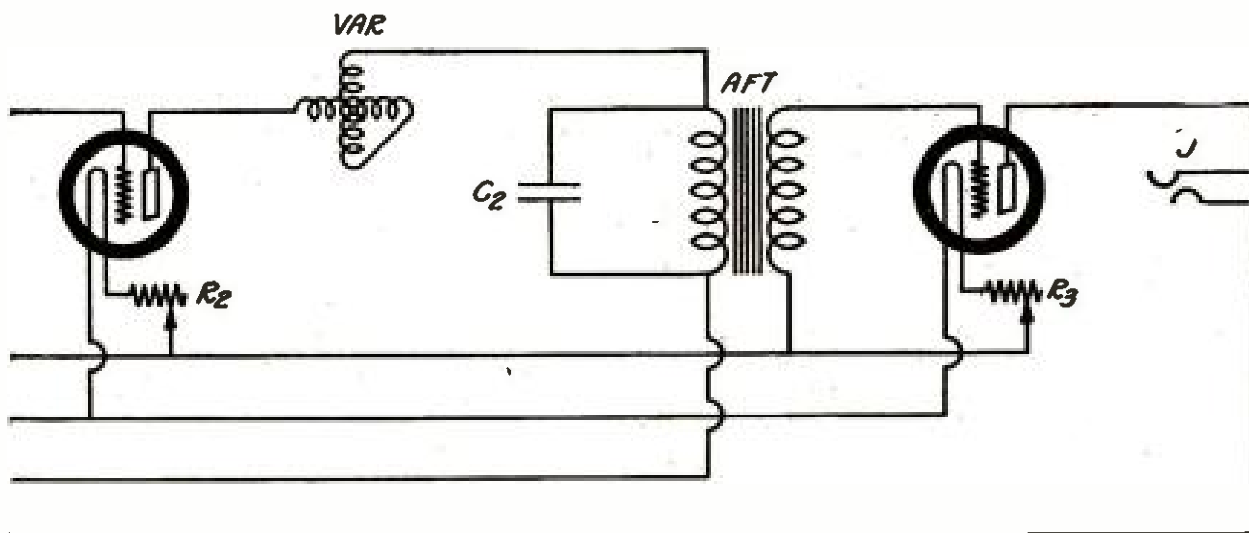
ANSWER: Of course, you would not be able to make a good soldered joint to the pipe while the water is still flowing in the pipe, as the temperature of the pipe could never get above 100 degrees Centigrade, which is the boiling point for water. We recommend that you buy a ground clamp for this purpose. A suitable ground clamp can be obtained from any radio store.

Changing to Single-control

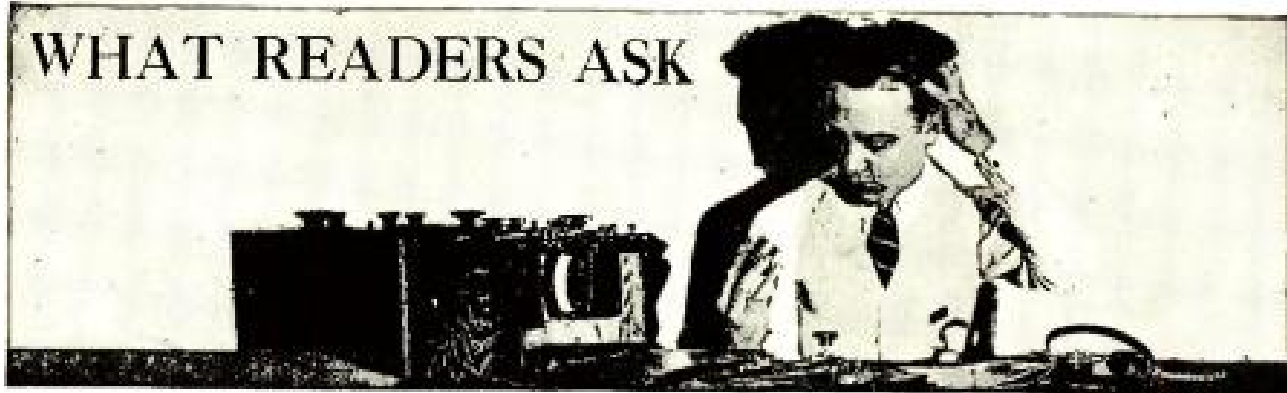
QUESTION: I have a two-stage, radio-frequency amplifier with three condensers for tuning. Would it be possible for me to incorporate the two last stages into single-control, as shown in an article in the April issue of POPULAR RADIO? I have noticed that these two dials run exactly the same throughout the whole scale of dial settings and I think I could use a double unit instead of the two separate

THE CIRCUIT DRAWING FOR THE NEUTRODYNE

FIGURE 1: This diagram shows the hook-up for a single-stage neutrodyne with a regenerative detector and a single stage of transformer-coupled audio-frequency amplification.



WHAT READERS ASK



CONDUCTED BY LAURENCE M. COCKADAY

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

A Single-stage Neutrodyne

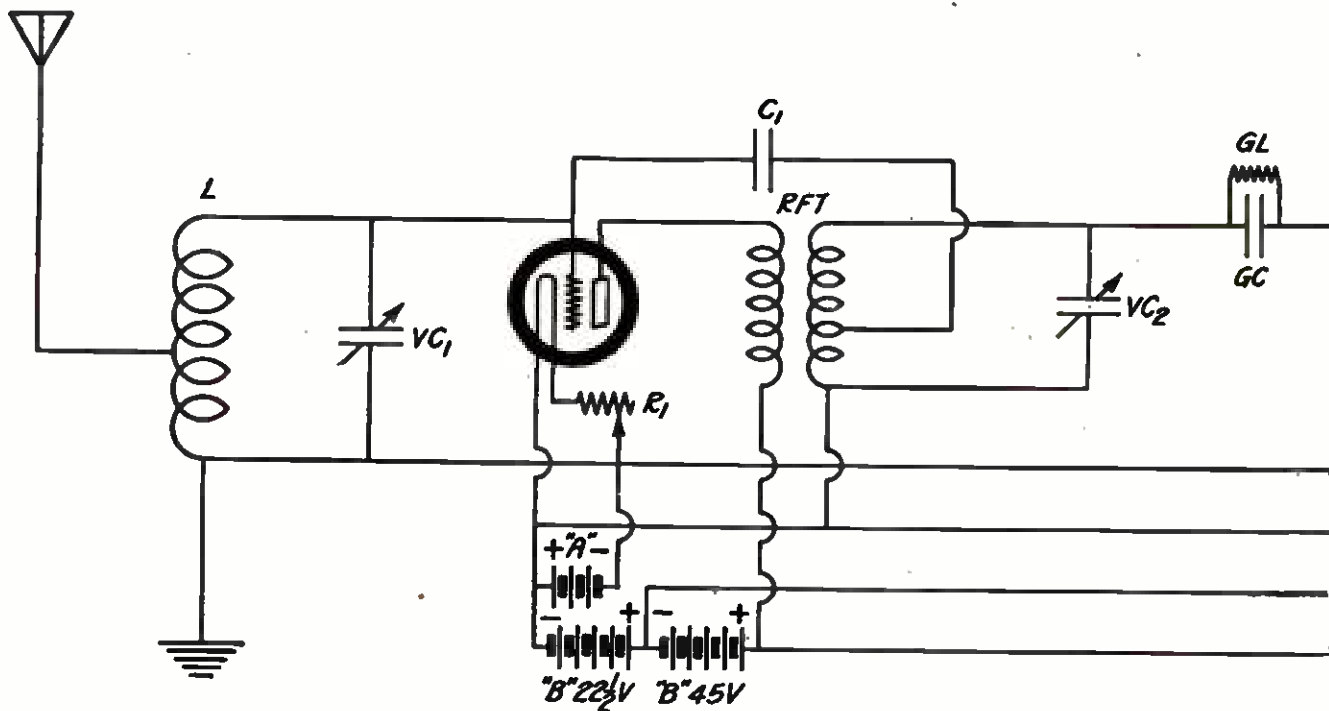
QUESTION: I want to obtain a circuit diagram for a single-stage neutrodyne that employs a regenerative, vacuum-tube detector and a single stage of audio-frequency amplification. I want to use hard tubes throughout. Please tell me what the filament consumption and the plate current would be for a circuit of this type:

T. S. SCRIBNER

ANSWER: In Figure 1 appears the circuit diagram for your consideration. The parts you will need to build up a set employing this circuit are the following:

L—tapped tuning inductance;
 VC1 and VC2—variable condensers, size .00035 mfd.;
 C1—neutralizing condenser;
 C2—mica fixed condenser, .0005 mfd.;
 GC—mica fixed condenser, .00025 mfd.;
 RFT—radio-frequency transformer (neutrodyne coil);
 VAR—variometer;
 R1, R2 and R3—filament rheostats, 20 ohms;
 AFT—audio-frequency amplifying transformer;
 J—single-circuit jack.

The coil L consists of 75 turns No. 24 DSC wire wound on a 3½-inch tube. The antenna tap is taken off at the tenth turn from the bottom of the coil. The tuning is accomplished with the condensers VC1 and VC2 and regeneration in the detector circuit is controlled by





From a photograph made for POPULAR RADIO

The Airway Receiver

MANUFACTURER'S NAME; Airway Electric Appliance Corporation

MODEL; Number 51

NUMBER OF TUBES; five

TYPE OF TUNING; tuned-radio-frequency

TYPE OF DETECTOR; vacuum tube

RANGE ON PHONES; 3,000 miles

RANGE ON LOUDSPEAKER; coast to coast

COST; \$125.00

ANTENNA RECOMMENDED; outdoor

KIND OF TUBES FOR R. F.; 6-volt

DETECTOR TUBE; 201-a or 301-a

AUDIO TUBES; same as above

TYPE OF "A" BATTERY; 6-volt

TYPE OF "B" BATTERY; same as above

DETECTOR "B" VOLTAGE; 45-volt

WAVELENGTH RANGE; 220 to 550 meters

NUMBER OF TUNING CONTROLS; three

"A" BATTERY CURRENT USED; 6-volt

"B" BATTERY CURRENT USED; 90-volt.



From a photograph made for POPULAR RADIO

The Atwater Kent Receiver

MANUFACTURER'S NAME; Atwater Kent Manufacturing Company

MODEL; Number 20

NUMBER OF TUBES; five

TYPE OF TUNING; tuned-radio-frequency

TYPE OF DETECTOR; vacuum tube

RANGE ON PHONES; 2,000 miles

RANGE ON LOUDSPEAKER; 1,500 miles

COST COMPLETE; \$100.00

ANTENNA RECOMMENDED; outdoor or indoor

KIND OF TUBES FOR R. F.; 6-volt

DETECTOR TUBE; 6-volt

AUDIO TUBES; 6-volt

TYPE OF "A" BATTERY; 6-volt

TYPE OF "B" BATTERY; 90-volt

DETECTOR "B" VOLTAGE; 22½-volt

WAVELENGTH RANGE; 200 to 550 meters

NUMBER OF TUNING CONTROLS; three

"A" BATTERY CURRENT USED; 1¼ amperes

"B" BATTERY CURRENT USED; 20 to 30 milliamperes.



From a photograph made for POPULAR RADIO

The Dayfan Receiver

MANUFACTURER'S NAME; Dayton Fan & Motor Company
 MODEL; Number 7
 NUMBER OF TUBES; four
 TYPE OF TUNING; tuned-radio-frequency
 TYPE OF DETECTOR; UV-200 or UV-201-a
 RANGE ON PHONES; 4,200 miles
 RANGE ON LOUDSPEAKER; 4,200 miles
 COST COMPLETE; \$98.00
 ANTENNA RECOMMENDED; single wire, 70 to 120 feet
 KIND OF TUBES FOR R. F.; standard amplifier tubes
 DETECTOR TUBE; standard detector tube
 AUDIO TUBES; standard amplifier tubes
 TYPE OF "A" BATTERY; 6-volt storage
 TYPE OF "B" BATTERY; 90-volt dry-cells
 DETECTOR "B" VOLTAGE; 22½-volt dry-cells
 WAVELENGTH RANGE; 200 to 600 meters
 NUMBER OF TUNING CONTROLS; three
 "A" BATTERY CURRENT USED; one ampere
 "B" BATTERY CURRENT USED; 9 milliamperes.



From a photograph made for POPULAR RADIO

The Radiola Super-eight

MANUFACTURER'S NAME; Radio Corporation of America
 MODEL; Super-VIII
 NUMBER OF TUBES; six
 TYPE OF TUNING; superheterodyne
 TYPE OF DETECTOR; UV-199
 RANGE ON LOUDSPEAKER; (not stated)
 COST COMPLETE; \$425.00
 ANTENNA RECOMMENDED; loop
 KIND OF TUBES FOR R. F.; UV-199
 DETECTOR TUBE; UV-199
 AUDIO TUBES; UV-199
 TYPE OF "A" BATTERY; 6-volt, dry-cells
 TYPE OF "B" BATTERY; 6-volt, dry-cells
 DETECTOR "B" VOLTAGE; 45 volts
 WAVELENGTH RANGE; 220 to 550 meters
 NUMBER OF TUNING CONTROLS; two
 "A" BATTERY CURRENT USED; .36 ampere
 "B" BATTERY CURRENT USED; 12 milliamperes.



From a photograph made for POPULAR RADIO



From a photograph made for POPULAR RADIO

The Crosley Receiver

MANUFACTURER'S NAME; The Crosley Radio Corporation
 MODEL; Model 50
 NUMBER OF TUBES; one
 TYPE OF TUNING; regenerative
 TYPE OF DETECTOR; vacuum tube
 RANGE ON PHONES; 500 to 1,000 miles
 RANGE ON LOUDSPEAKER; 500 miles
 COST COMPLETE; \$22.45
 ANTENNA RECOMMENDED; outdoor
 KIND OF TUBES FOR R. F.; none
 DETECTOR TUBE; standard detector tube
 AUDIO TUBES; standard amplifier tubes
 TYPE OF "A" BATTERY; to suit tubes
 TYPE OF "B" BATTERY; 22½-volt
 DETECTOR "B" VOLTAGE; 22½-volt
 WAVELENGTH RANGE; 200 to 600 meters
 NUMBER OF TUNING CONTROLS; one.

The Eagle Neutrodyne

MANUFACTURER'S NAME; Eagle Radio Company
 MODEL; Model B balanced neutrodyne
 NUMBER OF TUBES; five
 TYPE OF TUNING; tuned-radio-frequency
 TYPE OF DETECTOR; vacuum tube
 RANGE ON PHONES; 3,500 miles
 RANGE ON LOUDSPEAKER; 3,000 miles
 COST COMPLETE; \$175.00
 ANTENNA RECOMMENDED; outdoor
 KIND OF TUBES FOR R. F.; UV-201-a
 DETECTOR TUBE; UV-200 and UV-201-a
 AUDIO TUBES; UV-201-a
 TYPE OF "A" BATTERY; 6-volt
 TYPE OF "B" BATTERY; 90-volt
 DETECTOR "B" VOLTAGE; 18 to 22½ volts
 WAVELENGTH RANGE; 250 to 270 meters
 NUMBER OF TUNING CONTROLS; three
 "A" BATTERY CURRENT USED; 1¼ amperes
 "B" BATTERY CURRENT USED; 26 milliamperes.

“What Set Shall I Buy?”

A LITTLE more than a year ago there were only a very few ready-made sets on the market. Today there are about 140, ranging from small and inexpensive crystal receivers, which sell for as low as four or five dollars, to elaborate superheterodynes that run into the hundreds. Those that have been approved by the POPULAR RADIO LABORATORY will be pictured each month until the series is completed. They will be accompanied by brief but specific and authoritative data concerning them—as a helpful guide to the broadcast listener and to the prospective listener who is thinking of selecting the receiver that will best meet his special needs as well as the limitations imposed by his purse.



From a photograph made for POPULAR RADIO

The Pfanstiehl Receiver

MANUFACTURER'S NAME; Pfanstiehl Radio-Company

MODEL; Number 7

NUMBER OF TUBES; five

TYPE OF TUNING; tuned-radio-frequency

TYPE OF DETECTOR; vacuum-tube

RANGE ON PHONES; 4,000 miles

RANGE ON LOUDSPEAKER; 3,000 miles

COST COMPLETE; \$140.00

ANTENNA RECOMMENDED; indoor or outdoor

KIND OF TUBES FOR R. F.; UV-201-a

DETECTOR TUBE; UV-201-a

AUDIO TUBES; UV-201-a

TYPE OF "A" BATTERY; 6-volt storage

TYPE OF "B" BATTERY; 90-volt dry-cell or storage

DETECTOR "B" VOLTAGE; 22½ volts

WAVELENGTH RANGE; 210 to 570 meters

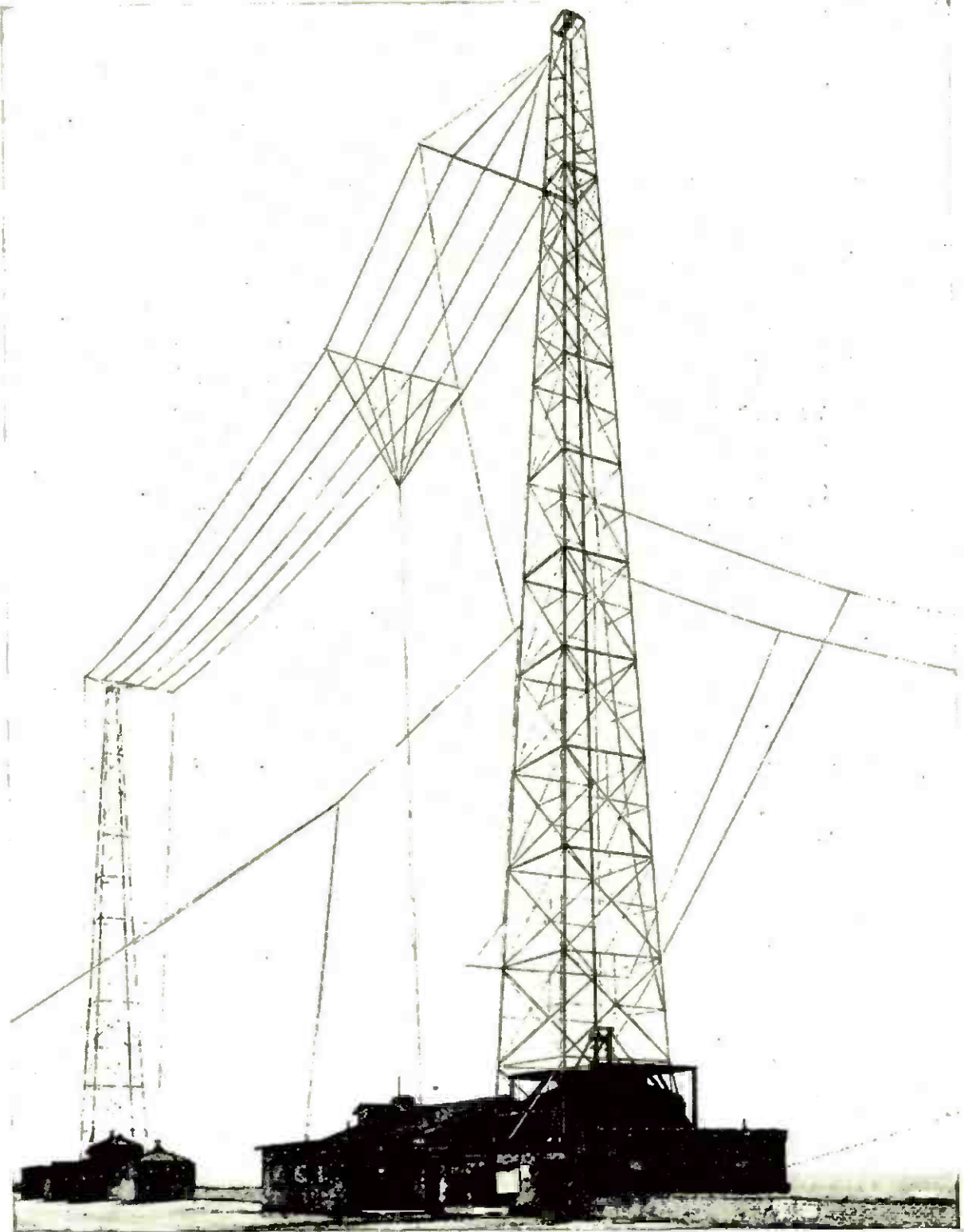
NUMBER OF TUNING CONTROLS; three

"A" BATTERY CURRENT USED; 1.25 amperes

"B" BATTERY CURRENT USED; 15 milliamperes.

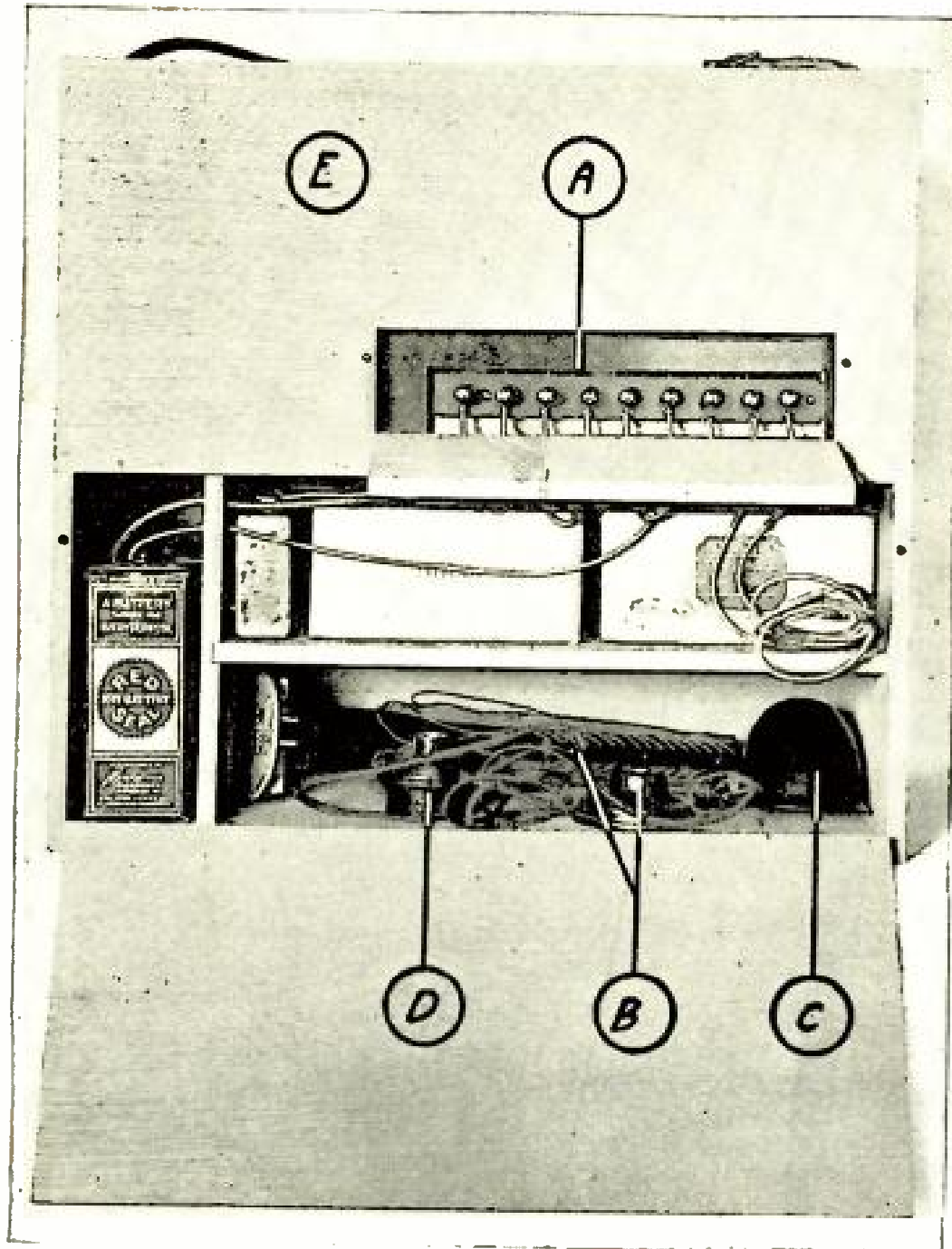
Next, the loudspeaker unit and the horn are put together and stood on top of the carrying case. The loudspeaker plug is then inserted in one of the jacks on the face of the receiver panel.

Thus, everything is in readiness to tune in a broadcasting station by following the tuning instructions that appeared in the descriptive article about the "Town and Country" receiver that was published in the May issue.



WHAT "SUPERBROADCASTING" REALLY MEANS

No recent development has been so significant or so directly affects the destinies of both the broadcaster and of the listener—or of the radio industry—as this new form of broadcasting which is now barely beginning. Station WBZ (shown above) is one of the few such stations now in existence. What it is will be told in POPULAR RADIO for July—next month.



From a photograph made for POPULAR RADIO

REAR VIEW OF THE CARRYING CASE, WHEN OPENED

FIGURE 3: *A is the binding post strip that is protected by a drop door; B is the loop antenna; C is the loudspeaker horn, and D is the loudspeaker unit. Behind E the receiver sets on its shelf. The whole layout of the case makes all the parts accessible for testing and for replacement of the batteries when they wear out.*

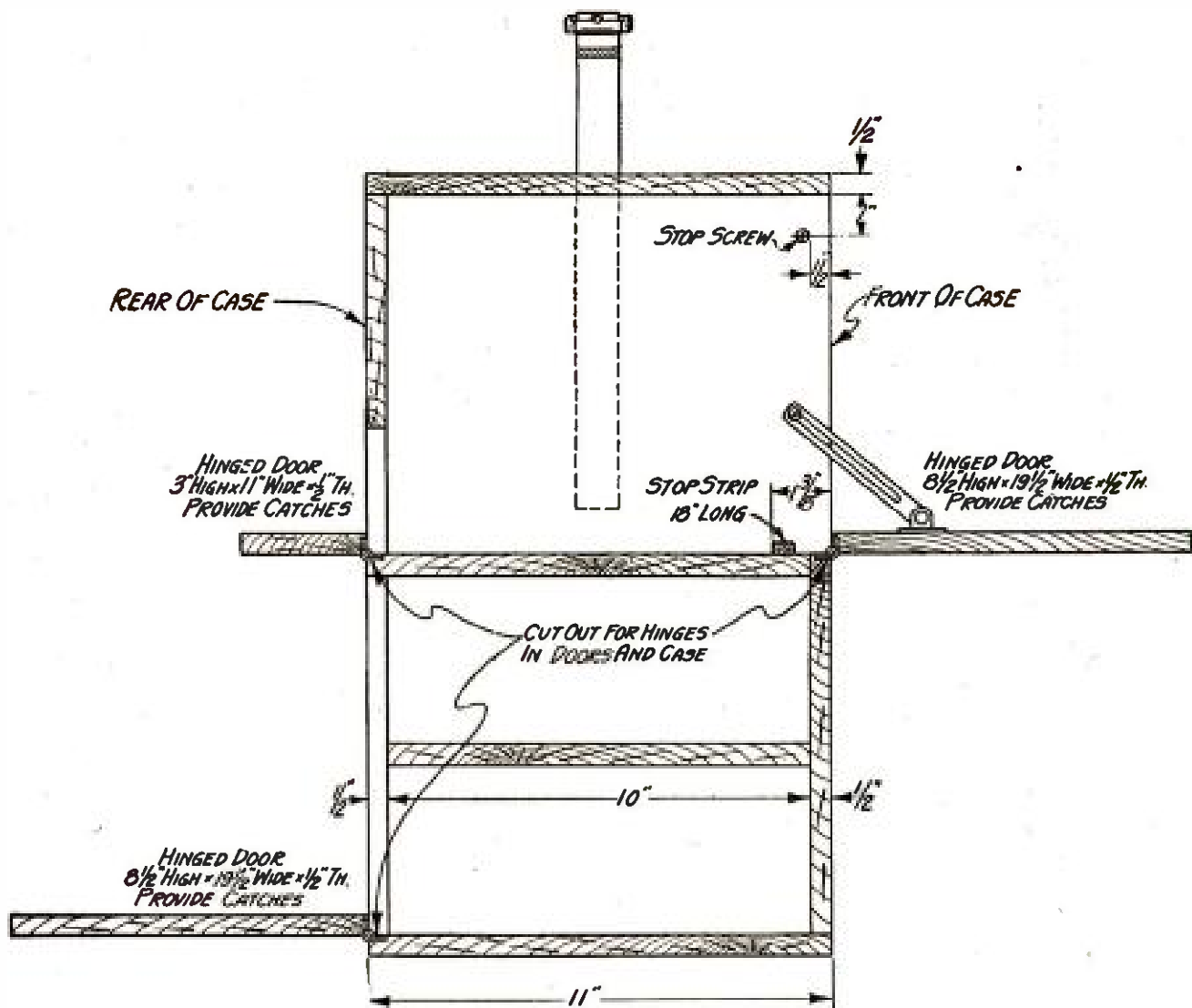
the receiver. The leads to the batteries are then run down through these holes and are connected to the batteries before the latter are slipped into place in the case.

The two leads to the loop antenna are brought down through similar holes and for these two leads two additional holes are provided at the right-hand end of the case (looking from the rear) just above the shelf where the "B" batteries rest. This means that the leads will be outside the case while the receiver is in operation, but when the case is to be carried, these two leads are pulled inside and curled up, as shown in Figure 3.

All of these connections may remain permanent, so long as the receiver and equipment are left in the carrying case. As long as the connections at the receiver and at the batteries are securely made, they are not likely to be jarred loose in transporting the receiver.

Assuming that the connections have been made as noted above and you want to put the receiver into operation, the process is as follows:

The loop is removed from its compartment, unfolded and mounted in its base. The two leads from the receiver are then connected to their proper places on the loop.



CROSS-SECTIONAL VIEW OF THE CASE

FIGURE 1: This working plan, as well as the one on the opposite page, may be turned over to a cabinet maker if you do not want to build the case yourself. This drawing indicates where all the hardware is attached and gives the dimensions of the wood stock that is used.

The first cost of the average portable receiver may be considered high because these receivers, on account of their appearance, are not suitable for home use, and therefore they become an idle investment for several months of the year.

As against these disadvantages of the average portable receiver, there is usually the advantage of small size. However, in the case of a completely self-contained, portable receiver to operate on a loop antenna it is impractical to make the receiver a "vest pocket" affair for the simple reason that the number of tubes and instruments required, with batteries, cannot be squeezed into a container much smaller than a suitcase. Naturally such

a receiver is not suitable to be carried by hand, as on a hike, for instance. Assuming therefore, that the receiver is to be carried in a motor car, a motor boat or in a train, it is only necessary that its size be limited to approximately that of a suitcase. When the case for the "Town and Country" receiver was designed these points were borne in mind.

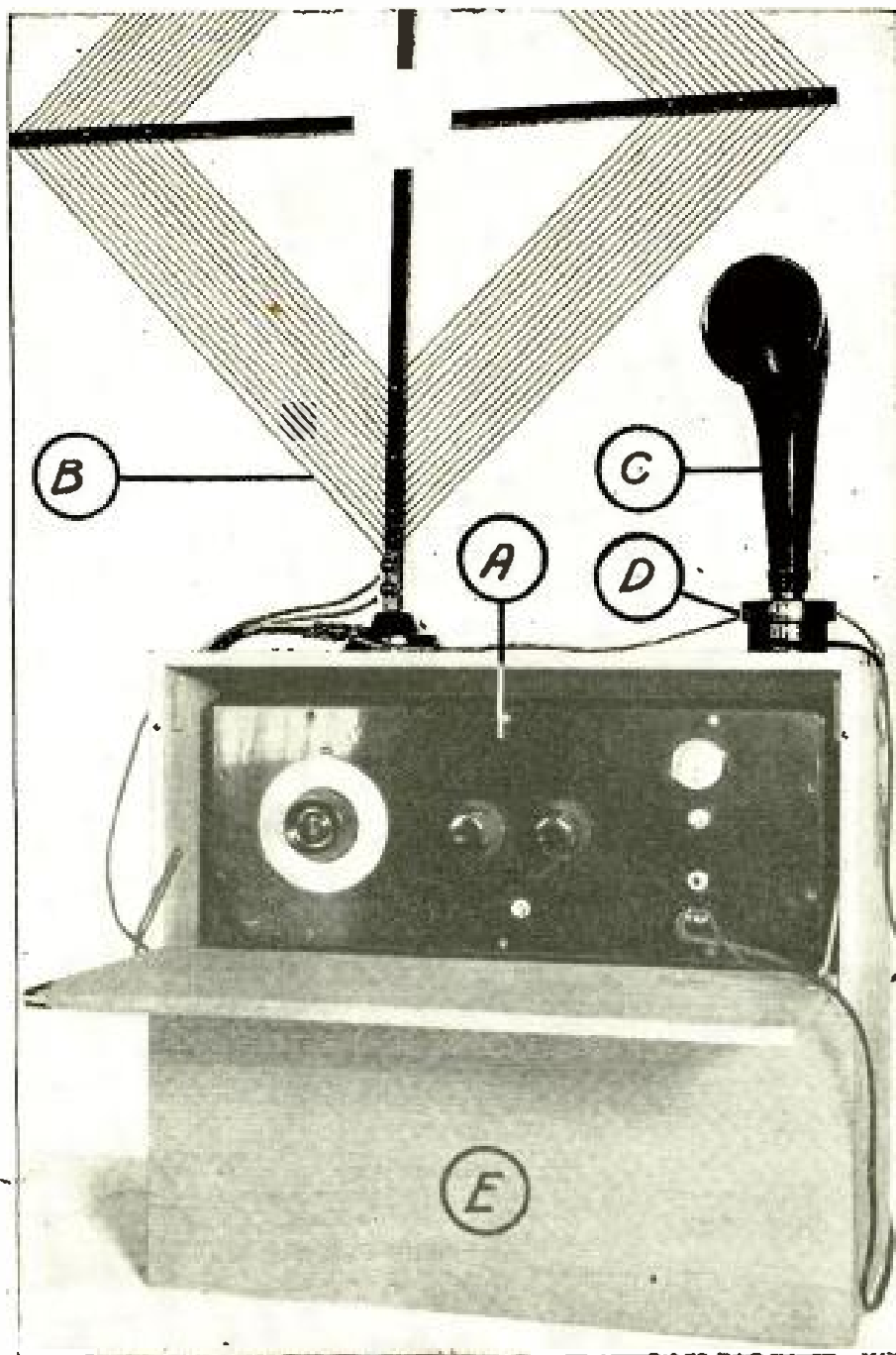
Besides, this is an all-year-round receiver as it may be removed from the carrying case and placed in one's living room where it will appear as a standard 7-inch by 18-inch cabinet and, finally it is sufficiently large to permit efficient spacing of the instruments without overcrowding.

one-sixteenth that of the large type that is used ordinarily with a receiver at home.

Because the cost of these small batteries is approximately half that of the large type, the "B" battery expense of operating a multi-tube receiver that is equipped with the small type batteries is almost eight times that of the same receiver with large-sized batteries. Inas-

much as "B" battery replacement represents almost the entire upkeep cost of the receiver, it is evident that this cost will be extremely high when small batteries are used.

The carrying case which is described in this article, is sufficiently large to accommodate the full size "B" batteries which reduces the cost of operating the receiver.



From a photograph made for POPULAR RADIO

THE RECEIVER WHEN READY FOR USE

A is the "Town and Country" receiver; B the loop antenna, and C and D show the horn and the loudspeaker unit. E holds the batteries and houses the loop and the loudspeaker when they are not in use.



From a photograph made for POPULAR RADIO

THE SET IS EASILY CARRIED ON A MOTOR TRIP

In a few minutes the receiver is ready to receive programs while one stops along the road for luncheon. While the automobile is in motion the set may also be used to relieve the monotony of a long motor trip.

How to Build a Carrying Case

—For the “Town and Country” Receiver

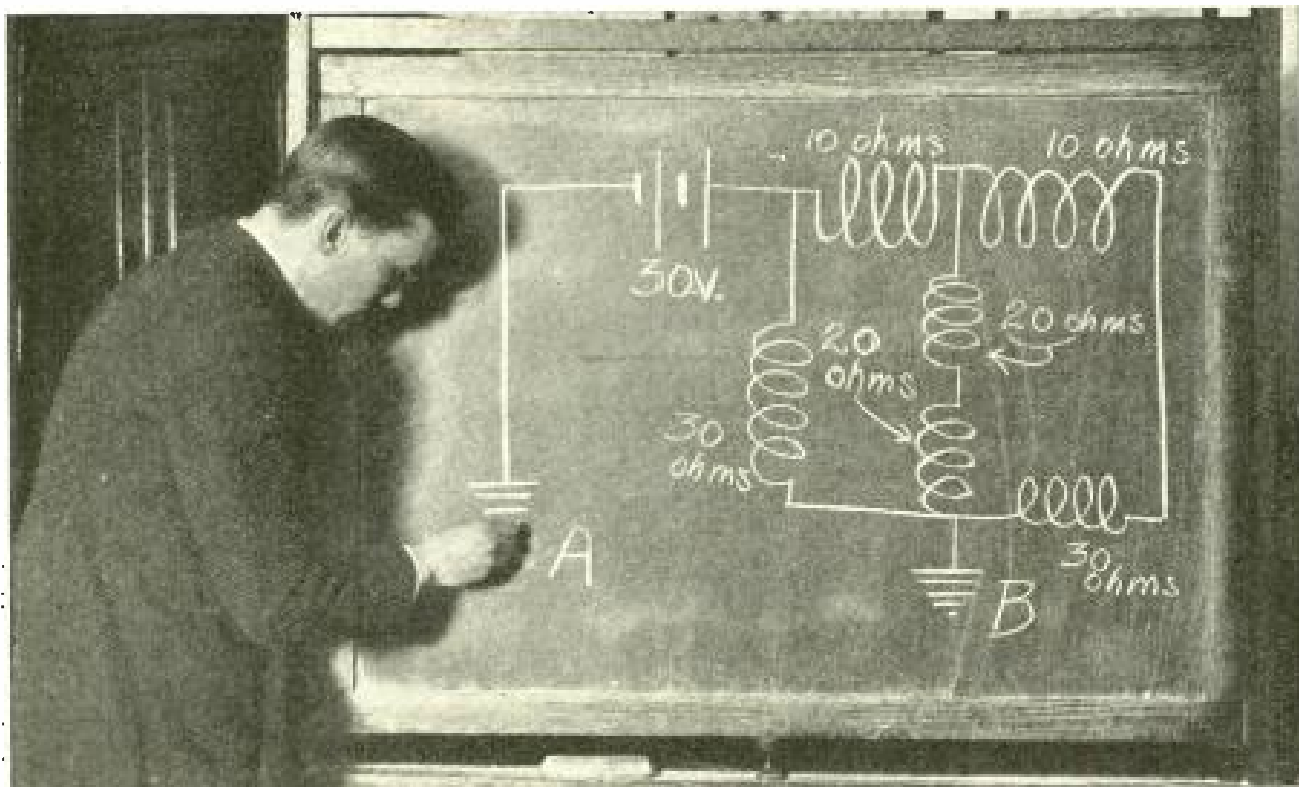
By S. GORDON TAYLOR

HERE ARE THE ITEMS YOU WILL NEED—

- | | |
|--|--|
| <p>A—The “Town and Country” Portable Receiver which was described in full in the May issue;</p> <p>B—Nazeley’s “Selecto” collapsible loop;</p> <p>C—Radion loudspeaker horn, without phone</p> | <p>cap;</p> <p>D—Nathaniel Baldwin “Phono Speaker Unit,” without base;</p> <p>E—Carrying case, working drawings for which appear in Figures 1 and 2.</p> |
|--|--|

The material used in the carrying case that is here described was half-inch mahogany; any other wood may be used, however, if it is thoroughly seasoned. The hardware used consisted of six nickel-plated hinges, one inch long by three-quarters of an inch when open (two used to each door); six one-inch eye hooks for door catches; two four-inch sliding brackets for supporting the front door when opened; one leather strap with buckle, to serve as the carrying handle, forty-six inches by one inch; eight three-quarter-inch, 6/32 round-head, brass, machine screws, each with two washers and a nut, for anchoring the ends of the strap handle; miscellaneous wire nails, wood screws and glue.

THE average self-contained, portable receiver is expensive both in upkeep and in first cost. The upkeep cost is high because usually the “B” batteries used in these sets are of the smallest type and have a life that is only about



HOW AN ELECTRIC CIRCUIT IS REPRESENTED

FIGURE 1: Can you figure out this problem? When you try, remember that *A* and *B* are connected through the ground just as though there were a wire between them.

fresh our memory on combined resistance.

Resistances in series equal the sum of the several resistances.

To find the number of ohms of resistances in multiple, add the reciprocal of the several resistances and take the reciprocal of their sum.

But, if there are only two resistances in multiple, the product of the two divided by their sum is the quicker way to get your answer.

Let's try this circuit problem.

In Figure 1, between *A* and *B*, there are among other units, the following:

Electro-motive force; volts. (E)

Resistance; ohms. (R)

Current; amperes. (I)

Power; watts. (W)

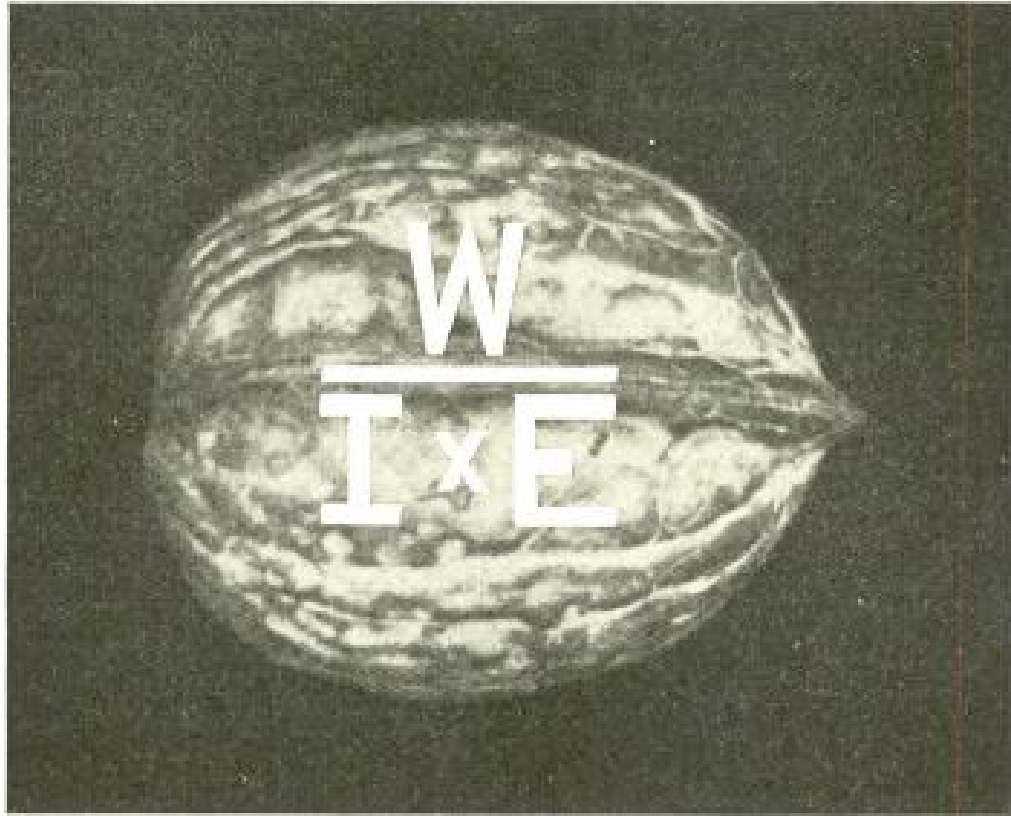
Neglecting the internal resistance of the battery and the resistance of the connecting wires, how many volts, ohms, amperes and watts are there between *A* and *B*?

The answer will be given in Talk No. 3.

¶ *The next Chalk Talk will explain "Current."*

"Radio Movies for the Home"

UNDER this challenging title the inventor of the Jenkins apparatus for transmitting pictures by radio (as first described in *POPULAR RADIO* for April, 1923) is now announcing a new and startling development of his creation. A full and authoritative description of it is now being prepared under the personal direction of Mr. C. Francis Jenkins himself, for exclusive publication in *POPULAR RADIO*.



WATT'S LAW IN A NUTSHELL

Chalk Talks in Radio—No. 2

This is the second of a series of short, informative articles that are written for the radio novice. Keep them for reference.

The first one explained Ohm's law

By J. W. GOOSTREE

IN the last chalk-talk we learned the value of a simple symbol in remembering Ohm's law. Now, we'll use the same symbol to help us remember Watt's law. But, in the upper part of the nutshell instead of having E (voltage) we will use W (watts), and in the lower half of the shell, we will put the symbols $I \times E$. (Current times electro-motive force.)

Here then is Watt's law in a nutshell:

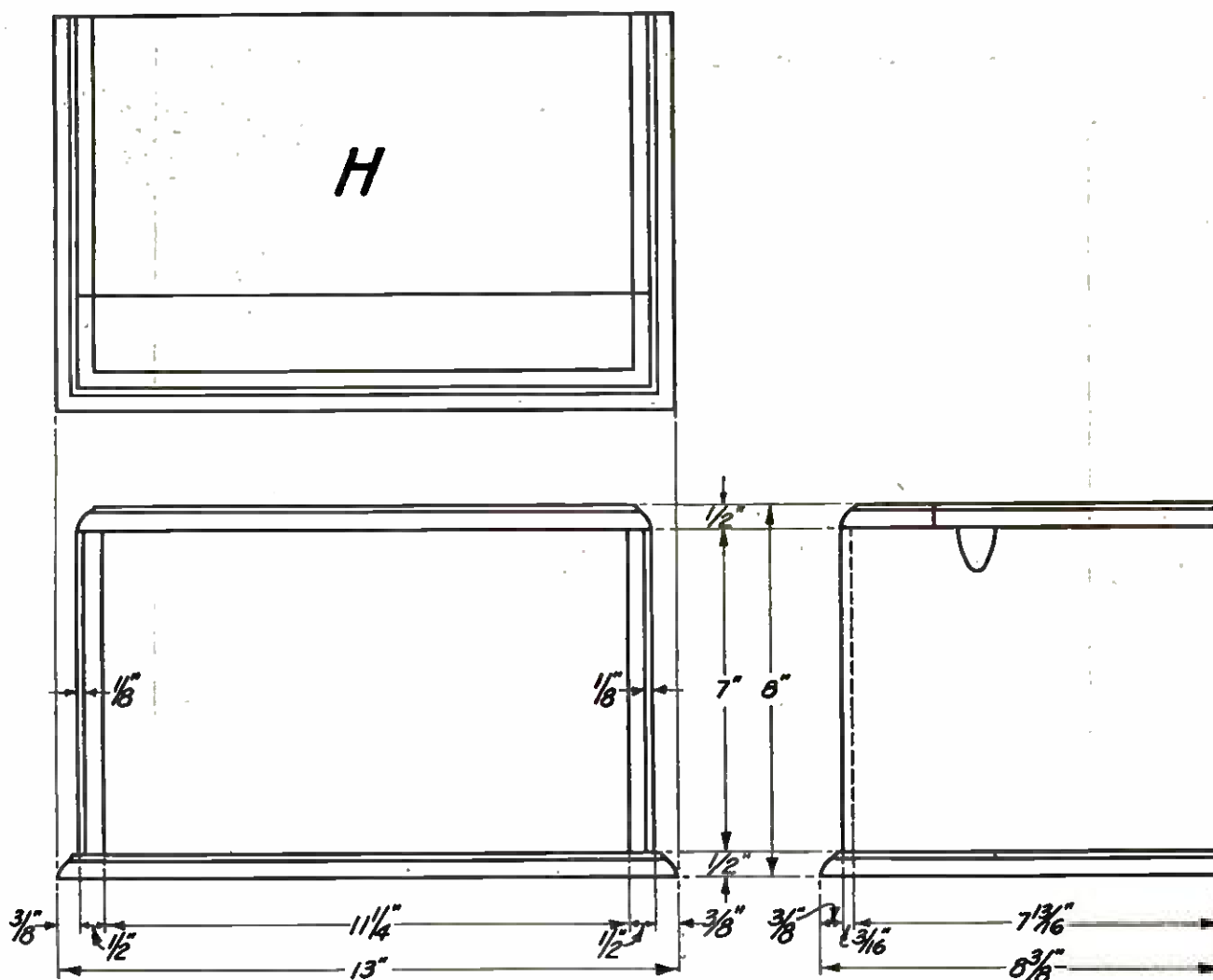
$$\frac{W}{I \times E}$$

W, covered with the finger tip, leaves $I \times E$. (Current times electro-motive force); equal watts—the letter covered by the finger.

Cover E and we have $\frac{W}{I}$, watts divided by the current, equal electro-motive force. And I, covered, leaves $\frac{W}{E}$, watts divided by the electro-motive force, equal current.

We have only these two symbols to remember in order to have Ohm's and Watt's laws at our finger tips.

Before we go any further, let us re-



THE DIMENSIONS FOR THE CABINET

FIGURE 3: This diagram (which contains the top, front, and side measurements for the hardwood cabinet) may be turned over for construction to a competent cabinet maker who can build it from these directions exactly the right size for the panel.

should be connected to the remaining terminal of the 'phones.

Set the switch lever F on the second or third tap and rotate the small knob, which moves coil B, until both the coils A and B are in close inductive relation with each other.

Then, rotate the dial of the condenser C until signals are picked up with the greatest intensity.

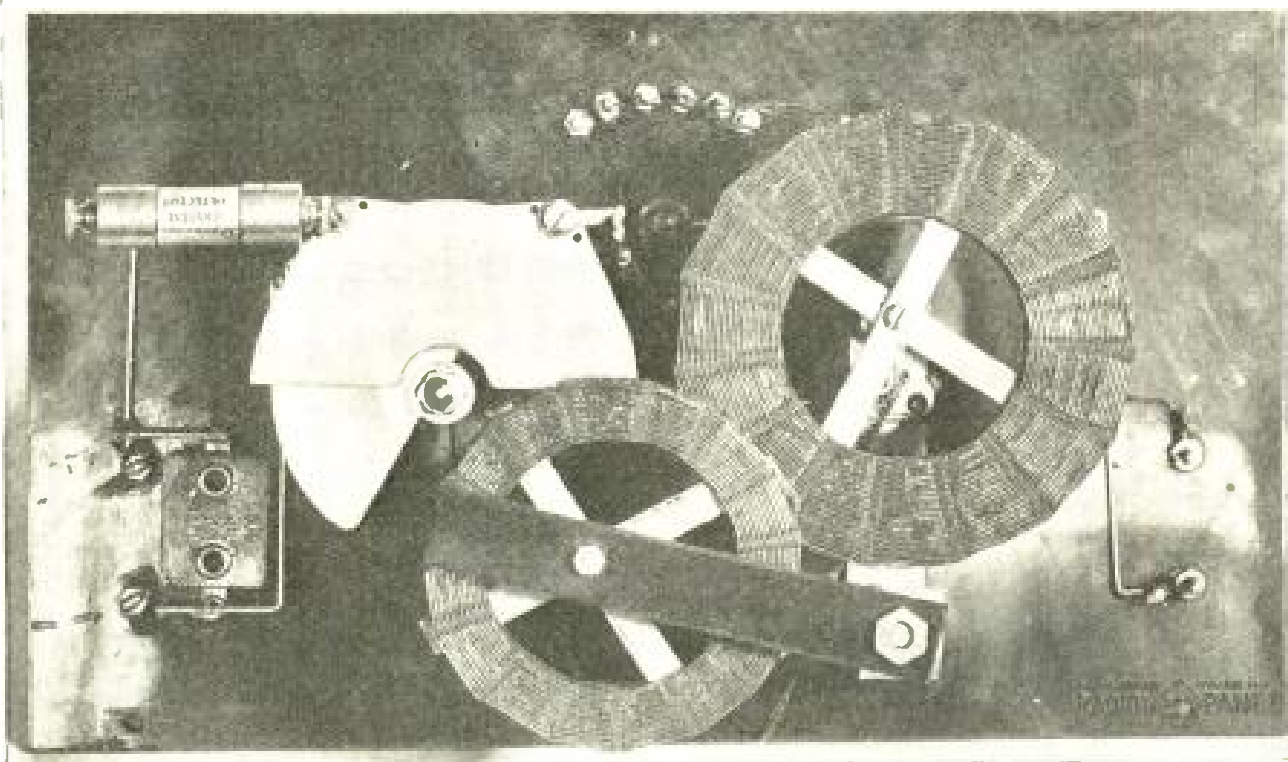
By adjusting the small knob that is connected to coil B, so that coil B drops away from coil A, the selectivity of the set will be greatly increased. In other words, when coil B is close up to coil A, the condenser C will be found to tune broadly and by loosening the coupling between these two coils and at the same

time slowly varying the condenser C, an adjustment will be found that will give signals from only one station, thus eliminating interference.

The crystal detector D needs no adjustment, as it is of the permanent carborundum type.

The correct type of antenna to use with this receiver is a single-wire antenna with a horizontal section of 100 to 150 feet in length.

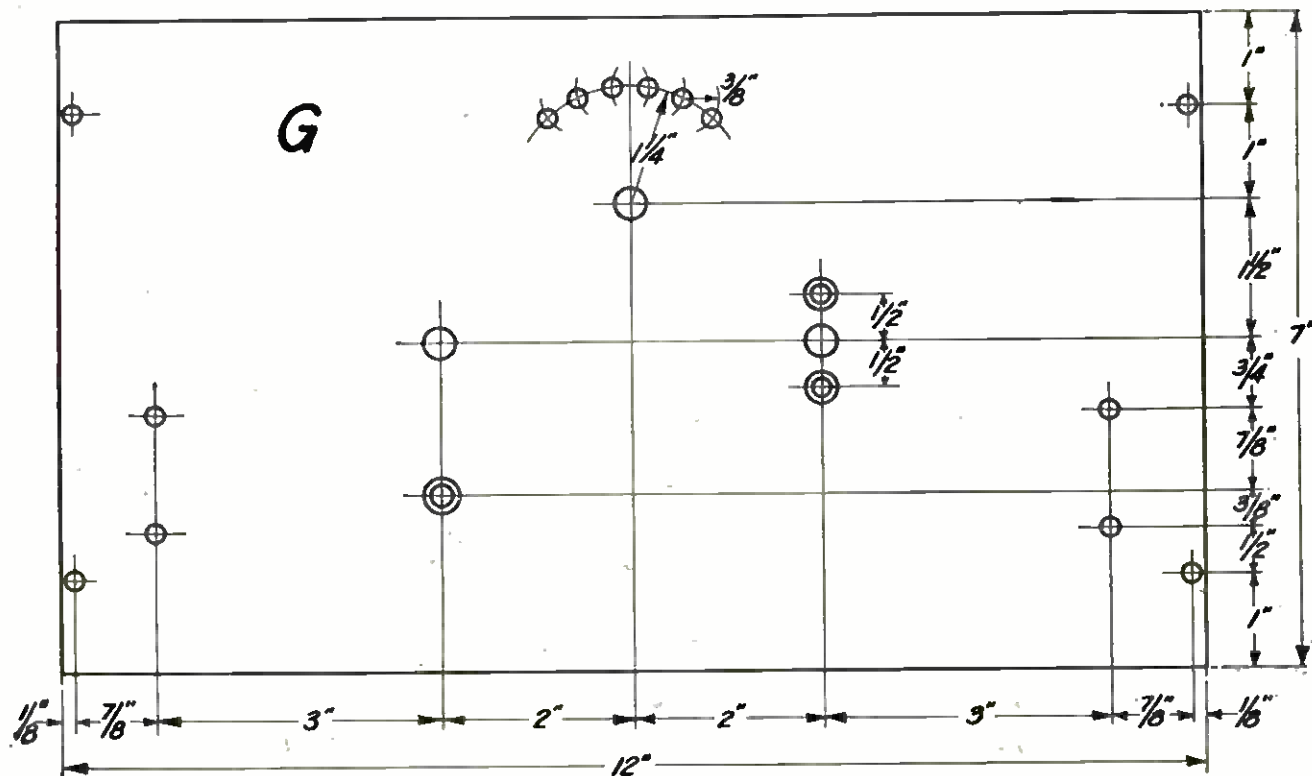
If the set is built correctly, as shown in the pictures and diagrams, the operator, after he has become familiar with the tuning characteristics, will find that he gets exceptionally clear reception on the headphones with greater selectivity than is usual with a crystal receiver.



From a photograph made for POPULAR RADIO

THE REAR VIEW OF THE SET

This picture shows the exact manner of mounting the crystal detector, the fixed and variable condensers and the pancake coupler.



THE DRILLING PLAN FOR THE PANEL

FIGURE 2: *This drawing shows where to drill the holes for mounting the instruments. The correct spacings are given for the holes from centers to centers. The holes outlined with a double circle should be countersunk. Always measure off and mark your panel with a centerpunch before you start to do any drilling.*

The unit that is described here was built and carefully tested in the POPULAR RADIO LABORATORY and was found to give very satisfactory results. The construction of this set is simple and the completed set is easy to operate.

Take this issue of the magazine to a radio store and ask the dealer to give you exactly the same parts as those that are included in the list at the beginning of this article.

Then, take the parts home and drill the panel G (as shown in Figure 2) which gives the size of the panel and the correct spacing for all of the holes that are used to mount the instruments and the binding posts.

Then, mount the instruments in their correct positions on the panel as shown in Figure 1 and in the two photographs. When this is done, wire up the instruments with standard, round bus wire, as indicated in Figure 1 below.

If you follow exactly the instructions

given there, you cannot make a mistake. All connections are clearly indicated and the instruments are marked with the same designating letters as those that appear in the text and in the list of parts.

When you have finished wiring up, place the panel in the cabinet (the details of which are given in Figure 3) and you are ready to connect the antenna and ground and the headphones to enable you to listen in.

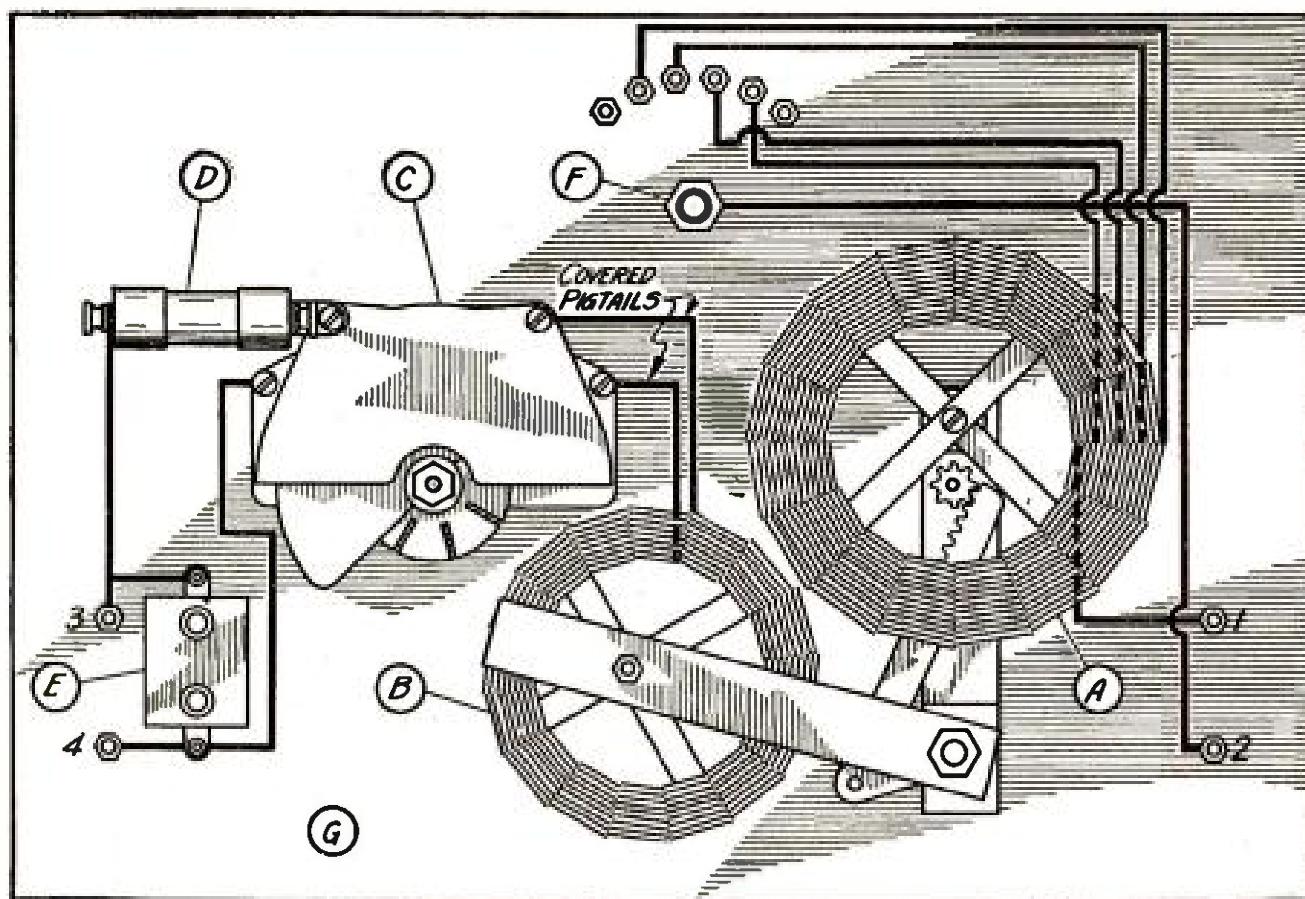
When the receiver is completed make the connections as follows:

Looking at the front of the panel, the top binding post No. 1 at the left should be connected to the antenna wire.

The bottom left binding post No. 2 should be connected to the ground wire.

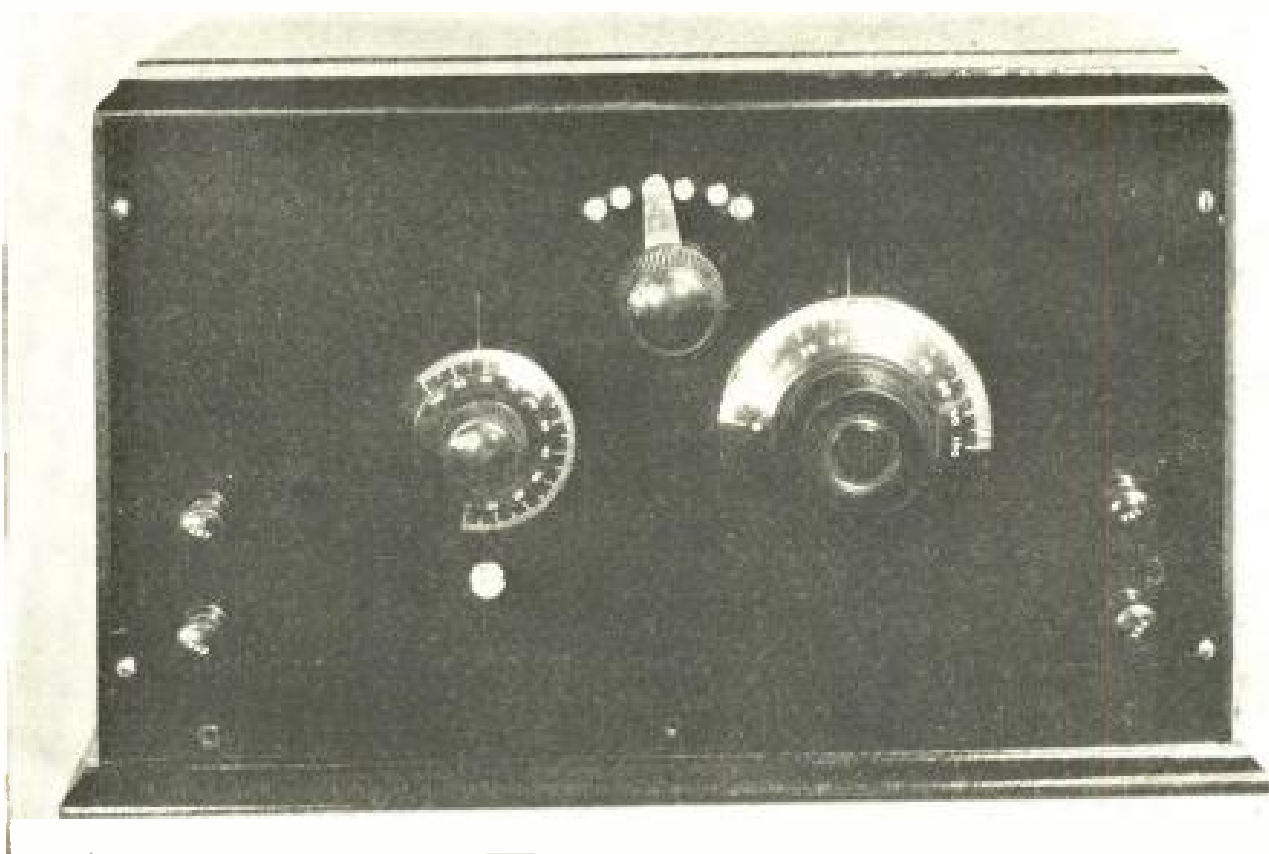
Connect one 'phone terminal to binding post No. 3, which is the top one located at the right of the set.

The remaining binding post No. 4, which is located directly under No. 3,



THE "PICTURE DIAGRAM" OF THE HOOK-UP

FIGURE 1: This illustration shows the exact manner in which the instruments are placed on the panel and how the wires run in relation to them. All the parts are lettered to correspond with the designations in the text and in the list of parts.



From a photograph made for POPULAR RADIO

THE PANEL VIEW OF THE RECEIVER

The left-hand dial controls the coupling; the switch knob with the taps is for cutting in or out the turns on the primary of the coupler. The dial at the right operates the tuning condenser. The small binding posts at the left connect to the antenna and the ground; and the posts at the right connect to headphones or to an amplifier.

Simple "How-to-Build" Articles for Beginners No. 9

How to build a selective, double-circuit, crystal receiver

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than \$18.00*

APPROXIMATE RANGE: *Up to 15 miles*

HERE ARE THE ITEMS YOU WILL NEED—

A and B—Primary and secondary of Pfanstiehl variocoupler;
C—Bradleydenser, .0005 mfd.;
D—Carborundum crystal detector;

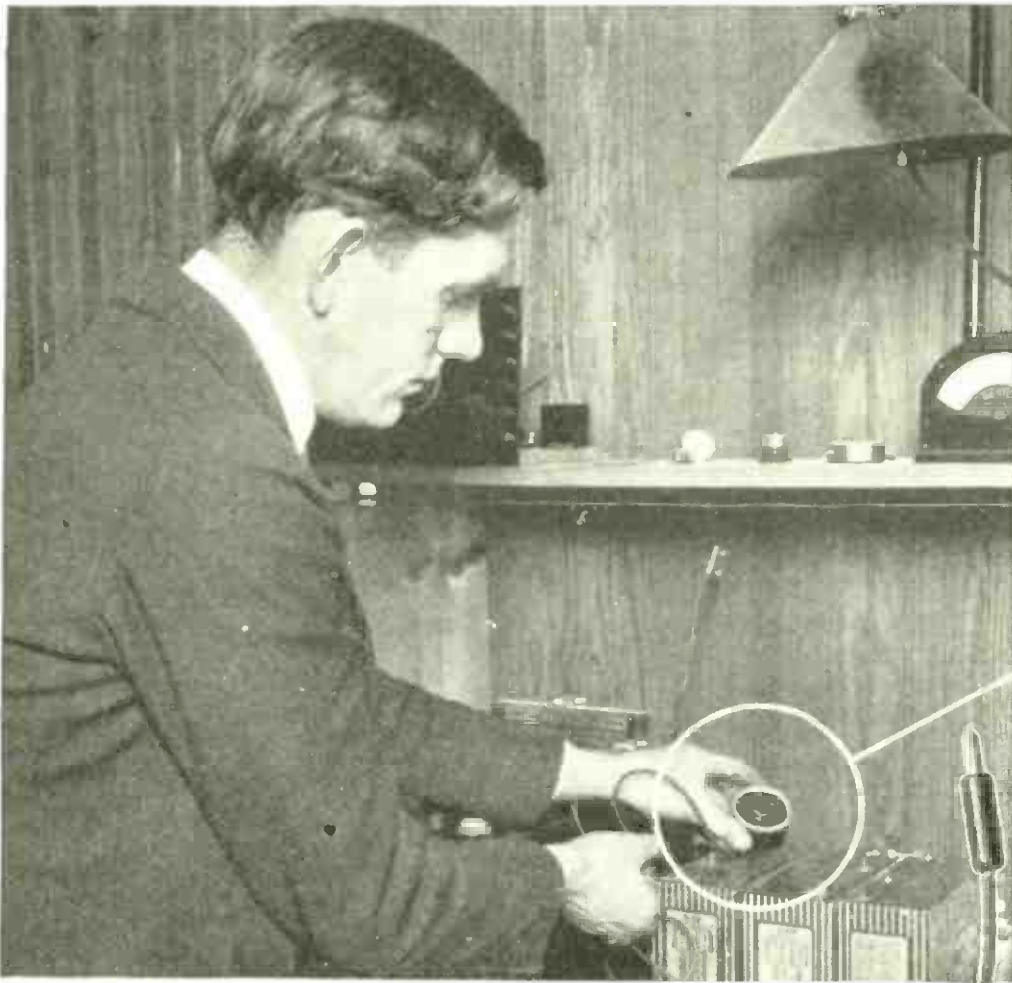
E—Muter mica, fixed condenser, .0005 mfd.;
F—Amsco switch lever with switch points;
G—Composition panel, 7 by 12 by $\frac{1}{8}$ inches;
H—Cabinet for 7 by 12-inch panel.

THIS latest receiver in this series of simple sets for beginners is a really efficient crystal receiver for local reception. It was designed especially to obtain selectivity and truthful reproduction.

In this set, there is an especially unique

coupler which gives a coupling between the antenna and the secondary circuits that may be reduced to approximately zero. This insures a selectivity which enables sharpness of tuning that is not found in ordinary crystal receivers.

Handy Tools for Radio Fans: No. 4



From a photograph made for POPULAR RADIO

THE BATTERY- TESTING VOLTMETER

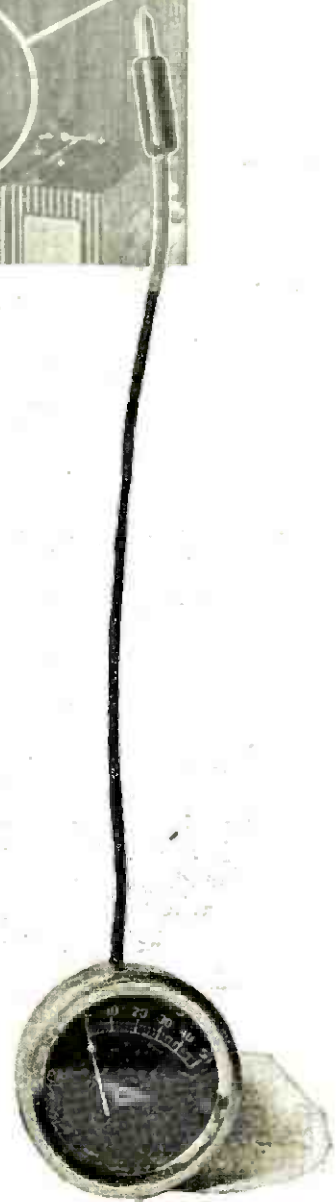
Keep your batteries fit

WHEN a set owner wants to test his instruments or to learn the condition of his "A" or "B" batteries, and thus find out whether they need recharging or replacing, he should have a battery-testing voltmeter.

With this inexpensive instrument, it is a simple matter to read directly the voltage of the "A" or the "B" batteries one at a time.

The voltmeter is equipped with a terminal on the meter and a second terminal at the end of the short piece of flexible cord. To get a reading, press the terminals of the meter on the two terminals of the battery and the pointer will indicate the voltage left in the battery.

The preceding suggestions in this series were SIDE-CUTTING PLIERS, SCREW-DRIVERS and THE HYDROMETER.



the two rheostats should be readjusted until they too are set for proper volume. Turning these rheostats beyond a certain point will not produce increased volume. The correct settings are determined by maximum volume, but in receiving from near-by broadcasting stations it is well to turn the rheostats back; otherwise the volume will be too great for comfort.

The last operation is to determine the switch point which gives the most satisfactory results. Point Number 3 (the right-hand point) will provide greatest volume. Selectivity is greater at point 2 and still greater at point 1, but the volume will decrease somewhat as selectivity increases. After changing the switch setting, the first tuning dial must be readjusted.

The setting of the rheostats is im-

portant, because the farther the rheostats are turned in a clockwise direction, the greater will be the "B" battery current consumption and the shorter will be the life of the vacuum tubes.

Charting the Receiver

As each broadcasting station is tuned in, a record should be made of the settings of the three main dials and also of the switch lever S. When a broadcasting station has once been logged in this manner, it can always be tuned in again at the same dial settings.

Perhaps, the best plan is to jot down the dial settings of one station after another as they are tuned in. After a dozen or so have been logged in this manner, it is well to make up a new chart, listing these stations in accordance with their wavelengths.

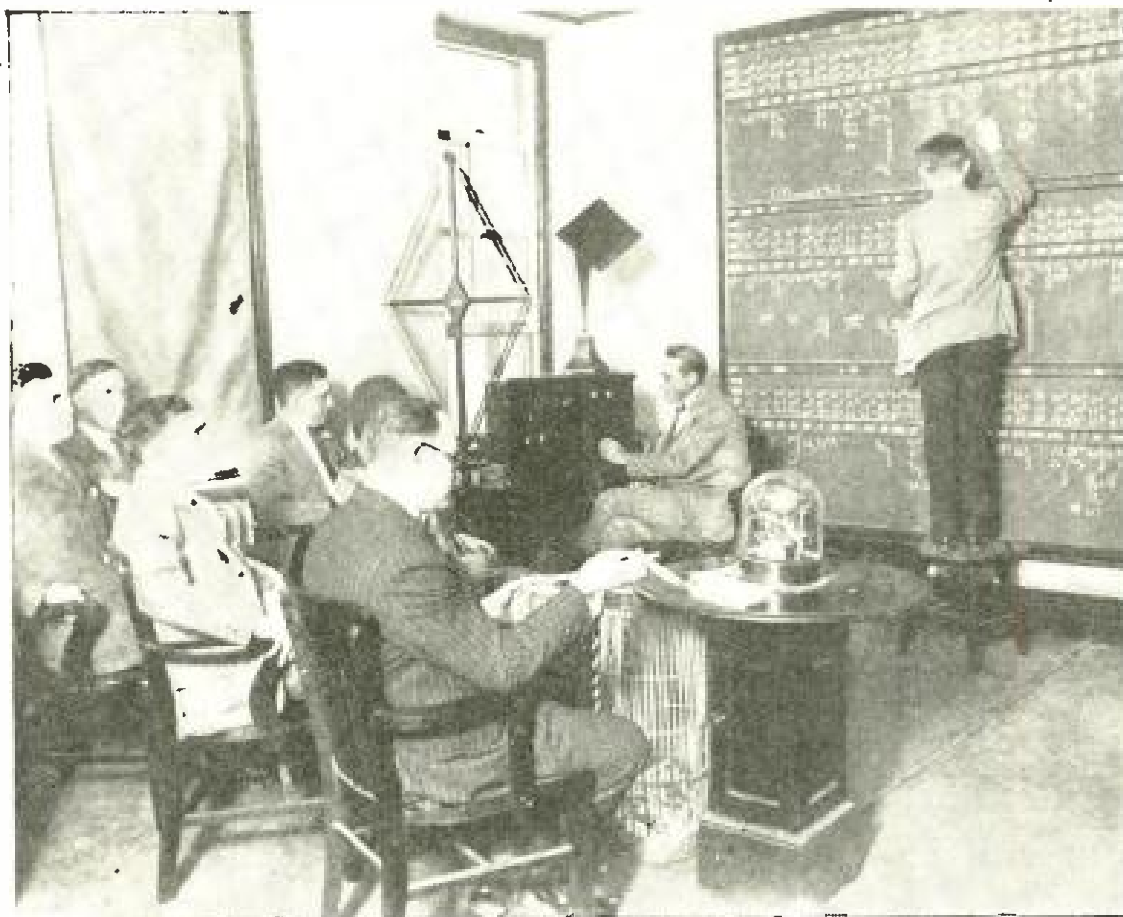
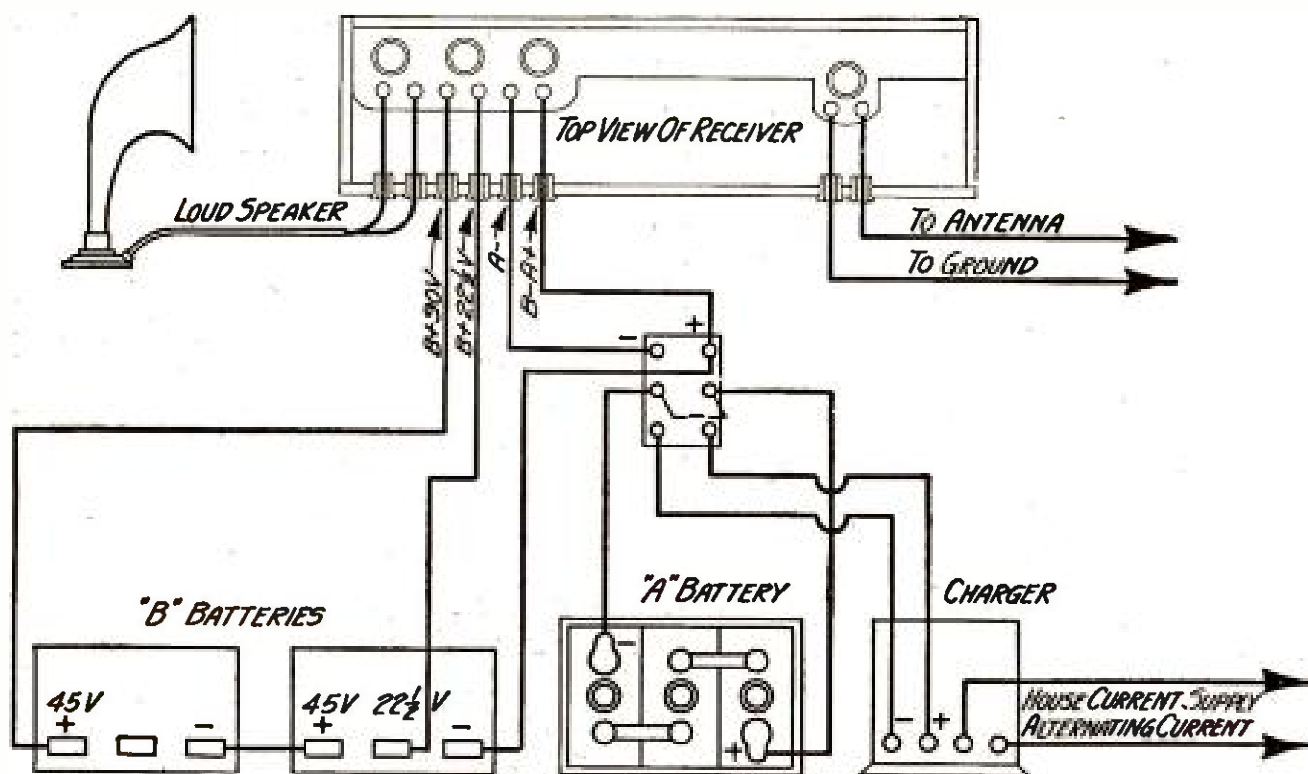


Foto Topics

HOW RADIO AIDS THE STOCKBROKERS

The set in this brokerage office keeps the traders informed of the news of the world, not forgetting the fluctuating prices in which their main interest lies. Radio gives a more nearly instantaneous connection with other traders than is possible by any other form of communication.



HOW THE RECEIVER IS CONNECTED UP

FIGURE 8: This is the way the batteries, loudspeaker and other apparatus are connected to the receiver. A switching arrangement for charging the storage battery is also shown, for use where the house lighting supply is alternating current. In the case of direct current house lighting supply, the arrangement shown in Figure 7 is substituted for the charging connections shown here.

slightly readjusted to obtain maximum volume.

If no signals are heard while rotating dial 1, there will at least be a rushing sound at one particular place on this dial. This is an indication that at this point the three dials are tuned to resonance with each other but not to the wavelength of a station which is transmitting. When this occurs dials 2 and 3 should be advanced one or two degrees and dial 1 tuned once more until either signals or the rushing sound is heard. By continuing this process (keeping the three dials tuned to resonance as indicated by the rushing sound) signals will be shortly heard.

The settings of dials 2 and 3 will be almost exactly alike for any given broadcasting station. Figure 9 shows that, with the receiver used in the tests, there was a difference of one degree between the setting of these two dials.

After signals have once been heard and tuned in with maximum volume by means of the three main tuning dials,

STATION LOG

Wave-length Meters	Call Letters	Dial Settings		
		Dial No. 1	Dial No. 2	Dial No. 3
273	WFBH	..	24	23
280	WNAC	..	25	24
286	WREO	..	27	26
300	WPG	..	29	28
309	KDKA	..	31	30
316	WGBS	..	32	31
322	KOA	..	33	32
345	WLS	..	38	37
360	WHN	..	41	40
370	WEBH	..	43	42
380	WGY	..	45	44
390	WTAM	..	47	46
405	WOR	..	50	49
422	WLW	..	55	54
435	CNRO	..	59	58
455	WJZ	..	64	63
469	WCAP	..	67	66
492	WEAF	..	74	73
509	WIP	..	79	78
526	WNYC	..	84	83
535	KYW	..	86	85

A TUNING TABLE

FIGURE 9: These tabulations were made up on the basis of tests in the POPULAR RADIO LABORATORIES.

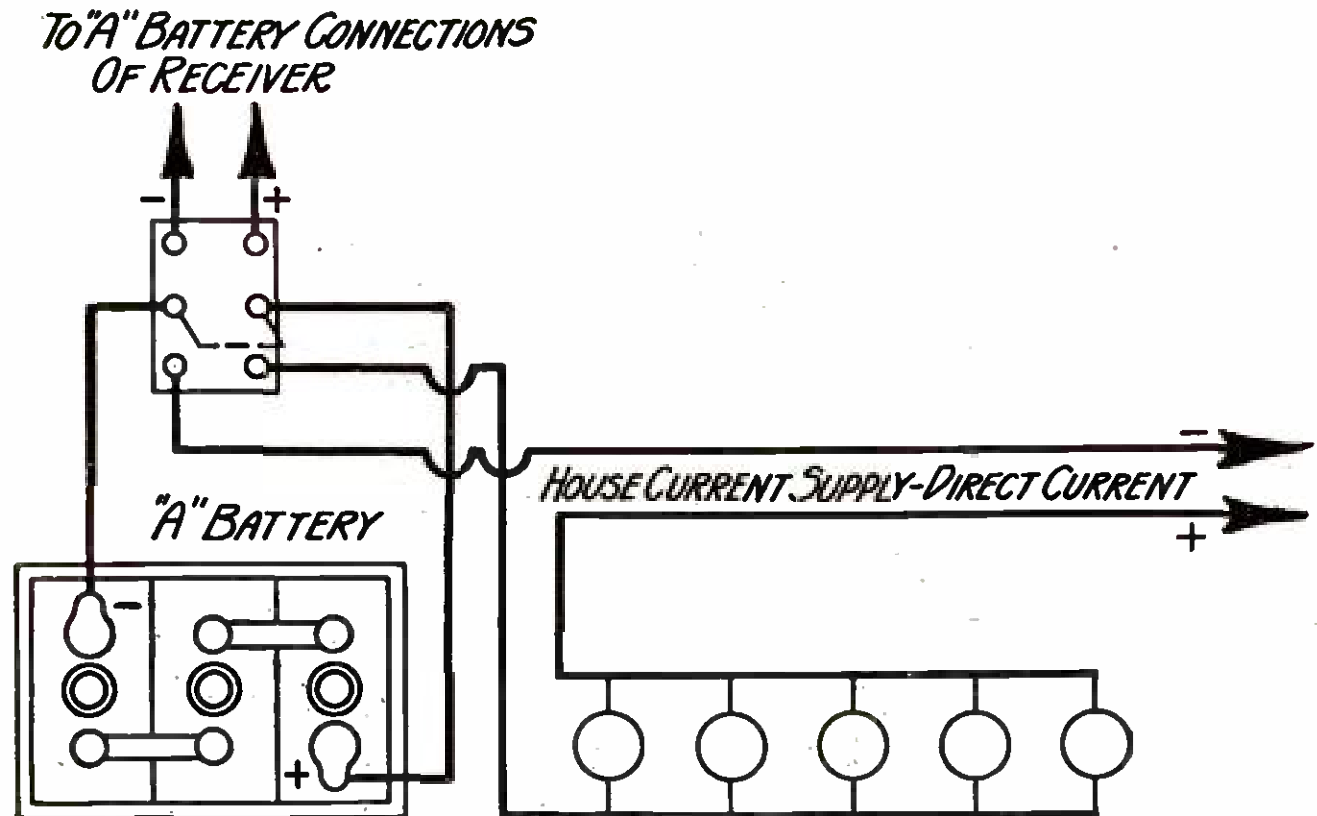
The first operation is to pull out the knob of the battery switch at the right-hand end of the panel. Then turn the right-hand rheostat knob about half a turn in a clockwise direction. Follow this with a similar adjustment of the other rheostat knob, and the five tubes should light up.

Now, set the antenna switch S on point 1. This setting depends a great deal upon the antenna used. If the antenna is short, it will probably be found that the switch should be set first on point 3. Points 1 and 2 will sharpen the antenna tuning greatly and for this reason, will make it somewhat difficult to tune in stations in the beginning. After a few stations have been tuned in, it will be easy to determine which setting of this switch gives the best all-around results.

In Figure 9 is shown a tuning chart made up for an Atwater Kent receiver. It will serve as a guide for tuning, but every receiver of this make and type

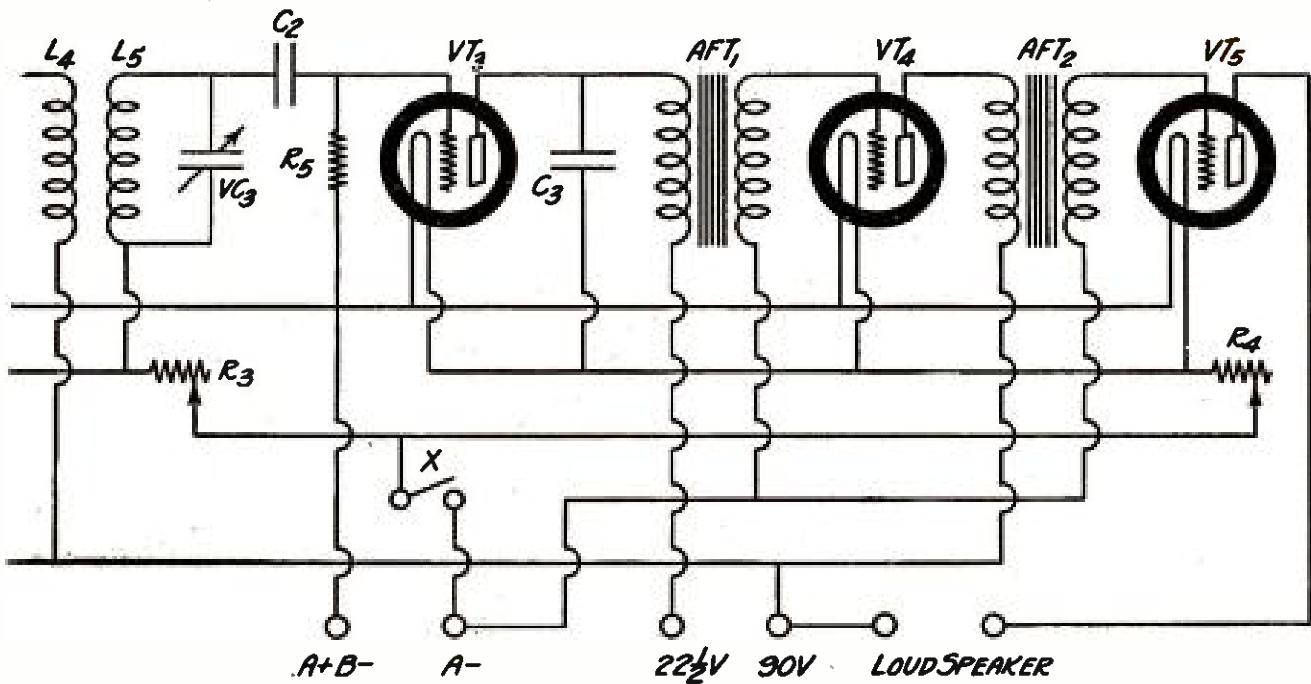
will not necessarily tune the various stations in at exactly the dial settings shown on this chart. However, the variation between different receivers should not be more than two or three degrees on dials 2 and 3. Dial 1 will vary much more because its tuning point is influenced greatly by the size of the antenna and the setting of switch S. Because of the variable character of the first dial, its settings have been omitted in Figure 9. However, the setting of dial 1 will remain the same for any particular antenna used, and it will therefore be advisable to record these settings on your own chart on which the settings for dial 2 and 3 appear.

When one of these receivers is being tuned for the first time, dials 2 and 3 should be set according to the figures that are given in Figure 9 for the station desired. Then dial 1 should be slowly rotated until the broadcasting is heard. Leaving dial 1 set at the point where signals are loudest, dials 2 and 3 should be



HOW TO CHARGE STORAGE BATTERIES ON HOUSE CURRENT

FIGURE 7: If the house lighting system is direct current it is necessary merely to use a few electric lamps to provide the charging resistance, connected as shown above.



of 1.185 and 1.285. Therefore, when the hydrometer reads 1,185, it is time to have the battery recharged. To use a battery after it gets below 1,185 is harmful to the battery plates.

In addition to the storage, "A" battery, a set of 90-volt, "B" batteries is required to provide the high voltage supply for the plate circuits of the vacuum tubes.

The large-sized 45-volt batteries are desirable, although four 22½-volt, large-sized batteries will serve. These batteries are the dry-cell type but if desired storage "B" batteries may be used and are less expensive in the long run than dry-cell batteries.

"B" battery substitute devices that operate on house lighting current may be used, but before the operator purchases one he should actually try the apparatus out on the receiver, as some of these devices do not prove satisfactory under all conditions. When storage "B" batteries or one of the "B" battery eliminators are used, the current consumption in the plate circuits is not important. When dry-cell, "B" batteries are used, however, current consumption is important because it governs the life of the "B" batteries; and it is the life of

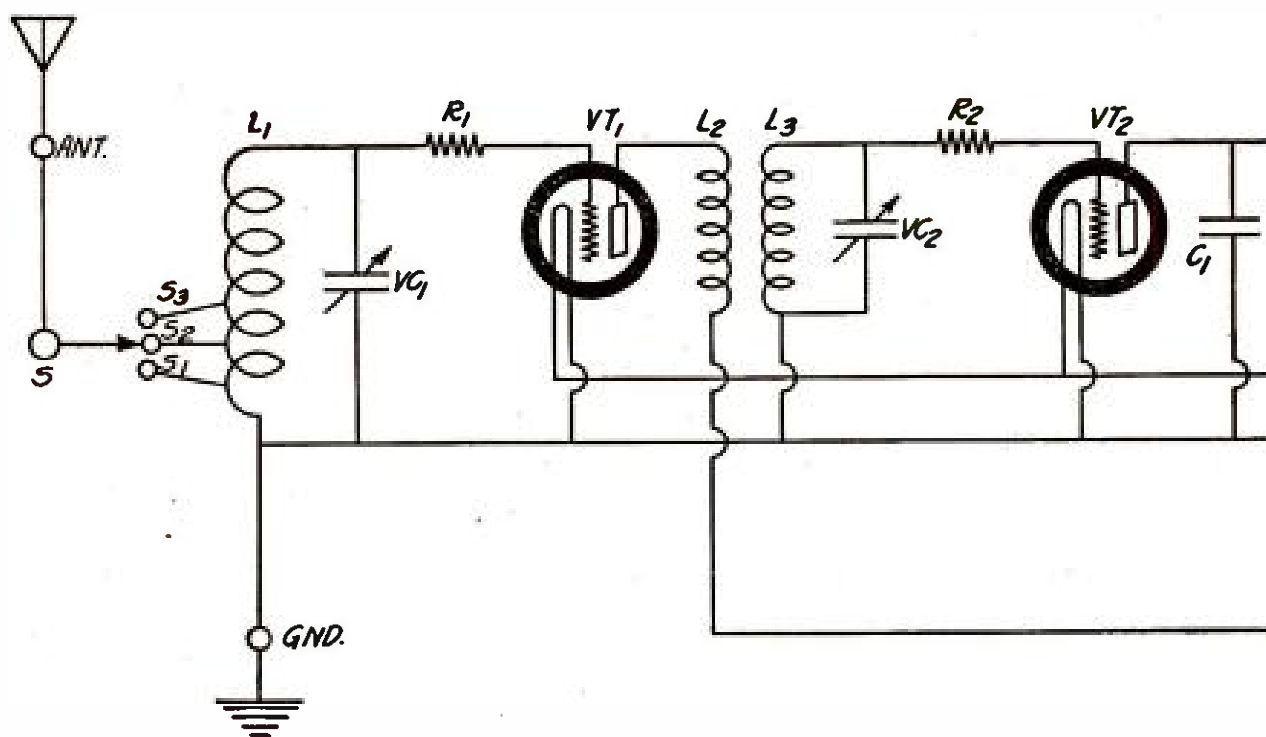
the "B" batteries that constitutes the main item of upkeep cost in a receiver.

Average Hours of Use Each Day	2	3	4
Rheostats 1/2 on	108 days	72 days	54 days
Rheostats 3/4 on	54 days	43 days	32 days

This table shows the estimated life of a set of large size "B" batteries with this receiver. For reception from near-by stations, ample volume is obtained with the rheostats turned about half-way on. For distant stations it will be necessary to turn the rheostats on farther, but this table shows the advantage of keeping the filament current as low as possible to be consistent with good volume of reception.

How to Operate the Receiver

First of all, the receiver is connected up as shown in Figure 8. In case it is desired to omit the battery charger at first, the "A" battery may be connected directly to the receiver instead of being connected to the double-pole switch that is shown in Figure 8. With these connections completed, all is in readiness to tune in on the broadcasting stations.



HOW THE RECEIVER IS WIRED

FIGURE 6: The designating letters are referred to and explained in the text, and in the other illustrations. The parts are:

L1—Conductively coupled tuning coil;
L2 and *L3*—First radio-frequency amplifying transformer;
L4 and *L5*—Second radio-frequency amplifying transformer;
AFT1 and *AFT2*—Audio-frequency amplifying transformers;
VT1, *VT2*, *VT3*, *VT4* and *VT5*—Vacuum tubes and sockets;

VC1, *VC2* and *VC3*—Variable condensers for tuning;
C1 and *C3*—Fixed by-pass condensers;
C2—Fixed grid condenser;
R1 and *R2*—Damping resistances;
R3 and *R4*—Filament rheostats;
R5—Grid-leak resistance;
S—Antenna tap switch;
S1, *S2* and *S3*—Switch points;
X—Filament battery switch.

The Tubes That Are Used

Standard five-volt, one-quarter ampere tubes, such as the UV-201-a, C-301-a or DV-2 are used in the Atwater Kent receiver. UV-200 or C-300 tubes cannot be used in this receiver as detectors and dry-cell tubes are not recommended.

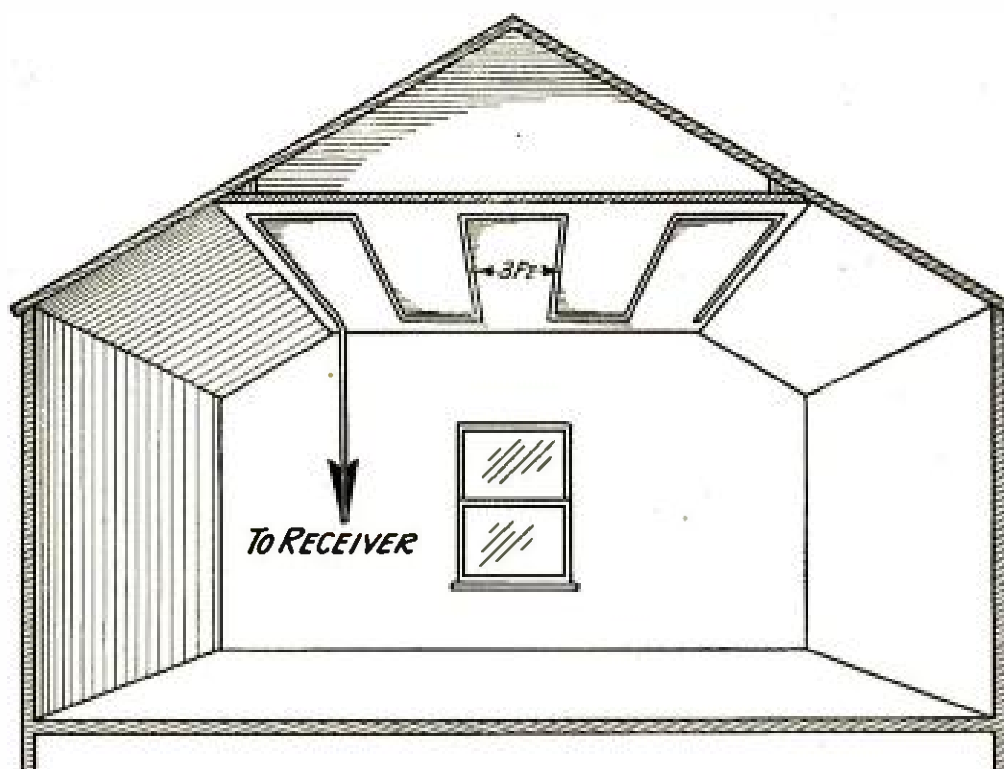
To find the best combination of tubes in the set, the tubes should be changed about. The tubes in the first and fifth sockets, for instance, should be interchanged; then those in sockets 2 and 3 and so on. Continue to do this until the positions in which the tubes give the best results are determined.

A six-volt, storage, "A" battery is used to light the filament of the five vacuum tubes. A battery of not less than 40 ampere-hour capacity is needed. A 100 ampere-hour battery is the most

suitable, and, if used at the rate of two hours a day, it should operate the receiver for more than a month on a single charge.

A battery charger makes it possible to charge the receiver at home. Connections for battery chargers that operate on an alternating-current house supply and a direct-current supply are shown in Figures 7 and 8.

An instrument which shows the specific gravity of the solution in a storage battery, known as a hydrometer, should be part of the operators' equipment. When a battery is fully charged, this instrument will give a reading of 1,285. When a battery is completely discharged, the hydrometer will indicate that the specific gravity of the battery solution is below 1,150. The best working range for the battery is between the readings



HOW TO ARRANGE AN INDOOR ANTENNA

FIGURE 5: Good results can be obtained with an indoor antenna if it is not possible to erect one outdoors. Here an indoor antenna is shown in an attic. If ordinary insulated bell wire is used it may be tacked directly to the ceiling without any insulators. If one does not have an attic available, a wire stretched around the picture moulding of one or more rooms may be used, as explained in the text.

not be erected, the next best thing is two wires as long as possible. These should be spaced three feet apart. Join the two wires at the end nearest the receiver and attach a lead-in wire at this point.

If an outdoor antenna is not obtainable, run a 100-foot wire around the picture moulding inside the house, or in an attic where the antenna may be stretched back and forth across the ceiling.

If the antenna is installed around the picture moulding, it should be in a straight line through several rooms rather than around four sides of only one room. A suggested form for an attic antenna is shown in Figure 5. Insulated bell wire is most suitable for this sort of indoor antenna, while a wire made of seven strands of No. 22 copper wire will do very well for an outdoor antenna. A single strand of No. 14 copper wire is also good but it is not as strong as the stranded wire.

Almost any kind of antenna insulators may be used with an outdoor antenna, but be sure that the eye through which the antenna wire passes is sufficiently large and smooth so that the wire will not be bent sharply or become worn down and probably broken so as to result in the collapse of the antenna.

Connections for a lightning arrester (which should be used with all outdoor antennas) appear in Figure 4. This piece of apparatus should be grounded outside the house on a pipe that is driven several feet into damp soil or on an outside water pipe if one is available. A suitable ground connection for the receiver is a cold-water pipe. If this is not easily reached, a ground connection may be made on a radiator. If either of these connections cannot be found in the house, the next best thing is to use the kind of ground recommended above for the lightning arrester. Sometimes a well is satisfactory, if it is close enough to the house.

ond stage of radio-frequency amplification. The third dial controls VC3 and tunes the input circuit of the detector tube.

The small tap switch between the first and second large dials varies the coupling between the primary and secondary of coil L1, thus regulating the selectivity of this circuit.

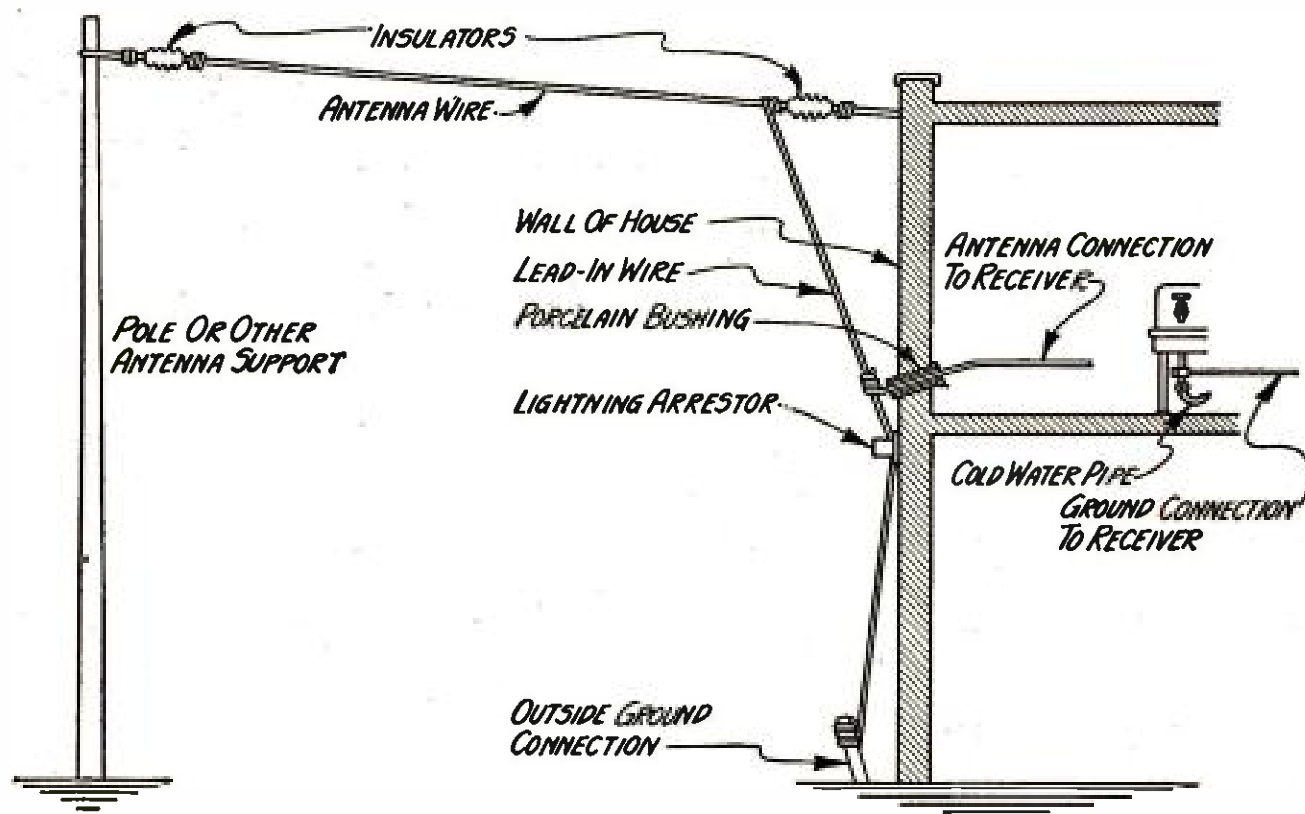
At the right-hand end of the panel is the vacuum filament control unit. The two large knobs are the rheostats. The one at the left regulates the filament current of VT1 and VT2, and the right-hand knob controls the current flow to the filaments of VT3, VT4 and VT5. The small push-pull switch that is mounted at the bottom of this unit cuts the receiver off from the "A" battery, which eliminates the necessity of turning off the rheostats which may therefore be left set for a long time at their best operating point.

The filament current cannot be cut off by means of the rheostats, because some current will flow through the filaments even when the rheostats are turned to the off position. Only pushing the switch in cuts off the receiver.

The Antenna and Ground

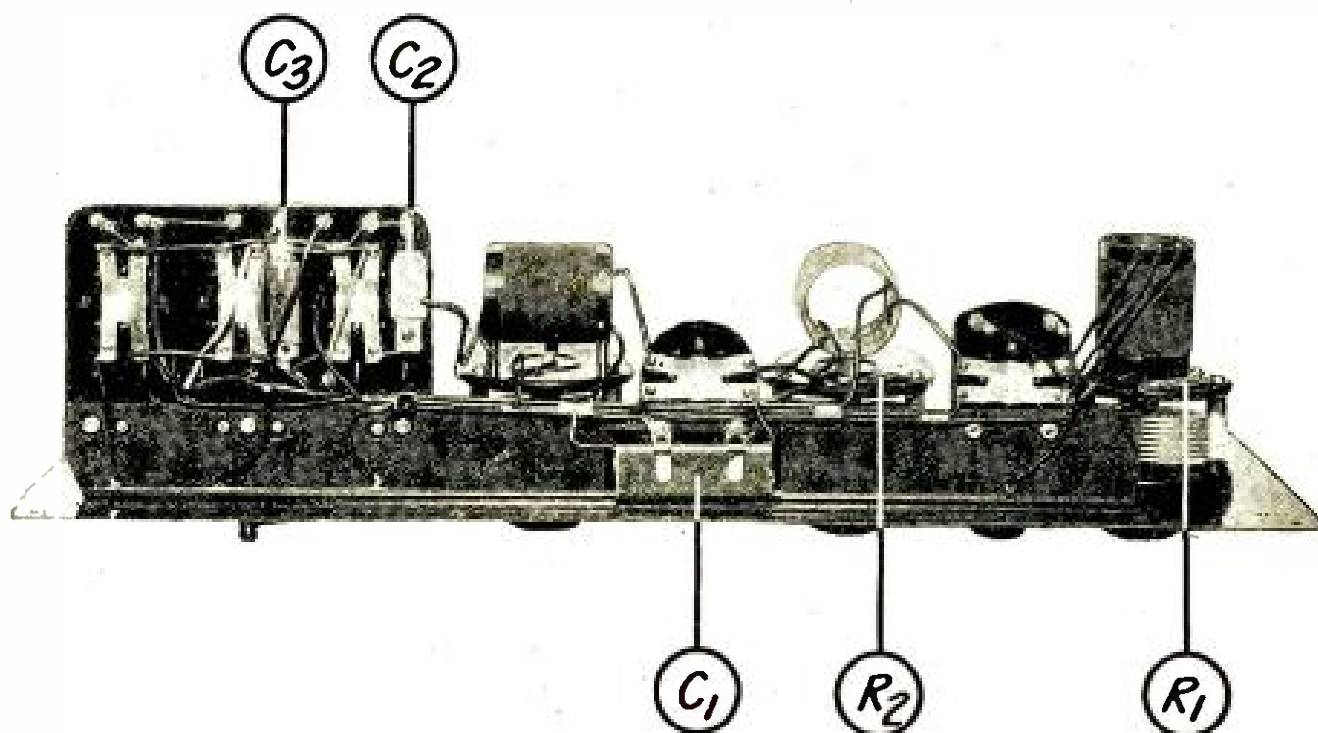
To get the best selectivity with most tuned-radio-frequency receivers, the operator should use an antenna not more than 60 feet long. With the Atwater Kent receiver a somewhat longer antenna is not only permissible but desirable. The fact that a long antenna may be used, without interfering with selectivity presents a real advantage so far as long distance reception is concerned.

Perhaps the best antenna for this receiver is a straight, single wire 100 to 125 feet long, as shown in Figure 4. If an outdoor antenna of this length can-



A SUGGESTED ANTENNA ARRANGEMENT

FIGURE 4: The recommended length for the antenna is from 100 to 125 feet, measured between insulators. It is advisable to make the antenna and lead-in one piece to eliminate a joint where the lead-in is taken off the antenna. If joints are necessary they should be soldered, or if this is not practical, they may be wrapped with tinfoil and then covered with rubber tape to prevent corrosion. The use of an approved lightning arrester is required by the Fire Underwriters of certain localities and the method for connecting it is shown here.



From a photograph made for POPULAR RADIO

A BOTTOM VIEW, WITH THE CABINET REMOVED

FIGURE 3: The assembly of the receiver is here shown. A metal strip is mounted on the large front panel, but at a right angle. To this strip the insulating sub-panels for the sockets and transformers are fastened. The designating letters are the same as those in Figure 1.

small and it would not be logical to expect a tube to produce additional energy that would increase its output. However, this additional energy is obtained from the high-voltage "B" batteries, for which the vacuum tube acts as a throttle to control the flow of current. The amount of current thus drawn from this battery varies in accordance with the variations in the input circuit of the tube.

The proper functioning of the receiver depends upon the temperature of the vacuum tube filaments. The rheostats R4 and R5 in Figure 1 control the current flow to the filaments from the "A" battery, thereby regulating the temperature of the filaments.

Construction of the Receiver

All instruments in the Atwater Kent receiver are fastened to the front panel. The panel is metal and is connected to the ground to prevent surrounding objects or the body of the operator from interfering with the tuning of the receiver.

The antenna coupler coil L1 is mounted directly on the back of the first variable condenser VC1. L2 is wound inside L3 and both are mounted on the back of VC2. L4 and L5 are constructed in the same manner and mounted on the back of VC3. The first two vacuum-tube sockets are mounted on the back of the panel by means of small individual sub-panels, and a third, larger sub-panel is used for mounting the last three sockets and the audio-frequency transformers.

This construction is all clearly shown in Figures 2 and 3. On the front of the panel (as shown in Figure 1) there are seven controls. Four of these do not have to be moved during tuning. The three large calibrated dials tune the various circuits to resonance with any transmitting station you want to pick up.

Looking at the receiver from the front, the large left-hand dial controls the variable condenser VC1, which tunes the input circuit of the first vacuum tube. The next large dial controls VC2 which tunes the input circuit of the sec-

After the signal goes through an amplifying action in the first tube, it leaves the plate side and passes through coil L2, then through the "B" battery and back to the filament of the tube. This completes the output circuit of VT1.

The energy flowing through coil L2 is transferred to the grid circuit of VT2 by induction, which means that despite the fact that there is no electrical connection between the coils, energy flows through coil L2 and sets up a flow of energy in coil L3. Coil L3 is tuned by the variable condenser VC2 that is connected across the coil.

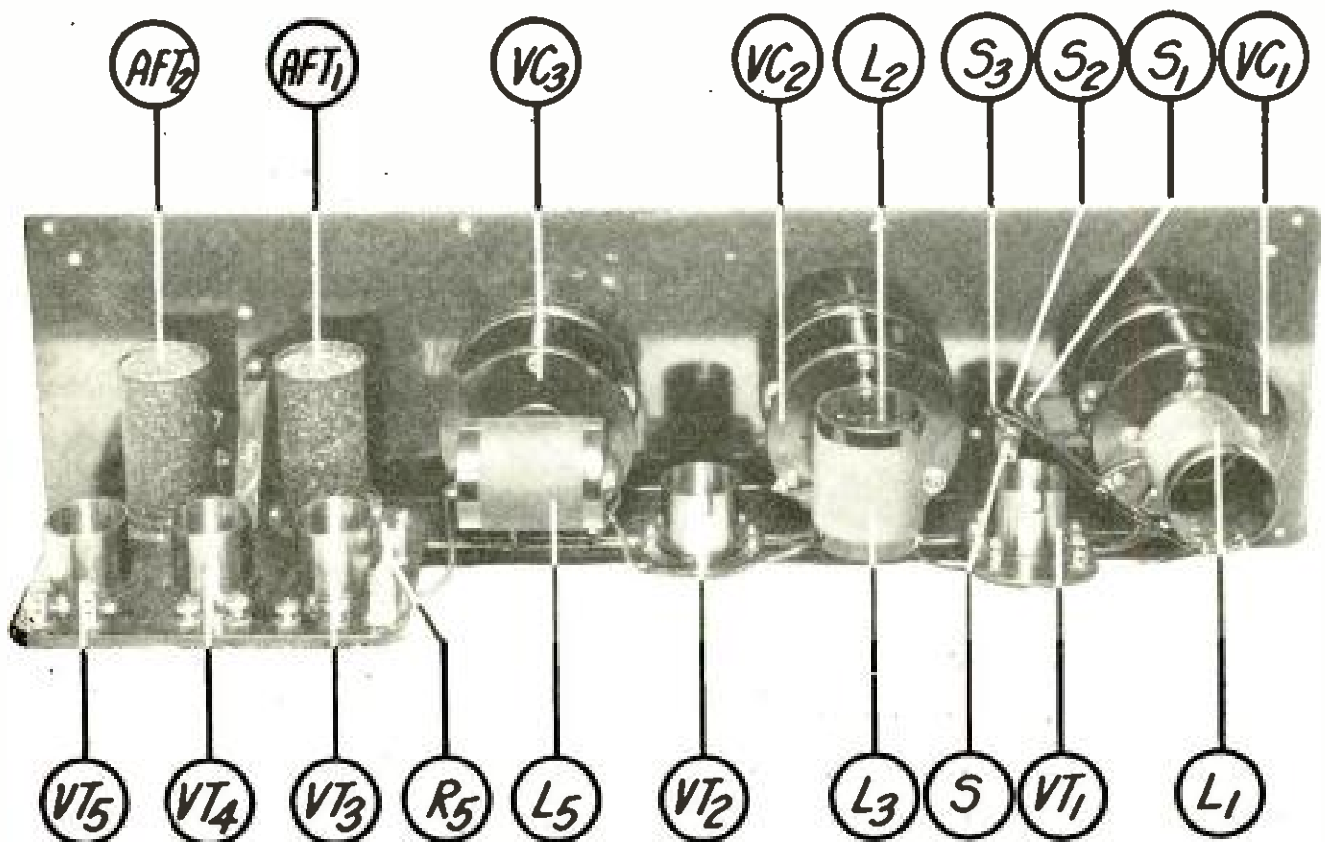
Through the action of VT2, the signal is again amplified, and by means of coils L4 and L5 this signal is passed on to VT3, which is the detector tube. The input of this tube is tuned by VC3. The fixed condenser C2 and the grid-leak resistance R6 are provided to facilitate the detector action of this tube. Detector action means changing the signal current

to a lower frequency to make it audible. Before detection occurs, the energy is a high-frequency current much too high to be audible.

Even after this transformation of the energy, its power is not sufficient to operate a loudspeaker, although on headphones it may be clearly audible.

Two stages of radio-frequency amplification increase the sensitivity of the receiver, but they add little to the volume. The last two tubes VT4 and VT5 give the desired increase in volume. In this part of the circuit the signals pass from VT3 through the audio-frequency, amplifying transformer AFT1 to VT4 and on to VT5 through the second transformer AFT2. The loudspeaker is then connected in the output circuit at the last tube which results in tremendous volume.

A vacuum tube has no power in itself to amplify signals. The energy at the input side of a vacuum tube is very



From a photograph made for POPULAR RADIO

THE REAR VIEW OF THE RECEIVER WHEN REMOVED FROM CABINET

FIGURE 2: Here the arrangement of the instruments is clearly shown. The designating letters refer to the parts listed in Figure 6 and the function of each part is explained in the text.

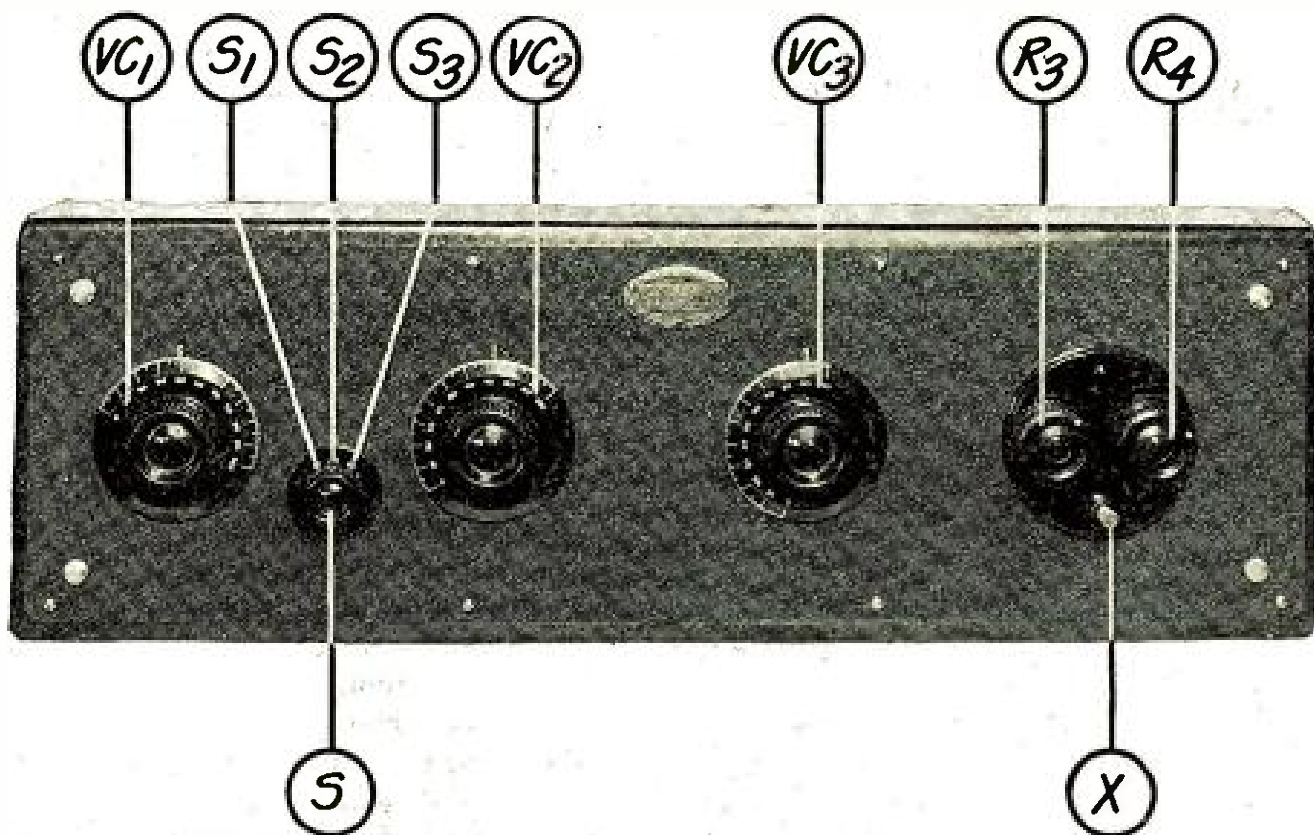
back is prevented by two factors. *First*; the various coils in the circuit are arranged in such positions (as shown in Figure 6) that there is minimum inductive inter-action. *Second*; fixed resistances are inserted in the grid circuits of the first and second tubes. These damping resistances are shown at R1 and R2 of Figure 3.

Under these conditions little or no feedback action occurs; it is killed by the fixed resistances. Consequently the receiver cannot be made to oscillate.

When this receiver is in operation the incoming signals from a broadcasting station are impressed on the antenna circuit, which consists of the antenna, a ground and a few turns of the coil, L1. Coil L1 serves as two coils. Its entire winding represents the secondary of the coupler, whereas only part of the coil is used as the primary, which is the part in the antenna circuit. This electrical

arrangement is called conductive coupling and is equivalent to the use of two separate coils. Variation in the coupling between these two coils is accomplished with the switch S by decreasing the number of turns in the antenna circuit.

When the incoming energy flows through the primary, it sets up a similar current in the secondary coil, which is tuned by means of the variable condenser VC1. When this circuit is in resonance or is tuned to the wavelength of some transmitting station, the signal energy passes through the resistance R1 and is impressed on the grid of vacuum tube VT1. Thus the complete input circuit of this vacuum tube consists of the coil L1, the variable condenser VC1, the resistance R1 and the connections to the grid and the filament of the tube. The electron flow within the tube itself forms the connecting link which completes this circuit.



From a photograph made for POPULAR RADIO

THE PANEL VIEW OF THE RECEIVER

FIGURE 1: The three principal tuning controls are the variable condenser dials, VC1, VC2 and VC3. The tap switch S, with switch points S1, S2 and S3, provide variation of antenna coupling, thus controlling selectivity. The knobs R3 and R4 regulate the "A" battery current to the tube filaments and the switch X is the battery cut-off switch.



From a photograph made for POPULAR RADIO

THE RECEIVER UNDER TEST

"B" battery life is an important consideration for the owner of a receiver. Here the author is making measurements of "B" battery current consumption to be used as the basis for calculating the expected life of the "B" batteries, as given in the table on page 539.

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

No. 6: THE ATWATER KENT

This series of articles explains the theory, operation, equipment and care of standard receiving sets

This series does not indorse the product of any manufacturer or make comparisons between receivers. The sets already described include: No. 1, the Eagle Neutrodyne; No. 2, the Radiola Superheterodyne; No. 3, the Melco Supreme Receiver; No. 4, the Crosley Trirdyn; No. 5, the De Forest Reflex.

By S. GORDON TAYLOR

IN receivers with one or more stages of radio-frequency amplification, it is necessary to employ some one of several methods for preventing oscillation.

In an ordinary one-tube set, the addition of radio-frequency amplification causes the transfer of a small amount of energy from one part of the circuit to another, which is called feed-back action. Up to certain limits this action

is desirable, because it takes energy from the output circuit of the vacuum tube, feeds it back through the tube by capacity or by induction to the input circuit, and thereby uses again the amplifying power of the tube. However, when this feed-back action becomes too great, the oscillating condition that it creates prevents reception or else distorts it.

In the Atwater Kent receiver, feed-

MADE RADIO

ONE OF THE CO-INVENTORS OF THE SLABY-ARCO SYSTEM

GEORGE VON ARCO, who assisted Dr. Slaby in his work in developing a radio-telephone method known as the Slaby-Arco system, carried out a practical radio-telephone transmission test in 1906 over a distance of about thirty miles. His inventions and research work in the past twenty years have culminated in the successful completion of what is perhaps the world's greatest radio station at Nauen in Germany.



Courtesy of The Teletunken Co

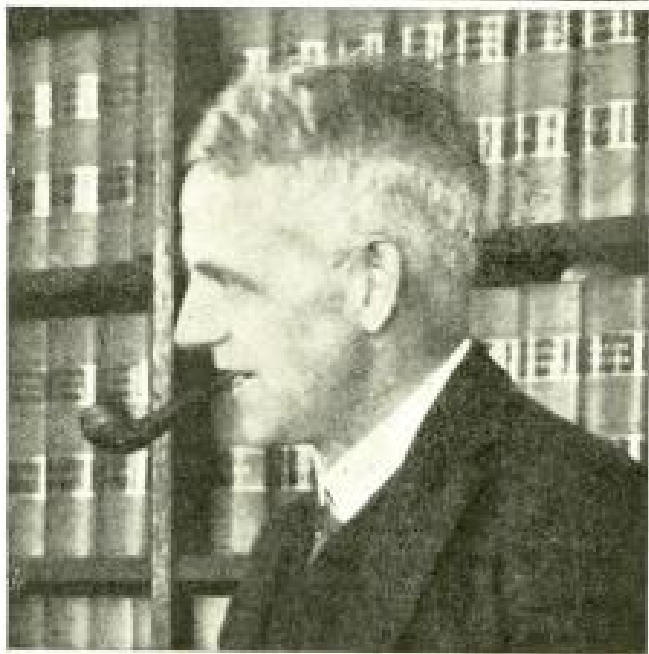
THE CREATOR OF THE TIKKER

LOUIS W. AUSTIN, who is in charge of the United States Radiotelegraphic Laboratory, has done considerable research work in quantitative high-frequency measurements. His most important invention was the rotary tikker which was used in receiving circuits to break up continuous waves used in radiotelegraph transmission.



AN EARLY INVESTIGATOR OF INTERFERENCE

FOR several years ROY A. WEAGANT was engaged in commercial radio work. At present he is closely associated with Dr. Lee De Forest. He has contributed a number of improvements in radio work and his most recent invention of a method of eliminating static interference is, perhaps, his most important and interesting patented idea.



De Forest Radio Co.

The MEN WHO

7th Installment



White Studio

THE FIRST TO SMELT BY RADIO

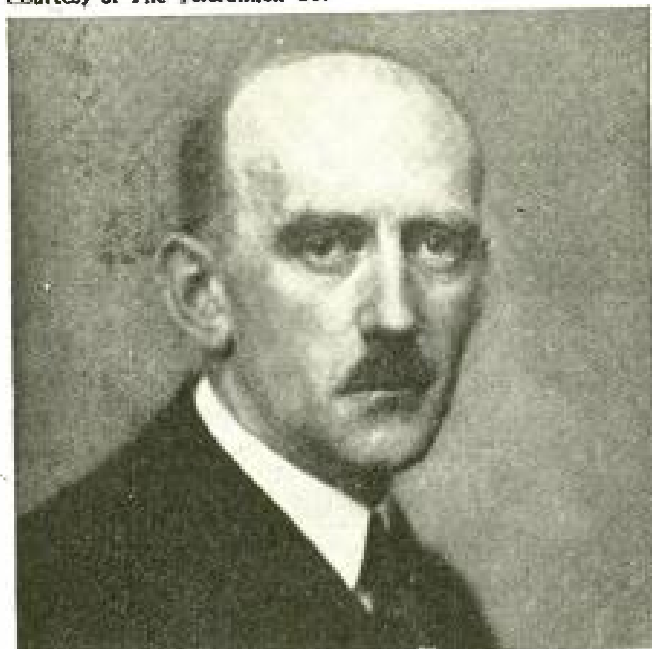
EDWIN H. NORTHRUP is widely known in electrical engineering circles for his work with electrical inductive heating units. He has proved that power transmitted by radio waves as well as by induction can actually melt and smelt metals. The inductive process is used in the well-known Northrup furnace.



Courtesy of The Telefunken Co.

THE GERMAN COMMERCIAL RADIO PIONEER

WHEN a Nobel Prize award was made some time ago in science, the fund was divided equally between Marconi and PROFESSOR ALFRED BRAUN, a German radio pioneer who, as well as Marconi, was the first to put radio-telegraphy to commercial use.



Courtesy of The Telefunken Co.

THE INVENTOR OF A TRANSMITTING ARC

GERMANY has given to the world a number of inventors who have contributed largely to the development of radiotelephony. One of the foremost is E. VON LEPEL, who invented a system of radio-telegraphy which was found to be adaptable to radio-telephone work by changes that were effected in a shunting system around the Lepel arc which possesses the property of setting up a train of rapid discharges suitable for radio-telephone transmission.

ments. If a manufactured receiver fails to tune in stations at exactly the same dial settings as shown in the "log" which is usually included in the direction book which accompanies the receiver, this indicates no defect in the receiver. This also applies to the tuning charts given in the "How to Build" articles in POPULAR RADIO. A variation of two or three degrees is quite within reason. In the case of a loop receiver the variation of the loop tuning dial may be even greater than this, because of the great variations in loop characteristics. This is one of the reasons why it is advisable for the owner of a receiver to make up a chart of his own—that exactly fits his

particular receiver and his antenna.

For the convenience of readers who have constructed receivers described in past issues of POPULAR RADIO, some of the charts are again given in the accompanying figures.

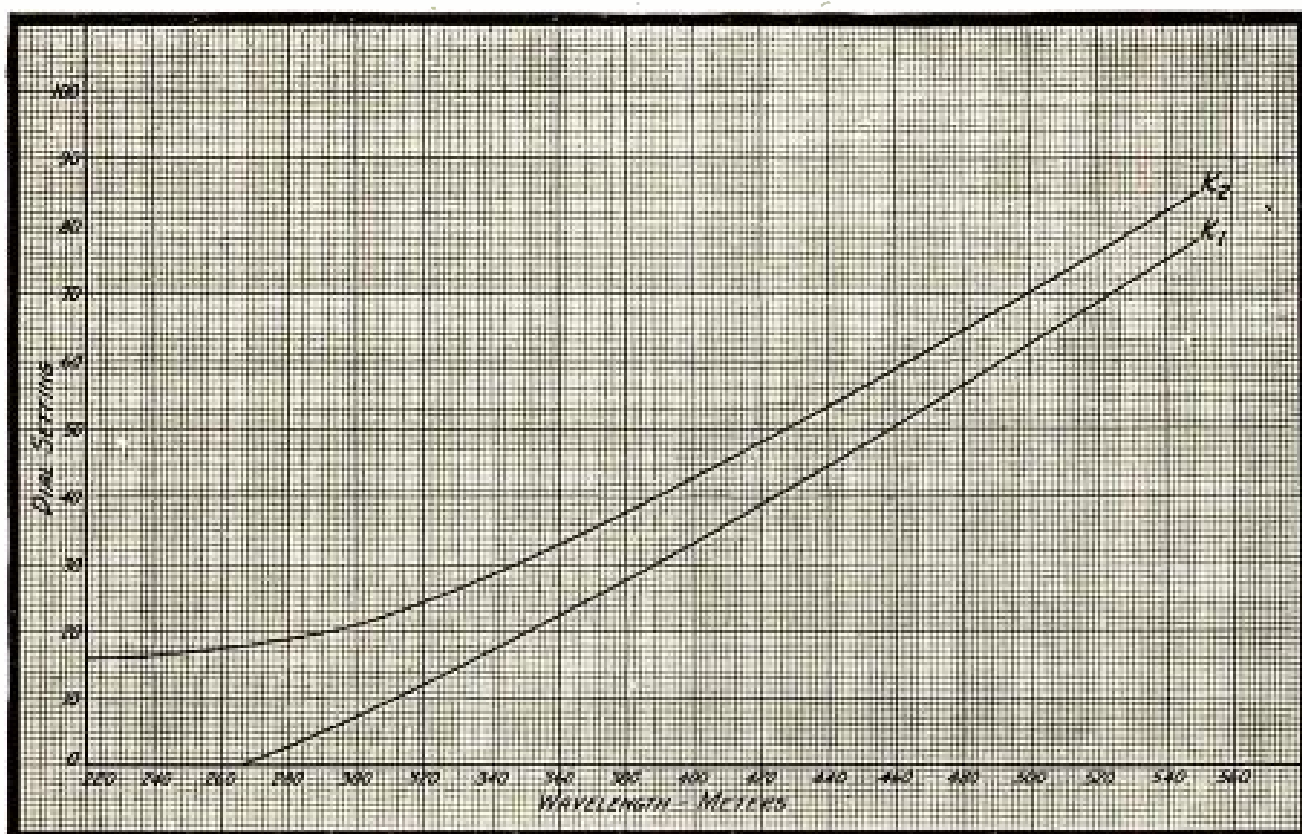
In Figure 4 a new tuning chart is given for the Four-circuit Receiver with resistance-coupled amplification which was described in the October, 1924 issue. The chart printed in that issue was made up using 100 degree dials. Inasmuch as the many builders of this receiver purchased 180 degree dials their tuning naturally did not agree with the chart. Figure 4 will therefore be helpful, as it was made up using the 180 degree dials.



From a photograph made for POPULAR RADIO

MEXICO'S INDIANS TO GET THE THREE "R'S" BY RADIO

Dr. Manuel Gamis, a graduate of Columbia University, has installed a broadcasting station at Mexico City and has sent superheterodyne sets into the remote parts of the country. A regular course in the rudiments of education is being given in daily two-hour lectures. As Spanish is not readily understood by all the "students," the instruction is also sent out in the ancient languages of Maya and Tarascan—tongues that were in use when Cortez subdued the nation.



THE CHART OF THE COCKADAY EIGHT-TUBE SUPERHETERODYNE

FIGURE 6: In making up this chart only one "curve" was shown for the oscillator dial, representing its upper settings. Also a single "curve" was shown for the loop tuning condenser dial. In a case where a tapped loop is used, it would be advantageous to also add curves for one or two other settings of the loop switch, and it would also be well to show a "curve" for the lower settings of the oscillator dial.

merce caused considerable confusion, inasmuch as publishers of broadcasting station directories could not keep pace with the frequent changes.

It is best to omit the dots which are much out of line, as they will represent stations whose wavelengths have been changed. When the proper wavelengths for these stations are determined later on they too may be plotted.

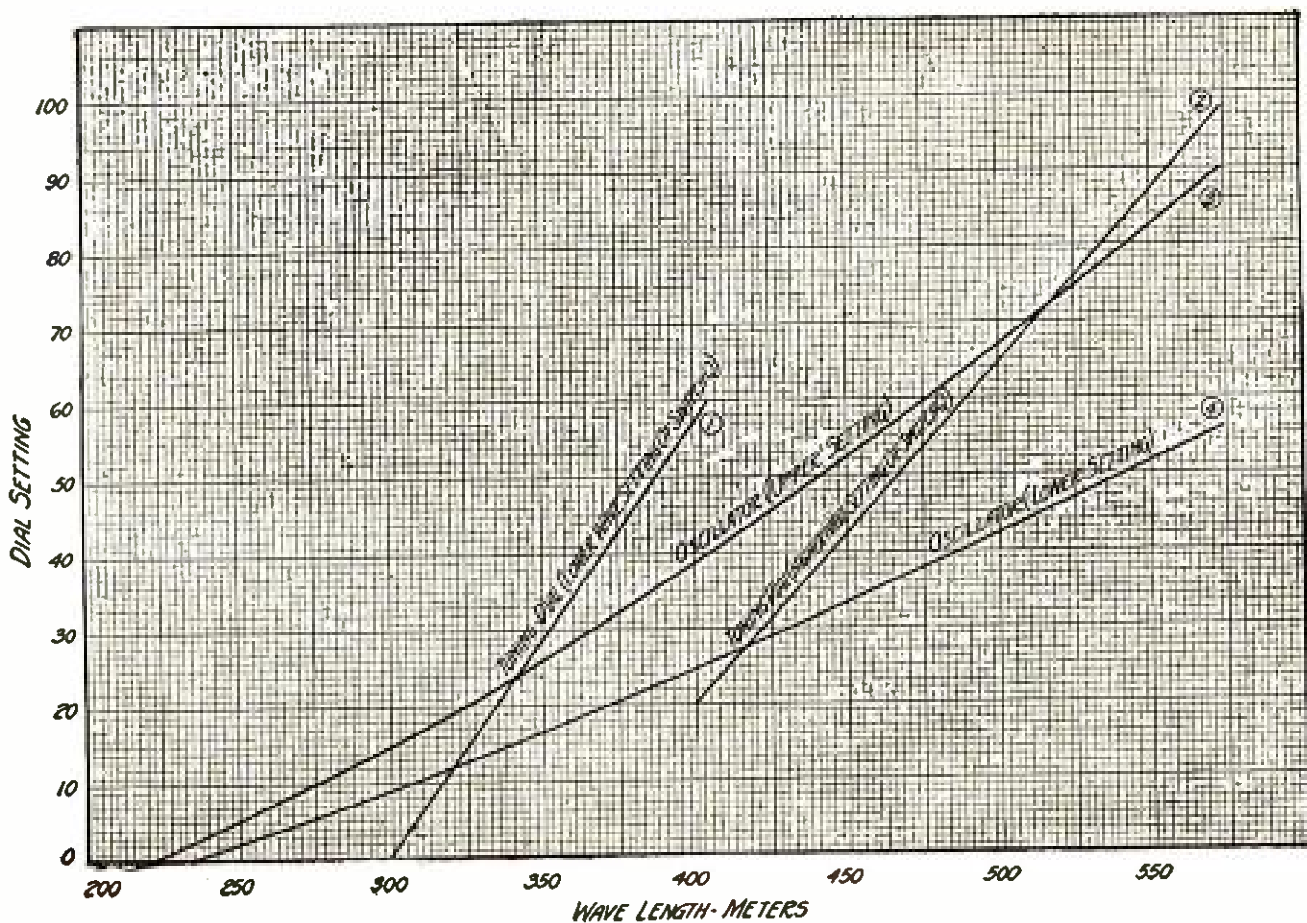
In Figure 2, for example, at the point marked X the dots representing station PWX of Havana, Cuba, are considerably off their respective lines. This is due to the fact that this station was listed in the call books as a 400-meter station. At the time of making up this chart PWX was working on 410 meters. When other stations had been marked out, and the lines drawn, then the dial settings for PWX were followed over to the right until they intersected the three curves. It became evident then that 410 meters was the correct wave-

length. The wavelength of PWX was then checked with a wavemeter and the latter wavelength proved to be correct.

After the completion of the line for dial number one, the same process is repeated for the settings of dial number two, and again for dial number three, if the receiver being charted has more than two tuning dials. When the chart is completed, therefore, it will have a line, or "calibration curve" that will represent each of the tuning dials on the receiver. Such a chart is shown in Figure 2, and is based on the dial settings given in Figure 1.

If you desire you may make two more lines to show the settings of dial number one with the antenna switch on the first and third taps.

Usually a "log" or chart made up for one receiver may not be exactly correct for another receiver that has been made up in accordance with the same plans and with the use of the same instru-



A CHART FOR A "SUPER"

FIGURE 5: A tuning chart is especially useful in the case of a superheterodyne receiver, as it greatly helps to eliminate the confusion resulting from the fact that practically all stations can be tuned in at two different settings of the oscillator dial on any superheterodyne receiver. This is the tuning chart for the Seven-tube Non-radiating Superheterodyne Receiver, described in the December 1924 issue.

tenth line up would be marked 20, and the twentieth line marked 40.

Assuming that the tabulation in Figure 1 is to be made up in chart form, the setting of the first dial for the first station on the list is marked with a dot on the cross-section paper. For the purpose of illustration the dial readings used are those with the antenna switch set on point 2. The placing of the dot is determined by finding the line at the bottom of the paper which corresponds to the station's wavelength in meters, then finding the line at the left-hand margin that corresponds to a setting of dial number one. Now, follow the horizontal line to the right and the vertical line upward until the two meet. This meeting point is the point for the dot. For the time being the settings for the other dials may be forgotten. Continue charting the settings for dial number one.

When the places for all the dots for this dial are found, draw the "curve" as shown in Figure 2. This line should be drawn so as to intersect the greatest number of points without kinks or sharp bends in the line. If the record of dial settings is at all accurate, this should be practically a straight line or possibly a line with a slight curve. The shape is dependent on the characteristics of the tuning instruments but in no case should there be a sharp bend in the line.

It will be found, of course, that some of the dots are slightly out of line, due to various causes, such as the broadcasting station being slightly off its published wavelength or its wavelength being incorrectly given in the list of broadcasting stations from which the wavelengths were obtained. Then, too, during the past winter the allocation of wavelengths by the Department of Com-

dial settings required for a station of a designated wavelength.

To make a tuning chart, tune in a number of stations and record their dial settings in a table such as that shown in Figure 1. This particular tabulation was made with the Atwater Kent Receiver, Model 20, which has three tuning dials and therefore requires three columns for tabulations.

Any change you make in your antenna will almost invariably affect your settings of the first tuning dial; therefore, when you use indoor antenna for local stations and an outdoor antenna for distant stations, the settings of the first dial should be separately listed for each antenna. Where a tapped antenna inductance is used this same plan may be followed as in Figure 1.

However, it is not especially important that the first dial be logged, because, with the second and third dials set for a given broadcasting station, it is only necessary to turn the first dial until the station is heard. In a triple control radio-frequency receiver, the first dial is usually not critical in its setting, unless the station that is to be tuned in

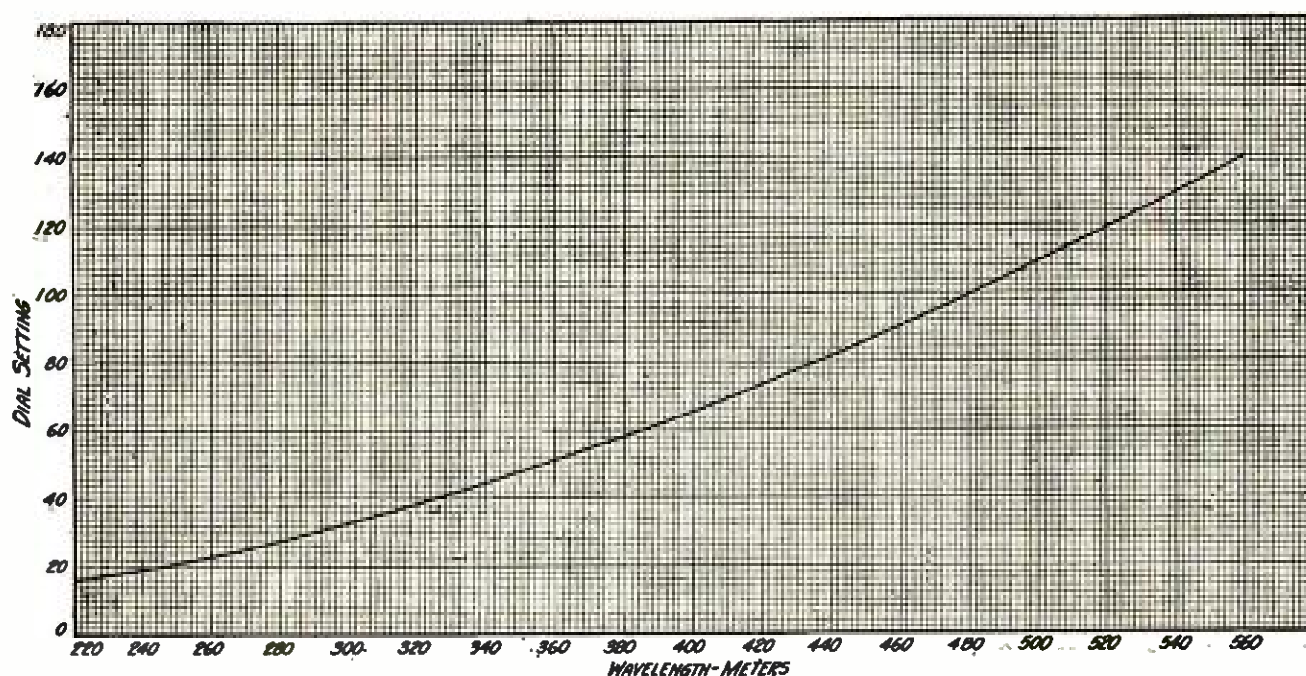
is at a great distance, or when an indoor antenna is used.

Obtain from your stationer a couple of sheets of cross-section paper that has twenty lines to the inch with every tenth line a heavy one.

Lay the sheet flat so that its length is horizontal and mark off on the left-hand margin divisions of 10 by beginning with the bottom line as zero. Mark the tenth line 10, the twentieth 20 and so on up to 100.

Next mark off the lower edge of the ruled lines. The first vertical line at the left-hand side is marked 160, the tenth line 180 and so on, counting two meters to each space. This makes the last vertical line at the right correspond to 560 meters. These vertical lines represent the wavelength. The chart will therefore cover a waveband of from 160 to 560 meters. The vertical scale at the left represents the dial settings, which allow one space to each degree of a hundred degree dial.

If the dials on the receiver to be charted are of the 180 degree variety, it will be necessary to make each horizontal space represent two degrees; thus the



A 180 DEGREE-DIAL CHART

FIGURE 4: This is a chart for the same receiver that is charted in Figure 3, but in which a 180 degree dial is used. This will be useful to many owners of Four-circuit Receivers who installed 180 degree dials instead of the 100 degree dials used in the model receiver.

Also difficulty is sometimes experienced in charting some of the superheterodyne receivers, because of the decided effect that rheostat and potentiometer settings have on the tuning of these types of sets. This sort of receiver can usually be charted, however, if all coupling coils, including the oscillator coupler, are fixed beforehand.

Nearly all tuned-radio-frequency receivers and practically all receivers recently featured by POPULAR RADIO can be definitely logged. The Four-circuit Receiver, despite its being regenerative, will always bring in the same station at the same dial settings.

Tuning charts like those which have accompanied the "How to Build" articles in POPULAR RADIO are simple to draw up if one follows instructions closely.

After a few stations have been tuned in and the dial settings marked on the chart, a "curve" may be drawn to show the dial settings of your particular receiver for any wavelength. Besides, stations which you have never tuned in, but of which you know the wavelength, can be readily picked up by referring to the chart to find out the

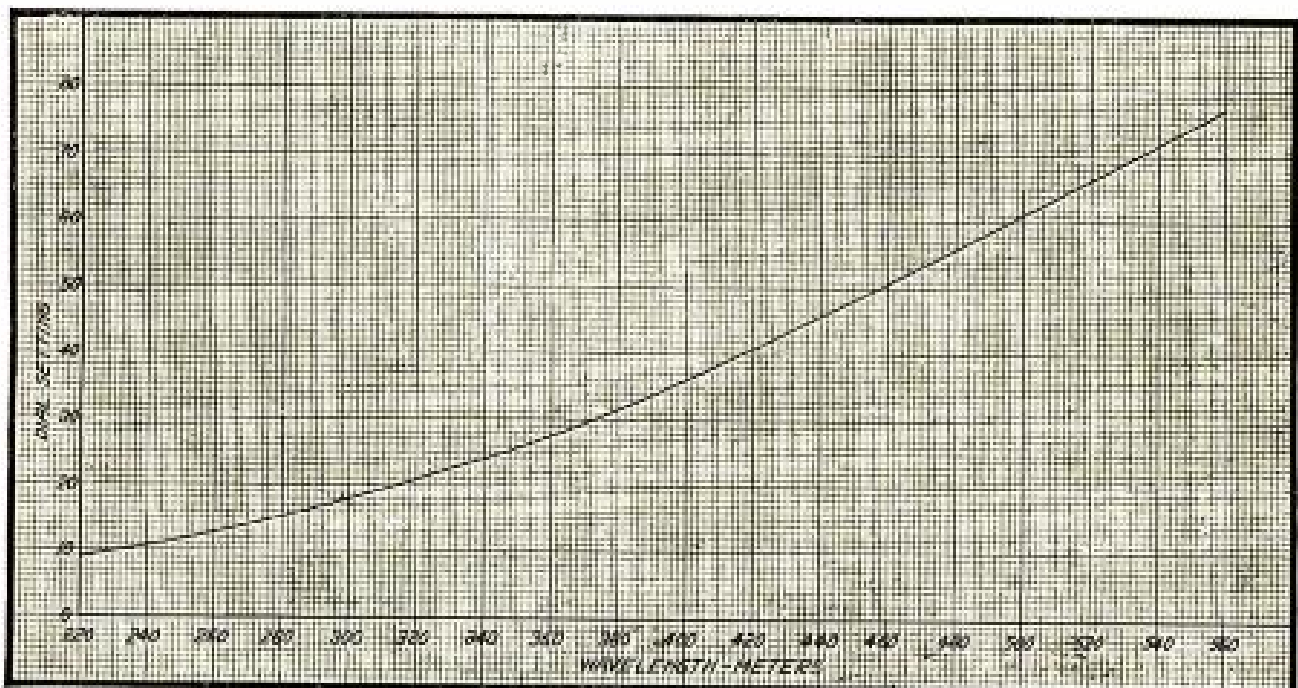
Station Log

Wave-lengths in Meters	Call Letters	Dial Settings		
		Dial No. 1*	Dial No. 2	Dial No. 3
273	WFBH	13	24	23
280	WNAC	15	25	24
286	WREO	17	27	26
300	WPG	20	29	28
309	KDKA	22	31	30
316	WGBS	24	32	31
322	KOA	25	33	32
345	WLS	31	38	37
360	WHN	34	41	40
370	WEBH	36	43	42
380	WGY	38	45	44
390	WTAM	41	47	46
400	PWX	46	51	50
405	WOR	45	50	49
422	WLW	50	55	54
435	CNRO	54	59	58
455	WJZ	59	64	63
469	WCAP	63	67	66
492	WEAF	70	74	73
509	WIP	75	79	78
526	WNYC	80	84	83
535	KYW	82	86	85

* At switch tap No. 2.

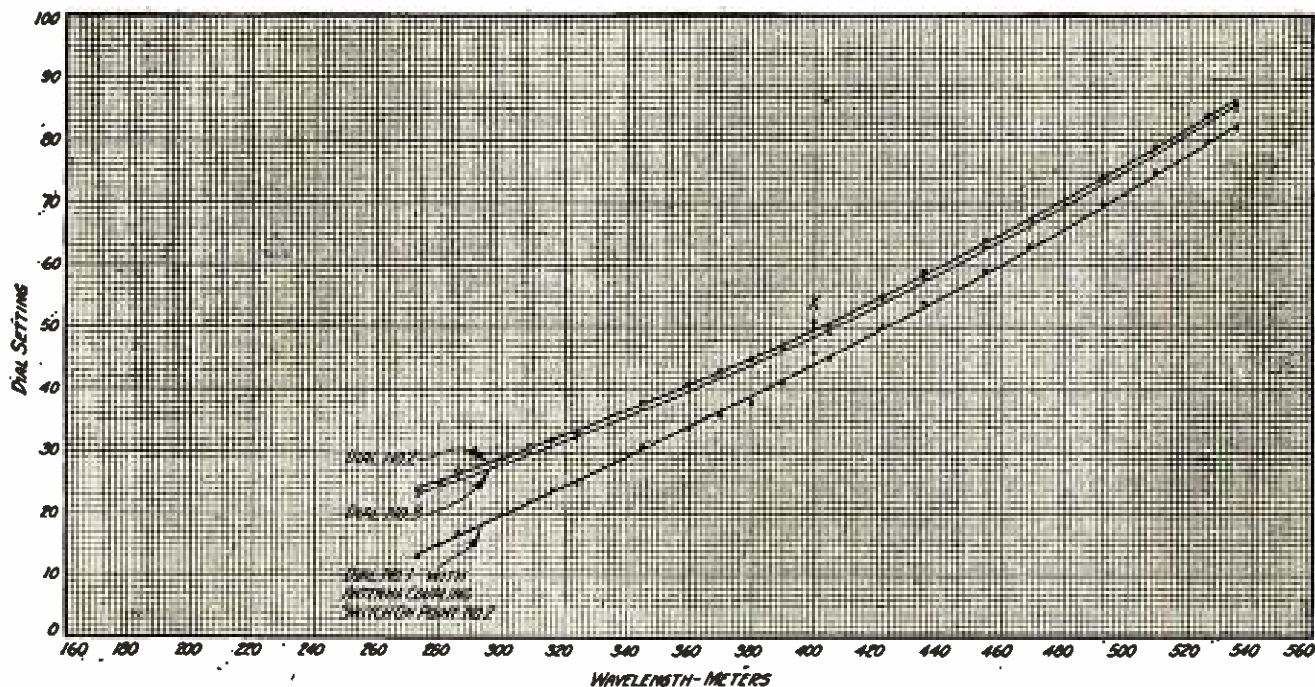
THE LOG OF AN ATWATER KENT RECEIVER

FIGURE 2: Such a list is easily made up for any type of receiver by marking the dial settings for each station tuned in.



A TUNING CHART FOR THE FOUR-CIRCUIT RECEIVER

FIGURE 3: If your Four-circuit Receiver (described in POPULAR RADIO, October, 1924) does not tune exactly in accordance with this chart you can easily make up your own chart by following the instructions given in this article.



A THREE-DIAL TUNING CHART

FIGURE 1: This complete tuning chart is made up from the "log" shown in Figure 2. With such a chart it is a simple matter to tune in new stations that have never before been heard—provided their wavelength is known. For instance, to tune in WBZ (which operates on 333 meters) it is necessary merely to find 333 on the lower scale, then follow this point straight up. This imaginary line intersects the "curve" for dial No. 1 at a point which, when followed over to the left, gives a reading of $27\frac{1}{2}$, which is the setting for dial No. 1 to tune in this station. The same procedure is followed for the other two dials, giving settings of approximately 34 and 35 respectively for dials 2 and 3.

HOW TO DRAW UP

Your Own Tuning Chart

To get the greatest enjoyment out of your receiver, a tuning chart is essential. This article explains how to go about plotting a chart that will enable you to pick up stations you have not heard before.

By DAVID LAY

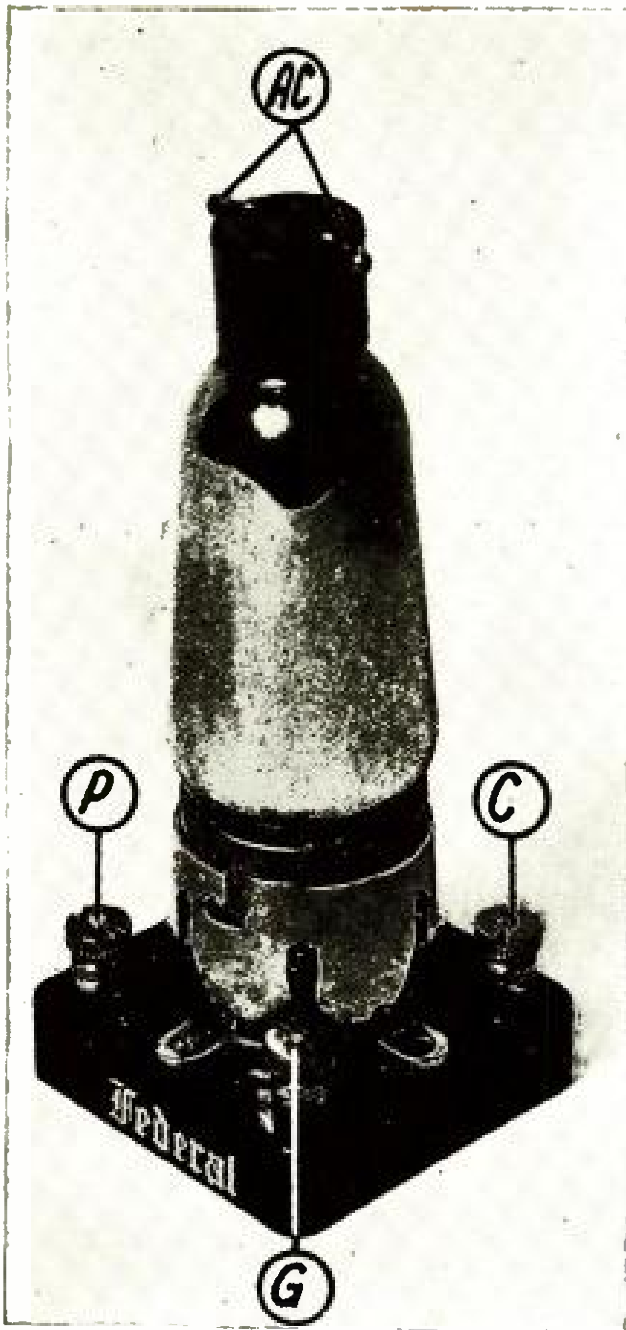
THE trend of modern receivers has been toward simplicity of operation and toward fixed coupling which permits the set owner to log his receiver. Practically all standard receivers that are being manufactured now can be definitely charted.

If a record is once made of the dial settings, at which a certain broadcasting station is tuned in on such a receiver, that station can always be brought in at the same dial settings.

Receivers with a variable coupling cannot be accurately charted unless the

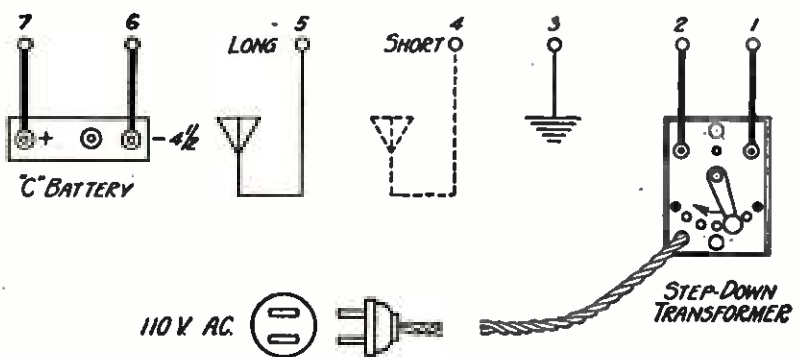
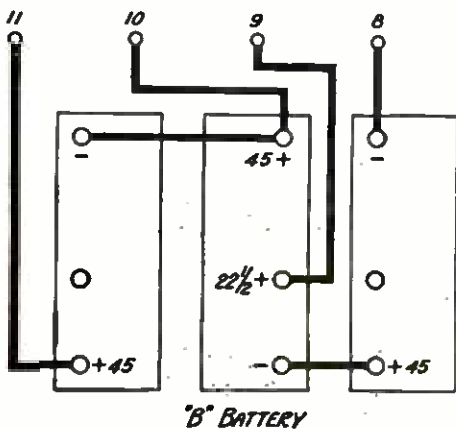
coupling instruments are set where the best average reception is obtained and then left at these settings permanently. Otherwise, the dial settings of the wavelength controls will vary, for a given wavelength, with changes in the coupling.

Many regenerative receivers that use tickler feed-back, even those using fixed coupling between primary and secondary of the antenna coupling unit, cannot be accurately charted because any movement of the tickler coil affects the setting of the secondary tuning circuit.



HOW THE NEW TUBE IS CONNECTED

FIGURE 10: This picture shows the connections for the new tube. P is the plate; G is the grid; and C is the cathode (which replaces the ordinary filament). The two terminals AC are the heater terminals.



Ask for transformer Type B Special).

Next insert the loudspeaker plug into the jack U and the set is ready for use.

Operating Data

The proper setting for the tapped switch on the lighting transformer will have to be determined by actual practice. It depends upon the voltage of your local AC lighting mains. If it is set on too high a tap, the set will oscillate; if set too low, the set will be lacking in volume.

Turn on the AC current by a switch and allow the heaters in the tubes about one minute to come to a proper operating temperature. The tubes operate at a dull orange color and should never be allowed to light up like a filament.

To tune in a station, set the two dials on condensers D and E at approximately the dial setting for the wavelength of the station you want to hear.

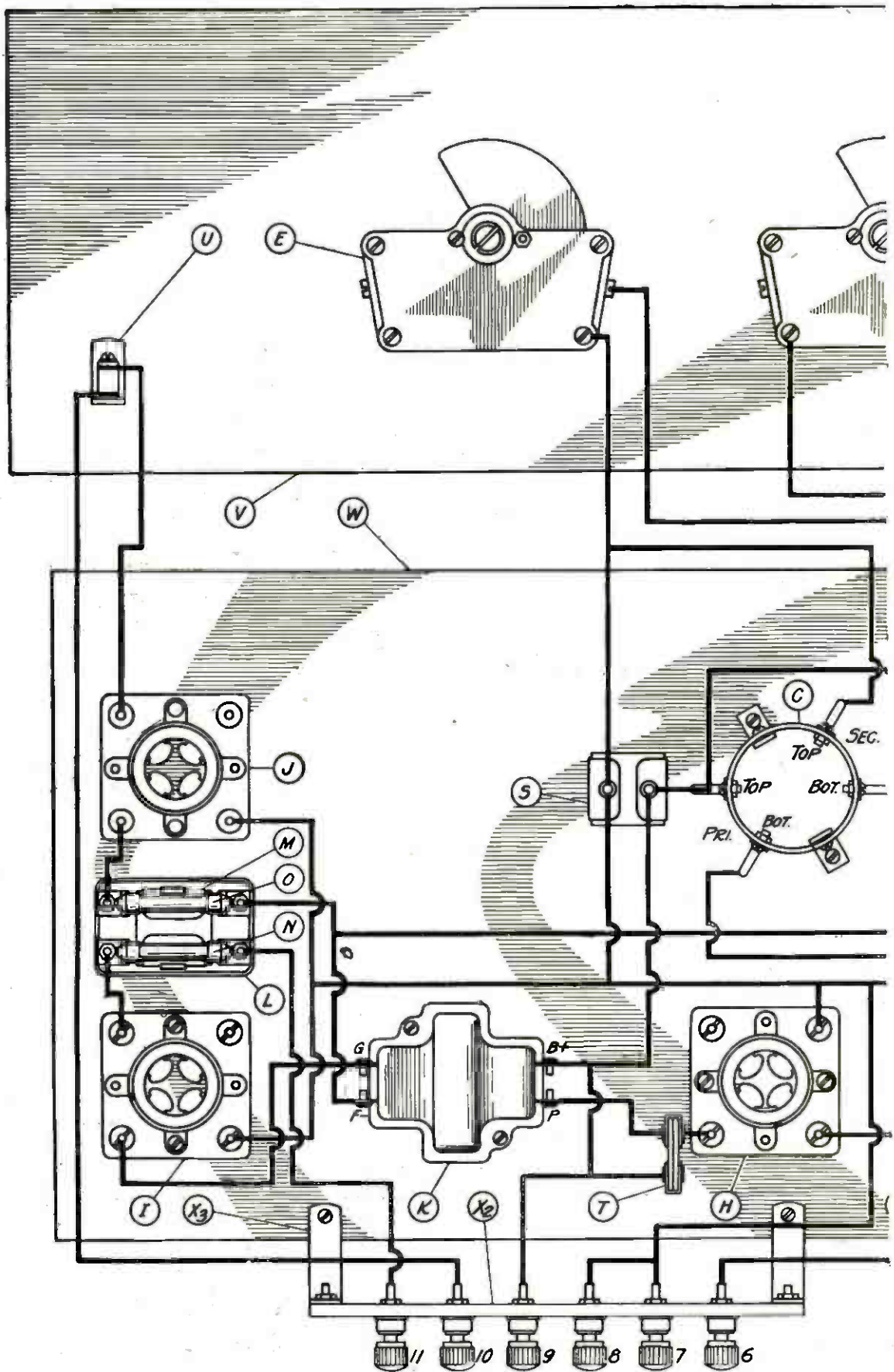
Then rotate the dial of the variometer A until the signal is brought in with the proper volume.

Two types of antennas may be used with this set. One is the ordinary 100 to 200 feet outdoor antenna of the single-wire variety. If this is used, it should be attached to binding post No. 5 on the receiver.

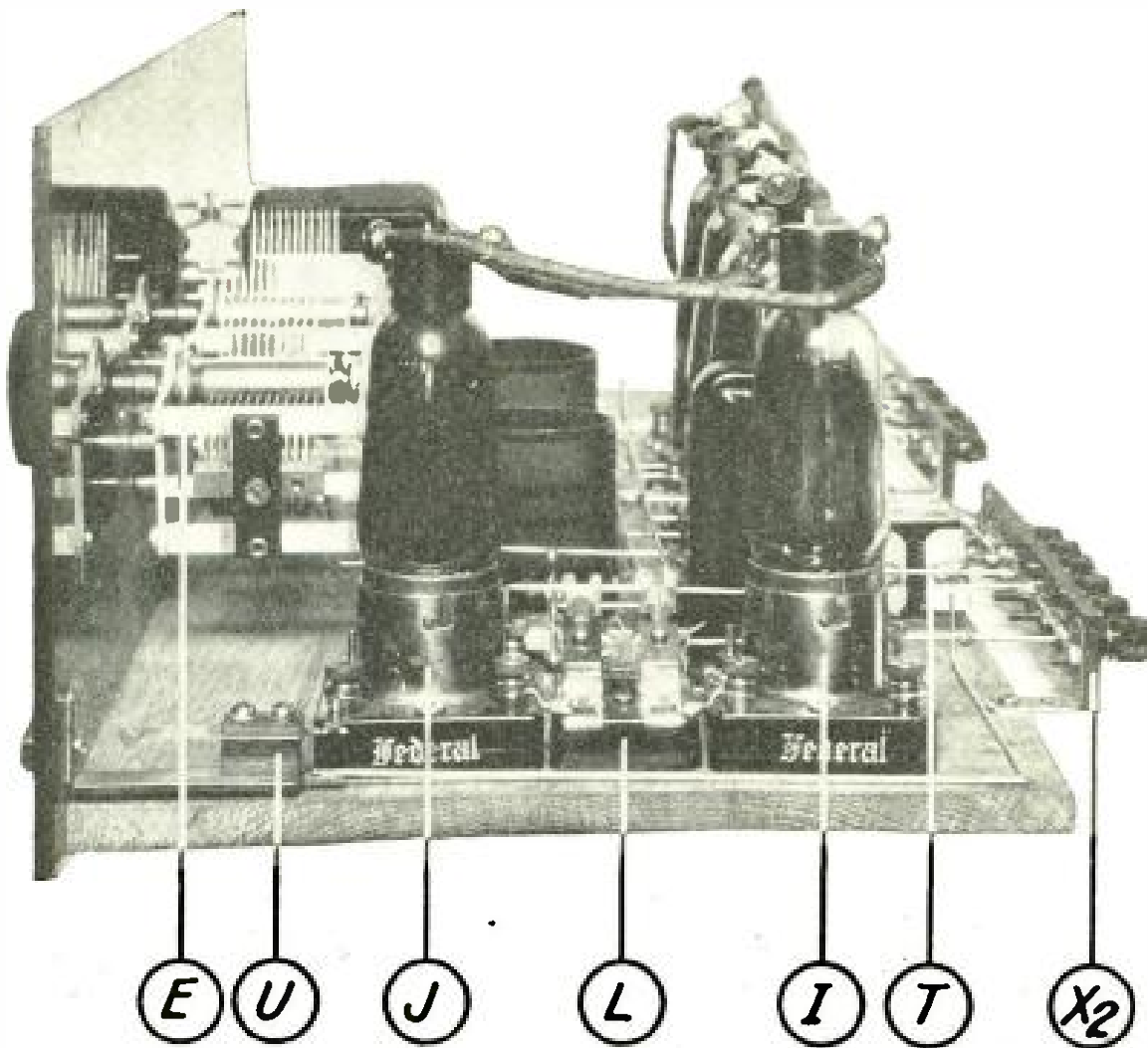
If a short indoor antenna is to be used with the set (and it may, with fine results), it is recommended that a wire be run around the picture moulding in one or two rooms or down a long hall. It should be from 40 to 60 feet in length and should be connected to binding post No. 4. Either of these two types of antennas when connected to the proper binding posts, will cause the variometer A to tune at approximately the same settings as the condensers D and E.

NO CHANCE FOR MISTAKES IN CONNECTING UP

FIGURE 11: This drawing will prevent you from making mistakes in connecting to the terminals at the back of the receiver. If you follow these instructions, the set will be hooked up correctly as the terminals shown in the wiring diagram are marked with designations that correspond with the numbers given here.

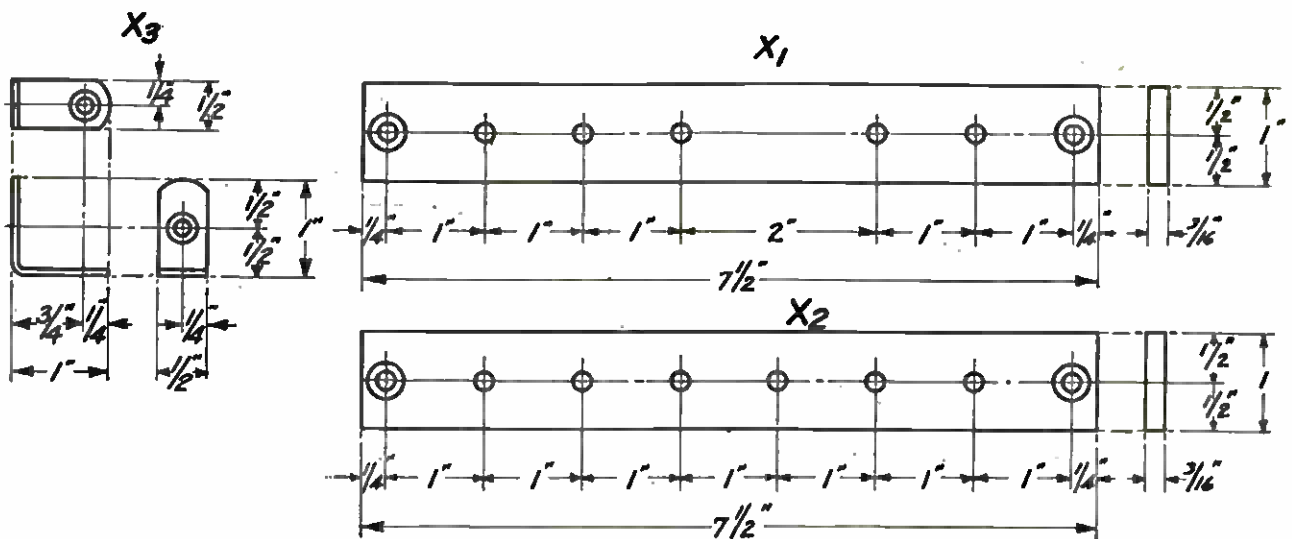


THE WORKING PLAN FOR CONNECTING UP THE INSTRUMENTS
FIGURE 9: The upper rectangle represents the panel and on it the instruments are drawn just as they appear. The lower rectangle represents the baseboard; the instruments are drawn in about their relative positions. The heavy black lines show the way to wire up the mounted instruments.



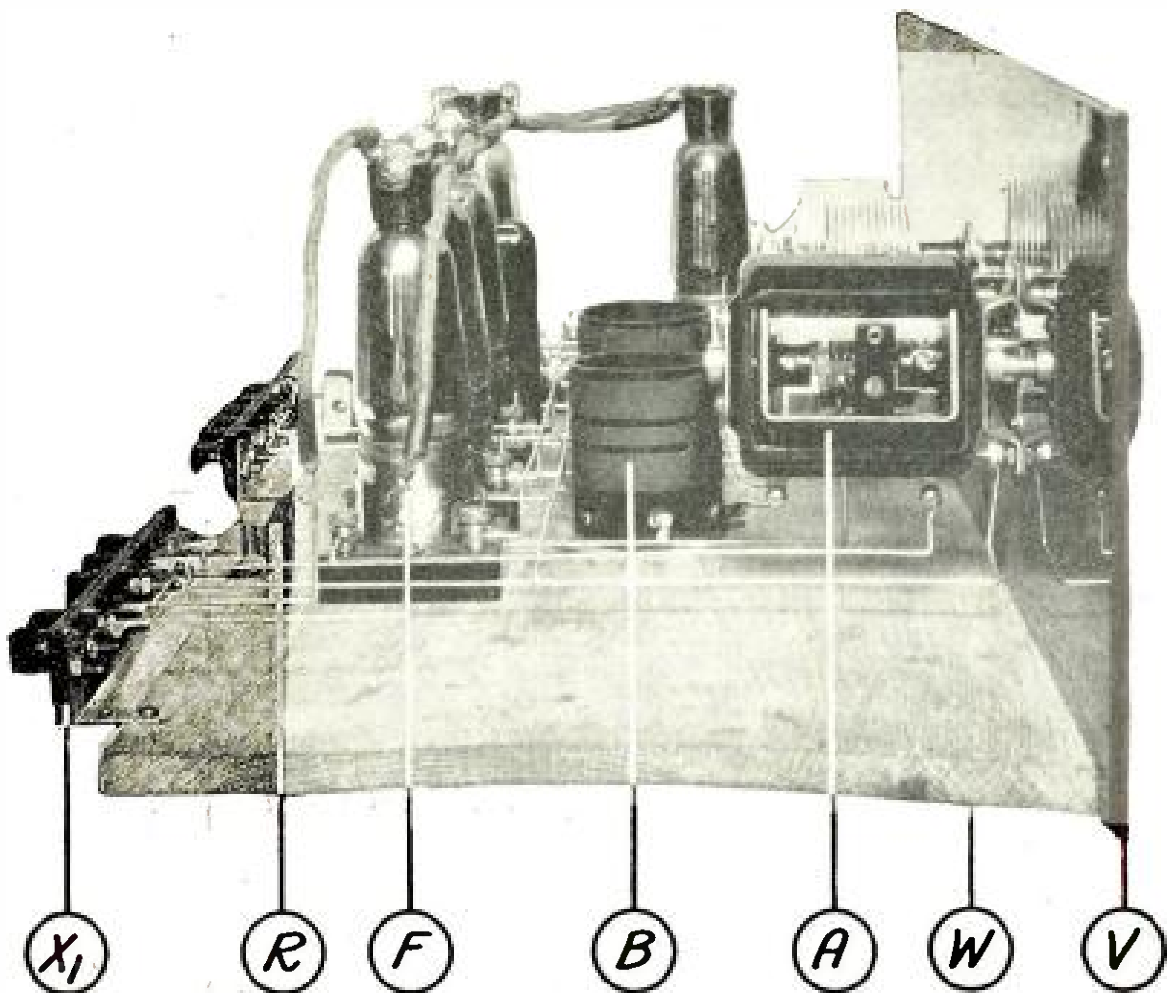
VIEW OF THE SET FROM THE RIGHT

FIGURE 7: This end view indicates the manner of mounting the variable condensers, the jack and the sockets.



DETAILS OF THE CONNECTION BLOCKS AND THE SMALL BRASS BRACKETS

FIGURE 8: This drawing gives the necessary data for making the insulated blocks or strips on which the binding posts are to be mounted. It also gives the dimensions for the small brass brackets that are used to fasten the blocks to the baseboard.



HOW THE SET LOOKS FROM THE LEFT

FIGURE 6: This illustration shows the general manner of mounting the variometer, the radio-frequency coils, the tube sockets and the binding post strips

Then run a wire from the case (end-plate) of the condenser to the top terminal of the secondary of the coupling unit B.

Next run a wire from the bottom terminal of the primary of the coupling unit B to the plate terminal of the socket F.

Do the same thing with coupling unit C and socket G.

Now run a wire connecting the terminals marked F (not F+) on all the sockets F, G, H, I and J. Run an extension of this wire over to binding posts Nos. 7 and 8.

Then run an extension of this wire over to the top terminal of the secondary of the coupling unit C and from there over to the case of the condenser E. The fixed condenser S should also be connected between this wire and the top terminal of the primary of the coupling unit C.

Next connect the terminal marked P on transformer K with the plate terminal of the socket H. The fixed condenser T should be connected between this point and binding post No. 9.

Next connect binding post No. 10 with a wire running around the left end of the set (looking from the back) to the bottom terminal of the jack U. The top terminal of the jack U should be connected to the plate terminal of the socket J.

The grid terminal of this same socket should be connected to the terminal G of the resisto-coupler L. The plate terminal of socket I should be connected to the terminal marked P of the resisto-coupler L.

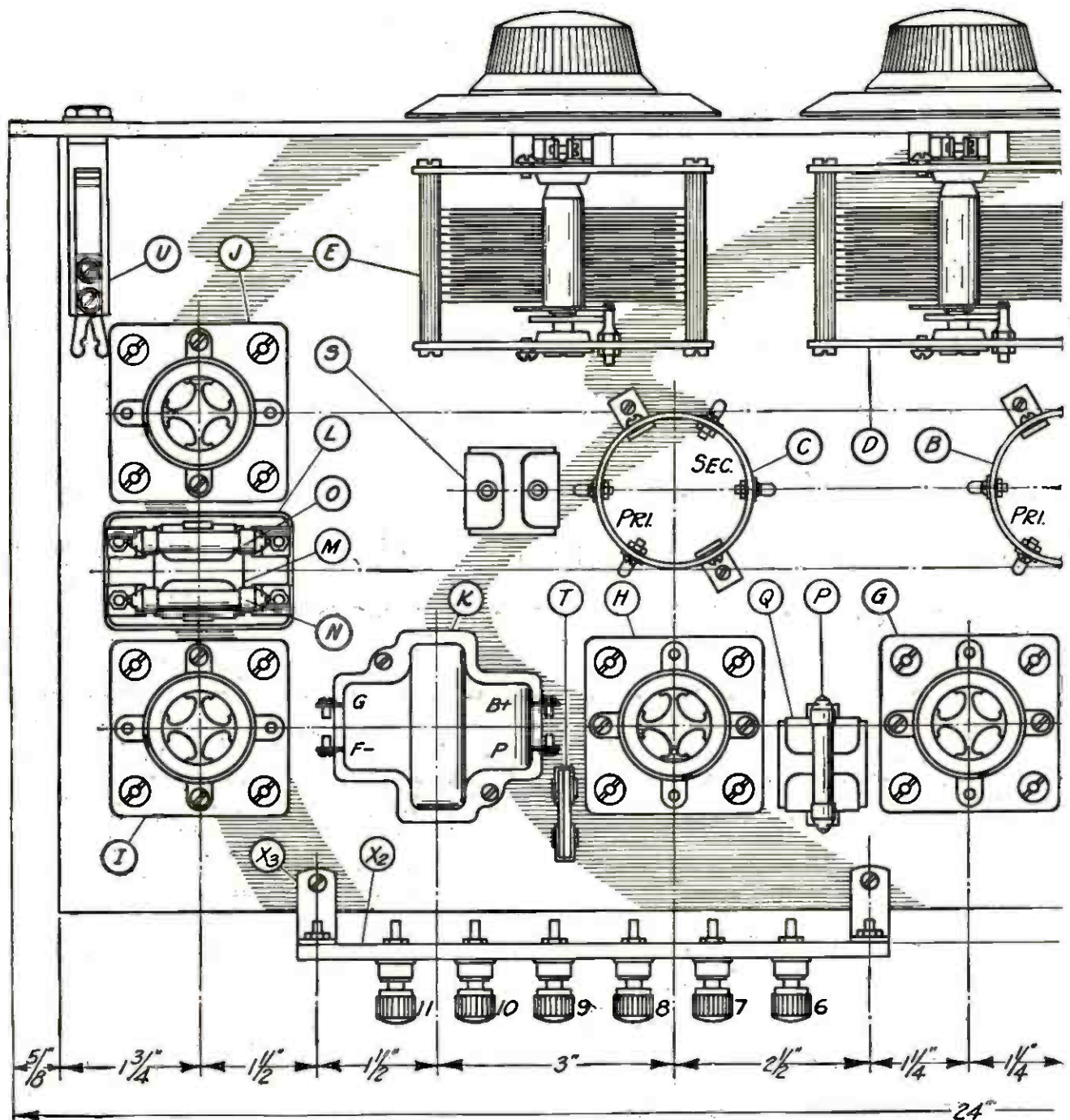
Next connect the grid terminal of socket I to the terminal marked G of the transformer K.

This leaves binding post No. 11 to be connected with a wire running to the terminal marked B on the resisto-coupler L and then the wiring is complete. Be sure that you have checked all your wiring until you are sure it is exactly as shown in Figures 1 and 9.

How to Install the Set

After the wiring has been completed, the cabinet may be attached by means of wood screws (nickel plated) inserted through the panel into the woodwork of the cabinet. The terminal binding posts Nos. 1 to 11 should now protrude through the two slots cut for them in the back of the cabinet.

To place the set in operation, tubes should be inserted and the AC heater leads should be connected, as shown in the diagram in Figure 10. These include the flexible connections between all of the top terminals on the tubes and the binding posts, Nos. 1 and 2.



THE WORKING DRAWING FOR CONSTRUCTION

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

ments on the base and it may be fastened at right angles to the panel V by means of three wood screws inserted through the holes drilled for them in the panel and into the edge of the baseboard W.

When this has been done, the set is ready to be wired up.

How to Wire the Set

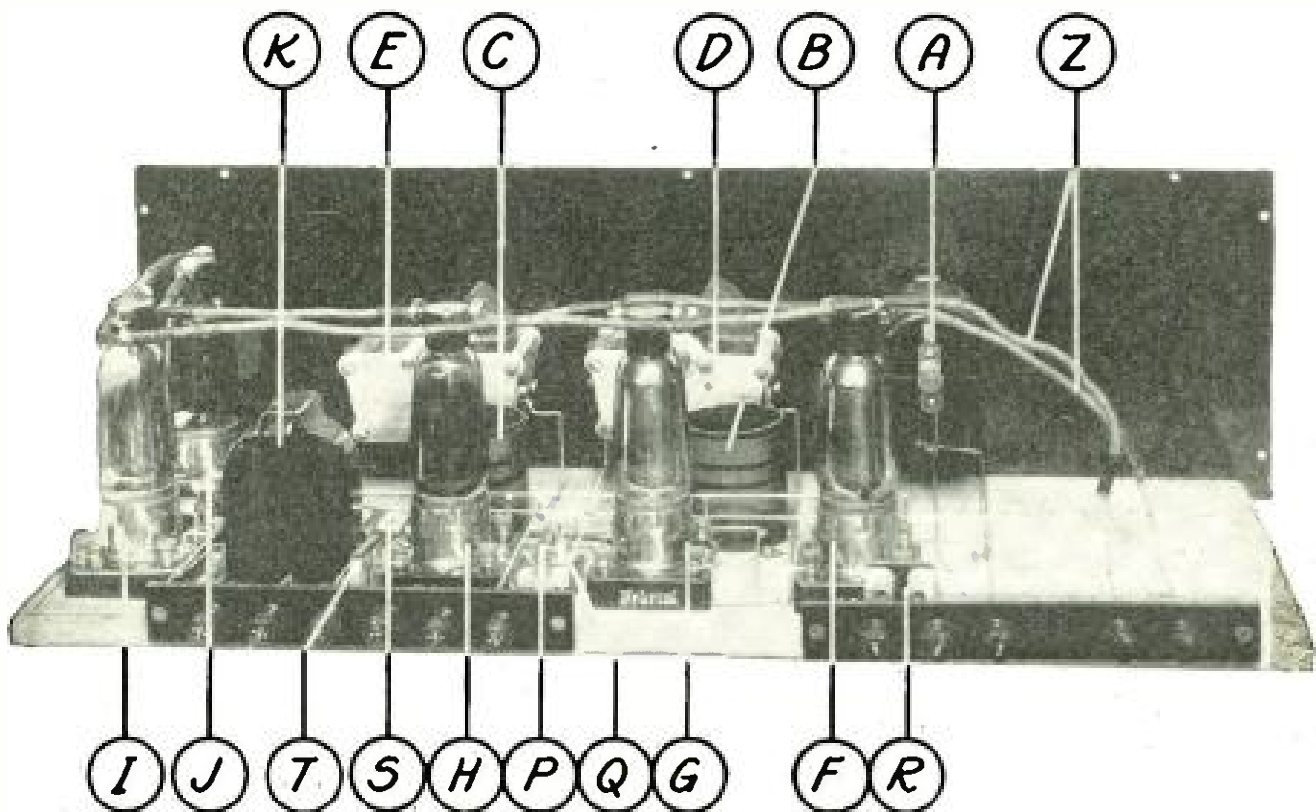
The design of this set is such that the wiring of the grid circuit of each of the four tubes is made extremely short and is isolated from other parts of the circuit. In fact, this idea has been employed throughout and the leads are so arranged that the shortest connections

may be used. As this is the case, the set should be wired with bus-bar.

A tinned-copper, round bus wire is recommended. All connections should first be shaped so that they will fit. They should then be soldered in place. Refer to the wiring diagram in Figure 1 and more specifically to the picture diagram in Figure 9 for the exact way in which to run the wires.

The AC leads for this receiver will not be considered a part of the wiring as they are flexible connections and are insulated from the rest of the set.

Start wiring up by connecting a wire from binding post No. 2 to binding post No. 3 and from here over to the bottom nut, which fas-



HOW THE SET LOOKS FROM THE REAR

FIGURE 4: This picture shows the general arrangement of all the instruments fastened to the panel or base. The exact locations for the instruments are shown in Figure 5.

panel lengthwise with fine sandpaper until it is smooth. This process should be repeated, except that light machine oil should be applied during the second rubbing. Then rub the panel dry with a piece of cheesecloth. A permanent dull finish will be the result. Or, the panel may be left with its original shiny-black finish, if care has been exercised, so that it has not been scratched during the drilling.

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

First mount the variometer A on the panel V by means of two screws fastened through the panel. Then attach the dial to the shaft.

Next fasten the two variable condensers, D and E, to the panel, with three screws to each instrument, and attach the two dials.

Then attach the jack U in its position at the lower right-hand corner of the panel (looking from the front).

For the above-mentioned operations, consult Figures 2, 3, 4, 5, 6 and 7.

This completes the work of mounting the instruments on the panel V.

The next job will be to prepare the baseboard W. It should be cut from one-half inch hardwood to the size shown in Figure 5. Be sure that it is squared up properly before you are ready to mount the instruments.

When the baseboard has been completed, mount the five sockets, F, G, H, I and J in their respective places, as shown in Figures 4, 5, 6 and 7. These are fastened to the baseboard by means of two wood screws to each socket.

Next, mount the two radio-frequency coupling units B and C in their respective places on the baseboard, as shown in Figures 5 and 6. They should be fastened in the same relative positions by means of two small wood screws to each instrument.

It should also be noticed that the two transformers, B and C, are mounted with the two secondary terminals facing the front, right-hand corner of the set. (These two terminals are the two outer terminals to the two outside coils on the units. The middle extremities of these two outside windings are joined together. This leaves the primary winding [the middle section of wire] terminals facing the rear left-hand corner of the set).

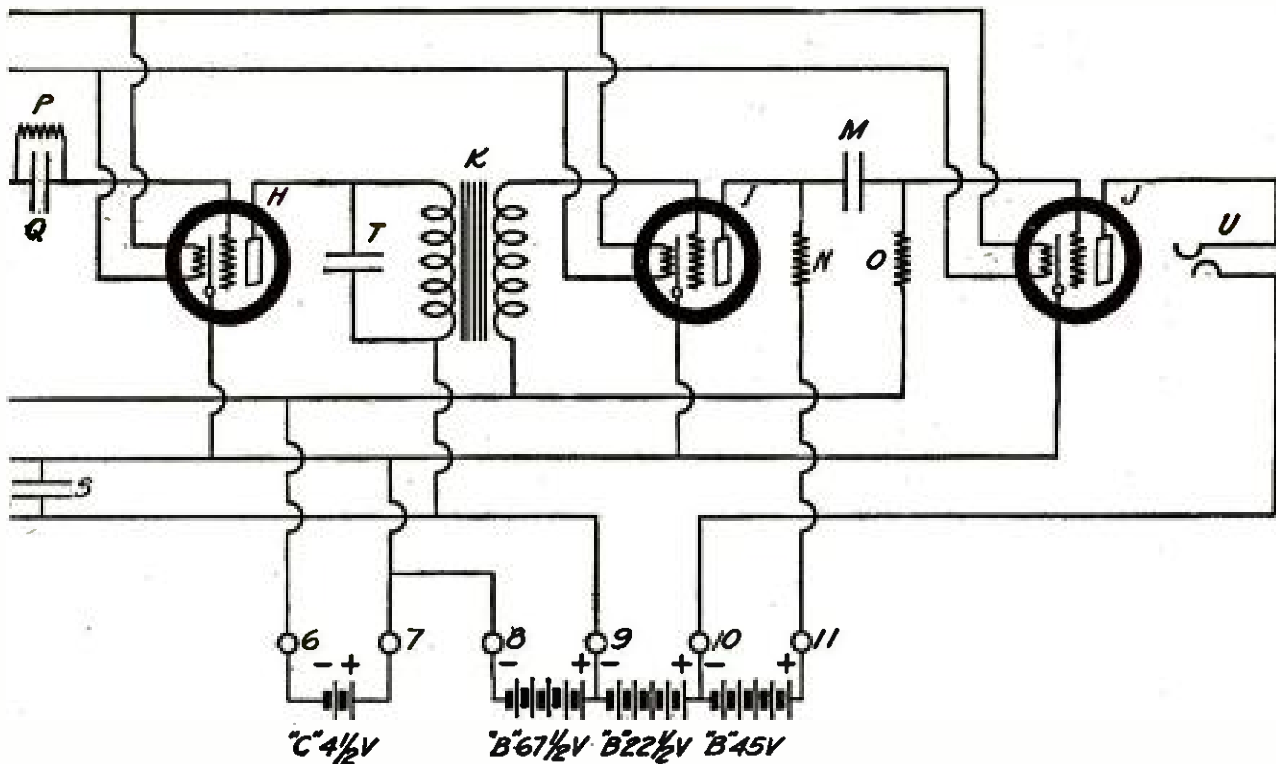
The transformer K should now be placed and fastened with two small wood screws, as shown in Figures 4 and 5.

The last instrument to mount is the resisto-coupler mounting L, which fits in between the two last sockets, I and J, as shown in Figures 5 and 7. It is fastened to the baseboard W by means of two wood screws.

Next prepare and mount the two binding post strips X1 and X2, the details of which are shown in the diagram in Figure 8. Strip X1 contains the three binding posts for the antenna and ground terminals and also the two heater terminals. Strip X2 contains the binding post terminals for the "B" and "C" batteries.

When the two strips are complete, mount them on the baseboard, as shown in Figures 4 and 5 by means of the small brackets X3. Two of these are used to each binding post strip.

This completes the mounting of the instru-



use with the large antenna. The binding post for the small antenna cuts out the series, fixed condenser and connects directly to the grid of the first tube, as shown in the diagram in Figure 1.

To meet points Nos. 2 and 4, the receiver incorporates two stages of tuned-radio-frequency amplification, in which the second and third dials are set on approximately the same settings for any given wavelength for either local or distant stations.

In consideration of point No. 3, the special heater arrangement of this tube, and the circuit design, prevents any hum in either the phones or loudspeaker.

The five tubes in this receiver when used with the special heating transformer draw a maximum of only 20 watts of energy from the lighting lines; thus the receiver may be operated for a whole evening for only a small fraction of a cent. This meets point No. 5.

There are no filaments to burn out!

The usual transformer and resistance-coupled stages follow the vacuum tube detector, so that the quality from the receiver will be up to the standard of the previous POPULAR RADIO receivers.

The set is a really practical and serviceable receiver; there is nothing experi-

mental about it. It has been fully tested and gives the same satisfaction when operated on AC that an ordinary set of similar type will give on storage batteries.

Parts Used in Building the Set

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

The same designating letters are used in the text and in the list of parts at the beginning of the article.

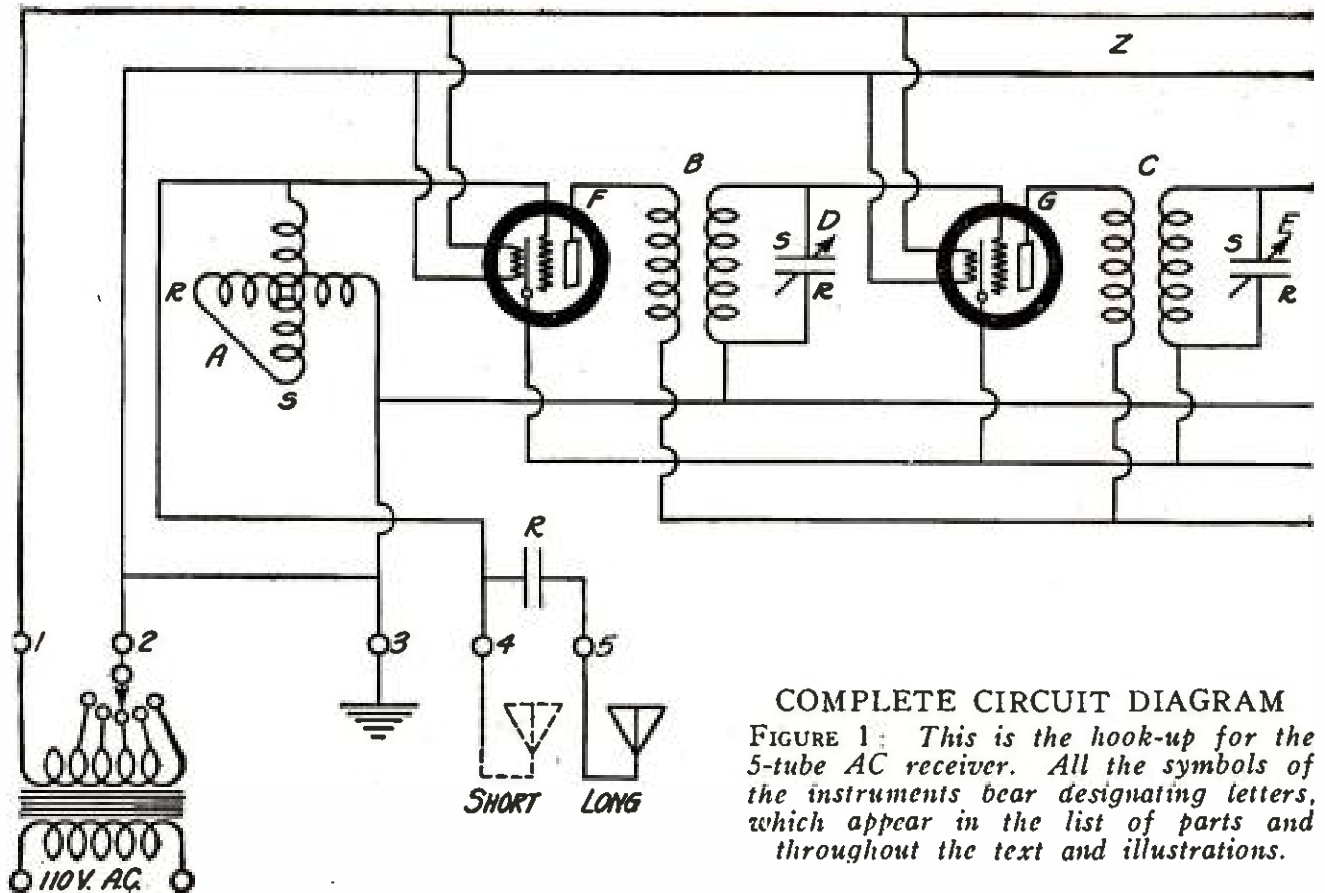
Q

The list of parts there given includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which may be used with equally good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections.

If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are to be drilled in the panel for mounting the instruments.

How to Construct the Set

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



COMPLETE CIRCUIT DIAGRAM
 FIGURE 1: This is the hook-up for the 5-tube AC receiver. All the symbols of the instruments bear designating letters, which appear in the list of parts and throughout the text and illustrations.

- S—Dubilier mica, fixed condenser, .006 mfd.;
 T—Dubilier mica, fixed condenser, .0001 mfd.;
 U—Pacient single-circuit jack;
 V—composition panel, 7 by 24 inches;
 W—hardwood baseboard, $9\frac{7}{8}$ by $22\frac{3}{4}$ inches;
 X1—antenna binding post strip;
 X2—battery binding post strip;
 X3—small brass brackets;
 Y—cabinet for 7 by 24-inch panel;
 Z—"PRSH" AC leads.

FIRST of all, the "McCullough" AC tube differs from other vacuum tubes in that it contains no filament.

In place of the usual filament for the liberation of electrons, it contains a cathode—in this case, a thin cylinder of metal coated with a special oxide which, when heated slightly, gives off a copious flow of electrons.

To supply heat to this special cathode, a heater is incorporated in the tube. This heater consists of a strip of resistance-wire material, that is doubled back upon itself through two holes in a small porcelain rod. The porcelain is used to insulate the cathode *electrically* from the heater wires, but at the same time to act as a *conductor* to the cathode for the heat

generated in these wires. An AC current of one-ampere at about 4 volts is required in the heater circuit. In this way a number of tubes may be run directly off the AC line through a small step-down transformer.*

In designing the new receiver especially for the use of these tubes, the following points have been kept in mind:

- 1; The receiver should operate on either an outdoor or a short indoor antenna:
- 2; The receiver should be capable of being logged:
- 3; The receiver should produce no hum when operated on AC:
- 4; The receiver should have a good distance range:
- 5; The receiver should be economical in operation.

To obtain the results in point No. 1, we have employed a variometer for tuning the input circuit with a fixed condenser in series with the binding post intended for

* The type recommended is the Dongan Special Type B transformer.



From a photograph made for POPULAR RADIO

A RECEIVER WITHOUT AN "A" BATTERY

The receiver described here runs without an "A" battery. It operates directly from a special step-down transformer, which is plugged into the AC lighting socket. The receiver contains only three dials and can be logged. There is absolutely no hum produced.

HOW TO BUILD A FIVE-TUBE AC RECEIVER

Everyone has heard or read of the prediction of a tube that will obtain its "A" battery current from the house lighting mains; many of us have wondered whether such a tube really would ever be placed on the market. In this article, a receiver that has been especially designed to use the new "McCullough" AC tube is described

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than \$65.00*

RECEIVING RANGE: *Up to 3,000 miles*

HERE ARE THE ITEMS YOU WILL NEED—

A—General Radio variometer, No. 269 equipped with Kurz-Kasch 4-inch dial;
B and C—"Precision" R. F. coupling units;
D and E—Hammarlund variable condensers, .0005 mfd. equipped with Kurz-Kasch 4-inch dials;
F, G, H, I and J—Federal sockets, No. 16;
K—General Radio audio-frequency transformer, No. 285;

L—Daven resisto-coupler, No. 41;
M—Dubilier mica, fixed condenser, .006 mfd.;
N—Daven resistor, $\frac{1}{4}$ megohm;
O—Daven resistor, $\frac{1}{2}$ megohm;
P—Daven grid-leak, 4 megohms;
Q—Dubilier mica, fixed condenser, .00025 mfd. with grid-leak clips;
R—Dubilier mica, fixed condenser, .00015 mfd.;

for it, a radical departure in set design and circuit hook-up will result, because the addition of 110 volts D.C. or A.C. to the proximity of ordinary set wiring will create disagreeable hums and buzzes. To overcome this a different method of wiring radio receivers will have to be resorted to. However, this need not create a great revolution in receiver design, as is shown by the construction of the new McCullough receiver that employs A.C. current.

One Newark (N. J.) manufacturer of independent tubes has been advertising widely a new type of tube with a very low amperage filament. One-tenth of an ampere is claimed for this filament, or about half the consumption of a 201-a tube. The success of this kind of tube will reduce the operating cost of multi-tube sets and it will increase the use of sets equipped with dry batteries.

To sum up what is going on behind the scenes in radio tubes, the new developments are as follows:

1. The elimination of the "jangly" super-sensitive spiral wire grid types of tubes which will make unnecessary the use of rubber-sponge-cushioned sockets;

2. Uniform tube characteristics are being brought about by machine spacing and uniform evacuation;
3. New methods of evacuation are being devised;
4. Entirely new types of filaments are being produced;
5. The 110-volt tube is being perfected;
6. The introduction of "juxtaposition" patent tubes to the market;
7. New vacuum-less tubes are being tried.

If we face these facts squarely it does not seem probable that within the next year or two any revolutionary type of vacuum tube or radio tube will overthrow the market. The great interests that control existing patents that are in effect in general tube manufacturing have millions of dollars of capital invested in quantity production machines that were built expressly for making vacuum tubes. They feel assured that nothing new will render their equipment obsolete. Besides, they control practically all of the improvement patents so that they can "sit tight," by reducing prices as market pressure increases until their vast capital investment is reproduced in profits.

Later, perhaps, the public will be given new types of tubes, but not very soon.



From a photograph made for POPULAR RADIO

WILL TUBES OF THE FUTURE STILL LOOK LIKE THESE?

These are only a few of the types that have appeared on the market in the last few years; most of them have been brought out within the past two years. They are all battery tubes which may find a dangerous competitor in the new A.C. and D.C. varieties or in tubes constructed on newer mechanical principles like the rigid-grid tubes.



Radio Corp. of America

HOW THE TUBE ELEMENTS ARE MOUNTED

The grids and plates in tubes must be fastened securely to the glass stems of the tubes. The small apparatus in front of the girl is an electric welding device which heats the glass element-supports sufficiently to allow the metal to be held rigidly by the semi-molten glass.

that are not suitable for quantity production.

Of greater general interest are the new "rigid grid" tubes that operate directly on 110-volt house current. The first, the "rigid grid" type are now being widely experimented with. Recently two patents involving the use of the "rigid grid" and the method of manufacturing tubes with its principles, were issued to a former World War veteran, G. L. Geisey. These tubes are patented in Canada, the United States and many foreign countries. The U. S. Serial numbers are 1,520,640 (issued December 23, 1924) and 1,514,898 (issued November 11, 1924).

The claims made for the "rigid grid tube" are that it is not sensitive to microphonic jolts and jars, and that it is not mechanically responsive to low-frequency disturbing electrical impulses that originate in telephone and telegraph

lines and in automobile induction systems. This rigid type of construction produces a shock-proof tube that is less likely to be damaged or broken in shipping.

The 110-volt tubes have been talked about for a considerable time and some experimental work has been done in the laboratories of the General Electric Company, the Western Electric Company, and a few others.

E. B. Myers, the noted radio-tube inventor, announced a short time ago that he had not only produced a 110-volt tube, but also that he had succeeded in making it work without a vacuum. This is indeed a new departure.

Besides, Mr. Myers has built his new tube so that the heat element, which supplants the filament as a source of electrons, is replaceable at the cost of a few cents.

If this tube fulfills the claims made

ment. The gases color up momentarily and then fade out blue again as they are thrown off by the newly-lighted filament and are sucked out by the pump.

Then the operator drops his V-Ray and applies a high-frequency alternator device, a small coil, which soon heats the enclosed metals by induction. The nickel and molybdenum of the grid and

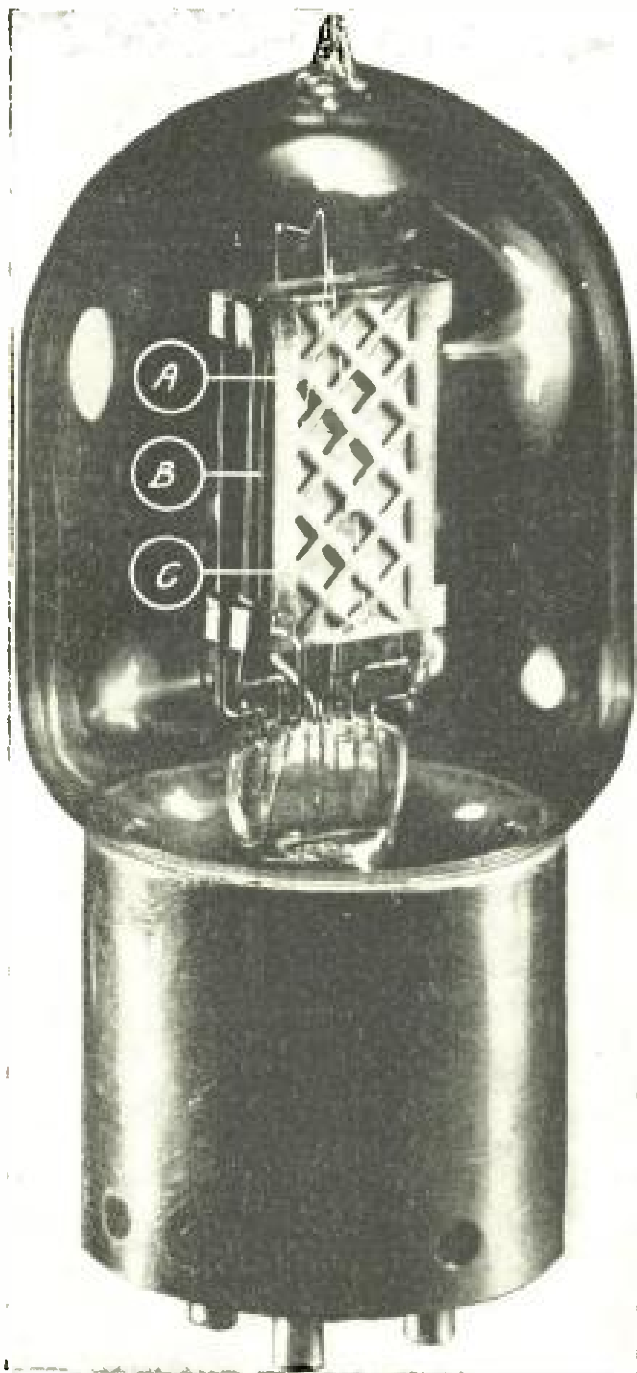
plate inside each tube begin to glow dull red and finally brighter until they are cherry in color or even brighter. Meantime the pumps are drawing the emitted gases out of the tube.

Suddenly there occurs a turbulent gaseous boiling within the tube and a sudden brightening. This is the critical point. Just when a sort of greenish flame appears, with the touching off of the magnesium-tape "getter" within the tube, the high-frequency coil is taken away and the filament current is quickly turned off. This is done to stop the evaporation of the thorium coat from the surface of the filament.

This process is hard on the filament. Its life is placed in danger by the presence of so much heat and it is likely to become brittle and to fracture easily. The tip is then sealed off.

In a somewhat similar process the exhausting is a separate operation from the flashing. In this method the tube is gently heated, exhausted, and sealed off. It is then subjected to the high-frequency treatment and flashed independently. This seems much safer, but there is a danger of inadequately exhausting, as well as producing a very unstable gaseous envelope around the elements of the tube.

The "juxtaposition" idea recalls that Doctor A. W. Hull of the General Electric Laboratories brought out some time ago a tube for amplification purposes, in which the electron stream from the filament passed through a sort of window. The central part of the stream passed unobstructed through the window. It was called the dynetron. It functioned by secondary emission. The electrons struck the flat surfaces of the control electrodes, and pushed off other electrons from the opposite sides. Further developments by him and his associates brought out the pliodynatron, which not only had a grid, but the dynatron secondary emitter plates besides. These two developments have not been put into practical operation because they involve special electrical circuits



From a photograph made for POPULAR RADIO

A RIGID-GRID TYPE OF TUBE

A is the plate and, B is the grid which are reinforced to withstand sudden shocks or vibrations so that the electrical characteristics of a tube will not be altered. C is the filament that is supported on a bracket between the two sides of the double grid.



General Electric

HOW THE ALMOST PERFECT VACUUM IS PRODUCED

Tubes must, of course, be exhausted of air just as electric light bulbs are before they can be used. This is one of the most "tricky" steps in the production of vacuum tubes. Gases that result from heating the filament for the first time must also be pumped out of the tube before it is finally "sealed off."

dense in the bulbs, the operator waits, and makes no attempt to tip off or seal off the tube. When the V-Ray is used, its high-frequency activity "jiggles" the molecules of remaining gases, and if the gases remain sufficiently dense they will glow with a violet light. As the

degree of vacuum mounts higher and higher the glow of the contained gases dims and becomes bluer and bluer under ray tests until a very faint blue color is noted.

At this point, with the tube still "on the pump," the operator lights the fila-

"juxtaposition patent," as the chief aim of tube designers for the past ten years seems to have been to get around the De Forest patents. The usual method of circumventing this De Forest position has been to place the grid *alongside of the filament*, and to trust to its potential control to affect the electron stream going to the plate. Hence the name "juxtaposition patent" was originated.

The ideal of the independent tube manufacturer has been, of course, to produce a tube upon which no grounds for suit by the alleged trust can be found. Many independents have applied these grid-next-to ideas, but with little success. Some attempted evasions have been to run the grid control wires through and under the looped filament and some others have built a kind of hollow square of filament wire with the tiny grid wires running through and mingled with the structure. Some of these have proved quite successful in laboratory experiments, but when it came to their more numerous production for marketing, a problem arose.

The other vacuum tube patents which, after the expiration of the De Forest structural and principle patents will still control the production manufacture of radio tubes, have been lost sight of. These have to do with the *use of* and the *method of* manufacture of the high vacuum. The *use of*, and the *method of* result in all kinds of different filament

wires, as well as sealing apparatus, the magnesium flashing systems and a number of others.

Right here we may stop to consider this flashing process. By flashing a tube, we mean the process by which we scavenge the remaining gases in the vacuum bulb after the pumps have done their utmost. This process is accomplished chemically. A strip of magnesium tape is placed inside of a tube before the glass shell is welded on to it. It is usually "spotted" electrically at the time when the grid and plate elements are mounted on their support wires.

The tube men call this scavenging process "getting" the gases, and the magnesium tape is called the "getter."

Phosphorus paint was formerly used as a getter. You will remember the dingy yellowish tinge of the old 201 types of tubes that were made just before the 201-a types were brought out. That was phosphorus.

Various combinations of magnesium, phosphorous, metallic salts and other "getters" that have the property of absorbing gases have also been used.

How does the "getter" do its work? The tube is placed on the pumps and is exhausted through a small tube at either top or bottom of the shell. The operator frequently tests each tube in the tube bank of the exhausting machine with a V-Ray or similar high-frequency ray producer. If the gases still remain

What the New Tube Developments Mean to the Set Owner—

- 1: Keen competition will reduce prices still more than it has at present, and this will tend finally to standardize prices as in the electric light industry;
 - 2: Great activity in research and experiment will result in better tubes that will have more constant characteristics and longer life;
 - 3: The developments in tubes that operate on house current may eliminate the use of at least the "A" battery in the receiver.
-



Kadel & Herbert

HOW THE CHARACTERISTICS OF TUBES ARE FOUND

Minor defects in vacuum tubes can only be discovered under laboratory tests like the one that is shown above, which is being conducted with a bridge set-up.

electrons from grid and plate are partially successful today. One new tube on the market, the Magnavox tube, has an unobstructed passage for the electrons that are emitted by the filament to the plate, the control or modulator electrode being to one side. How this type of tube will really prevent the bombardment of electrons is hard to see, for the absorption capacity of the plate and the voltage of the plate circuit, as well as the normal space charge between the filament and the plate, will produce a stalemate. Also the electrical conductivity of the space between the filament and the plate under certain conditions is affected in a peculiar way.

There is, for instance, a saturation point beyond which this space between the filament and the plate will not carry any more current. It is believed that at this stage in the operation of a tube,

the heavy particles of molecules of gas are so violently agitated that the on-rushing stream of electrons is baffled and a "traffic jam" results.

The success, then, of such tubes as the Magnavox tube will depend upon the degree of evacuation and also upon the area and the spacing of the plate, which is the collector electrode.

This idea of side-placing the grid or control electrode is not particularly new. As long as a year ago I saw and handled such a tube that was made in the experimental laboratory of a prominent Cincinnati set manufacturer. As a matter of fact, several weeks previous to seeing this tube, a New York patent attorney showed me a drawing of such a tube.

There are a number of patent claims for this kind of a three-electrode tube, which in the tube business, is called a

they are until the trust is "busted." Nothing could be further from the truth.

The existence of misconceptions about the tube situation is accounted for very largely by the fact that few "fans" really comprehend the intricacies of vacuum tube manufacturing processes.

A radio tube is a most peculiar device. Its efficiency depends upon such tiny or minute factors, that it is a wonder that a tube can be made to function satisfactorily. The vacuum tube is a great tribute to the engineering brains which have made its present standard of excellence possible. When one considers the comparatively narrow electrical limits within which the qualities of a tube must fall, the present-day radio vacuum tube appears as a wonderful creation.



From a photograph made for POPULAR RADIO

A NEW TUBE THAT RUNS ON HOUSE CURRENT

The new McCullough A.C. tube marks a distinct step forward. It operates from a small transformer directly on the alternating current lines, and consequently requires no "A" battery.

Notwithstanding the certain amount of satisfaction with the present models of vacuum tubes, the tube design engineers are not resting on their oars. The speed of development of the entire radio art prohibits any self-satisfied spirit to creep into tube development activities.

An indication of the behind-the-scenes work may be seen in the great number of radio tube patents issued during the past year, 1924.

Every week, in the *United States Patent Office Gazette*, from five to ten new ideas are brought out in tube principles and design. These patents range over a wide area. Inventors are not satisfied with sources of emission, or with the filament and the heating elements. It is, of course, true that the thoriated tungsten filament is regarded as the most stable type today, and the oxide-coated platinum filament wire is also eminently satisfactory. Nevertheless, new substances are being tried out. It is an open secret, in fact, that yttrium, molybdenum, strontium, barium, caesium, potassium, selenium, sodium and every metal possessing electron emission qualities are being experimented with in order to develop new types of filament.

Present-day filaments tend to wear out quickly. Return bombardment from grids and plates is partly responsible for this. Crystallization furnishes another source of early-life disintegration and excessive heating of filaments tends also to evaporate the electron-stimulating coatings applied to filaments.

One queer quirk in filament development ideas is that several independent experimenters have announced a partial success with carbon base filament wire. This is a return to the old Edison hair-pin-in-a-bottle idea. Just how the new carbon filaments are being impregnated with electron-emissive substances has not been disclosed. Perhaps a chemical union between certain salts and carbonates has been effected.

Several methods of getting away from this destructive return bombardment of

Popular Radio

VOLUME VII

JUNE, 1925

NUMBER 6



NEW DEVELOPMENTS IN VACUUM TUBES

—and What They Mean to the Broadcast Listener

By DAN C. WILKERSON

New types of tubes—some of which operate on new principles—and significant experiments with new types of filaments, are opening up vast possibilities that directly affect radio reception*

A NATURAL curiosity in things of a general scientific nature has become an inherent part of us human beings since the rapid development of radio woke us all up. It was just as if we had found some hidden source of great wealth which we suspected all along, but never bothered to ferret out.

Yet what do most "fans" know about vacuum tubes besides their type numbers? Do they know whether they are hard or soft? Whether they operate on dry-cells or not?

We have not been curious enough about tubes because we have had little opportunity to satisfy even superficial curiosity through published information.

Radio has been a source of great wealth for many. One of our radio millionaires four years ago was unheard of; he made his pile in the development of a low-priced radio tube set, which was within the reach of everyone's income. It was made on the Ford production basis.

The foundation stones of the radio industry thus far are the sets, and the tubes which actuate the sets. What Crosley did for the set business, no one or group has done for the tube business.

Some misinformed people maintain that the tube situation is controlled by a radio trust and that therefore the prices will be fixed and remain where

* One of the most important of the new types of tubes is the McCullough tube, which permits the operation of a receiving set by A.C. current that may be obtained by plugging in on the ordinary electric light socket, thus eliminating the "A" battery. See page 511 for a "how-to-build" description of a new receiver that has been especially designed for the use of this new tube, and which is here announced for the first time.



General Electric

The David and Goliath of "Radio Bottles"

SOME conception of the vast progress that has recently been made in the development of the vacuum tube may be obtained by a comparison between the tiny peanut tube that Dr. Irving Langmuir is holding in his right hand and the gigantic "water-cooled" tube in his left. And the scientists tell us that new marvels that mean much to the radio fan lie immediately ahead!





From a photograph made for POPULAR RADIO

The Invaluable Service Rendered by POPULAR RADIO

POPULAR RADIO, in making available information based on sound theory and reliable laboratory work, is doing a great service to the army of radio enthusiasts who are not satisfied with anything but the facts and the reason for them. When so many know-it-alls are disseminating a mélange of information and misinformation which, in many cases is creating confusion and distress amongst those who take their radio work with a moderate degree of seriousness, such a source of trustworthy information is invaluable.

Clayton H. Sharp

TECHNICAL DIRECTOR
ELECTRICAL TESTING LABORATORIES

Only Four Strings

a horse-hair bow, and a resonant box—yet under the hand and out of the soul of an artist what a world of ecstasy, of rare delight . . . of sadness, too, . . . comes from these simple instruments. *Only Bits of Metal*, glass encased, and an incoming antenna current delicate as a fairy footfall—yet in a Cunningham Radio Tube these combine to trap the artist's world of music and release it to eager millions. Both in the violin and in the Cunningham Tube it is quality of material, knowledge of design, and skill in manufacture which produce tones of almost uncanny purity.

Since 1915—

Standard for all sets

Types C301A, C299, C300, C11, C12
In the Orange and Blue Carton

Price \$3.00 Each



Cunningham

RADIO TUBES

A. J. Cunningham Inc.

HOME OFFICE:

CHICAGO 182 Second Street, SAN FRANCISCO NEW YORK

PATENT NOTICE: Cunningham tubes are covered by patents dated 2-18-08, 2-18-18, 12-30-18, 10-23-17, 10-23-17, and others issued and pending.

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

**EVEREADY HOUR
EVERY TUESDAY AT 8 P. M.**
Eastern Standard Time

For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations—

WEAF New York	WEAR Cleveland
WJAR Providence	WSAI Cincinnati
WEEI Boston	WWJ Detroit
WFI Philadelphia	WCCO Minneapolis
WGR Buffalo	WOC St. Paul
WCAE Pittsburgh	WOC Davenport

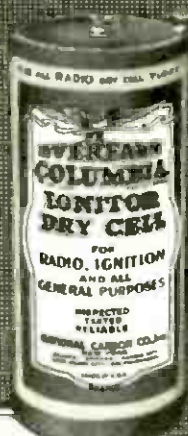
Evereadys have long-lasting power

THE long-lasting power of Evereadys more than justifies their price. It is false economy to buy batteries that may be cheaper in first cost, but which are much shorter lived. Considering price and size, Evereadys are the most economical batteries there are, and in addition they are most satisfactory. Buy Eveready "B" Batteries. To light the filaments of all radio dry cell tubes, use the famous Eveready Columbia Ignitor.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, Inc.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

EVEREADY Radio Batteries

- they last longer



Eveready Columbia Ignitor "A" Battery
The proven dry cell for all radio dry cell tubes
1½ volts

No. 766
22½-volt
Large
Horizontal
Price
\$2.00



No. 772
45-volt
Large
Vertical
Price
\$3.75



No. 768
21-volt
Medium
Vertical
Price
\$1.75

PAGES WITH THE EDITOR

(Continued from page 4)

tion that is essential to the fan who is deciding what kind of a set will best meet his own particular needs.

* * *

THE late Oliver Heaviside, the English scientist who gave the radio world the "Heaviside Layer" hypothesis, was a recluse (according to his former associate, B. A. Behrend, an American engineer), who was so averse to meeting people that he used to deliver his manuscripts for the *Electrician* to a grocery store, where the publishers collected them. There is only one photograph of Heaviside known to be in existence—and that was reproduced on page 421 of POPULAR RADIO for last month.

* * *

"I HAVE just completed an analysis of the articles contained in POPULAR RADIO for the year 1924," writes Mr. George Lewis, of Cincinnati, "and wish to compliment you upon the splendid manner in which the editors have not only covered the so-called popular radio field, but the unusual articles to be found each month dealing with subjects of marked scientific importance."

* * *

So extraordinarily rapid has been the development of radio and so universally has it won popular approval and become incorporated in our life, that it is difficult to realize that present-day broadcasting is barely three-and-a-half years old. Or that radio apparatus only six or eight years old are regarded as curious museum pieces!

* * *

INDEED, it is almost with a sense of surprise that we learn that certain radio inventors whose names are household words, are still living—and that they are still young men!

* * *

WHEN POPULAR RADIO recently published some old photographs of pioneer radio apparatus (March, 1925), some of the pictures were twenty-five years old. One of the pictures showed the "Earliest American Receiver," dated 1901—which was back in the dark ages of radio.

* * *

It was with special interest, therefore, that the Editor opened a letter from Mr. Walter W. Massie of Edgewood, R. I., to whom the apparatus had a very personal interest indeed. He writes:

* * *

"I NOTE in your March issue a receiver and a sending key. You might be interested to know that I designed and built both when I was head of the Massie Wireless Telegraph Co. There is probably a name plate of the company attached to each instrument. The key was originally designed and built for the first five stations built in Alaska by the Signal Corps, U. S. A. The receiver was first furnished to the United States Navy for use on ship and shore stations."

THAT POPULAR RADIO is read throughout the civilized world is brought home to the Editor, sometimes, in unusual ways. Here, for instance, is an excerpt from a letter written by Mr. A. G. Landres, of the Amplex Instrument Laboratories of New York:

* * *

"AN item that may be of great interest to you is the great and wide field from which we have received replies to our POPULAR RADIO advertising. Since December (this letter is dated February 18th) we have received thirty-nine inquiries or orders from countries outside of the United States, including New Zealand, Spain, England, Japan, Philippine Islands, Cuba, Mexico, China, Austria, Portugal, Guatemala, Australia, Newfoundland, Hungary, Argentine and Malay Peninsula—in fact, from all corners of the earth."

* * *

NEARLY every week reports reach the Editor of the use of POPULAR RADIO as a text-book in schools and colleges. "I use it as a source of authoritative information in physics and chemistry classes," writes Mr. Joseph G. O'Shea of Bellevue, Pa. "I admire your stand on 'religion and radio.' Your departments are excellent and your articles on scientific development are superfine."

* * *

DURING the experimental work on the new five-tube AC receiver (which will be announced for the first time in the next issue of this magazine) the POPULAR RADIO LABORATORY was broken into. But the electrical protective apparatus with which the laboratory is guarded gave the alarm and brought the police before the potential thieves were able to obtain the information they were after.

* * *

THIS is the third time within three weeks that thieves have unsuccessfully attempted to steal the plans and ideas of radio apparatus that is in process of development by POPULAR RADIO, and the results of which constitute such a valuable part of the editorial content of the magazine.

* * *

AND on all three occasions the attempts to steal information have proved futile. The ideas and plans developed by the POPULAR RADIO LABORATORIES are reserved exclusively for the readers of POPULAR RADIO.

* * *

IN the next number of POPULAR RADIO—for July—will be published the first authoritative and complete description of the new "radio movies for the home," written under the direction of the inventor himself, Mr. C. Francis Jenkins.


Wendell Banning

Editor, POPULAR RADIO



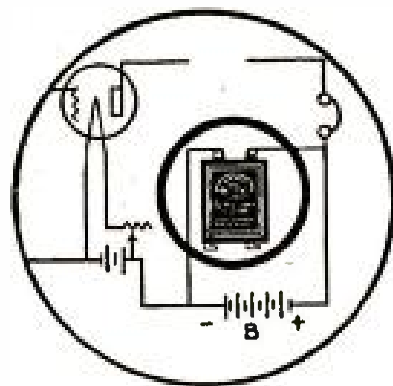
**By-Pass
Condensers**
*remove disturbing
noises and
reduce losses*

By-Pass Condensers do a double job. They filter the fluctuating "B" battery current. They provide a free bath for the radio frequency currents around the high internal resistance "B" battery.

The first function tends to remove disturbing noises—the second increases efficiency by reducing losses and properly routing the available energy.

The tone quality of every set will be greater in strength—purer—smoother—with a By-Pass Condenser.

External connections for the By-Pass Condenser may be made by connecting it from the minus "B" terminal to the plus "B."



Dubilier

CONDENSER AND RADIO CORPORATION

PAGES WITH THE EDITOR

ON page 503 of this number of POPULAR RADIO appears the first, authoritative announcement of a new type of vacuum tube that will have an immediate and far-reaching effect upon the methods of radio reception. For this new tube operates on the ordinary AC house current—and thus entirely eliminates the bothersome "A" battery.

* * *

AND on page 511 begins a detailed "how-to-build" description of a radio receiver that has been developed by the POPULAR RADIO LABORATORY for the special use of this new AC tube.

* * *

THESE two articles constitute a real and significant contribution to the radio art, and are of importance to the radio amateur as well as to the broadcast listener.

* * *

EVERY month brings reports of the extending use of POPULAR RADIO as a text and reference book in our schools and colleges. No better evidence can be had of the regard in which the magazine is held than this gratifying recognition by the scientists and educators. One of the latest reports comes from William W. Hildreth, principal of the Pickering School in Wolfeboro, N. H., who uses POPULAR RADIO as a reference volume in current science. And "It is the only radio magazine we use," he concludes.

* * *

OVER two and a half years ago—at a time when broadcasting was still in its swaddling clothes—POPULAR RADIO observed that government-owned radio stations would inevitably

fall into the clutches of the politicians and be used for political propaganda by those in office.

* * *

SINCE then New York City has put into operation its own station, WNYC. And the news has just come that from that station will be broadcast the entire contents of Mayor Hylan's 208-page campaign book which he has had published to help re-elect him to office!

Q. E. D.

* * *

"WHERE can I get a complete file of the '100 Best Hook-ups' that you ran serially in POPULAR RADIO a while ago," inquires a reader in Lyme, Conn.—along with hundreds of other readers who were either unable to obtain or who failed to keep the eleven consecutive issues of the magazine in which this popular feature originally appeared.

* * *

As several of these back numbers are out of print, POPULAR RADIO has been unable to accommodate the many who want to keep these hook-ups as a reference. To meet the growing demand, however, POPULAR RADIO will publish next month—in July—a special *Annual Hook-up Number* that will contain this complete list of hook-ups, expanded, revised and brought up to date.

* * *

THIS *Annual Hook-up Number* will be invaluable as a reference and guide to every user or prospective user of a radio receiving set, as it will include over 100 of the most approved circuit diagrams, together with the cost of parts, approximate range and other information.

(Continued on page 6)



Pacific & Atlantic

WHO IS AMERICA'S YOUNGEST AMATEUR?

According to one correspondent, Wendelin Luckner, eleven years old, of Bridgeport, Conn., is the youngest of licensed amateurs in this country; his license number is 30,504. Does anyone know a younger one?

Inherent Selectivity

THE inherent selectivity of each tuned stage in the Synchronphase is maintained even when the set is operated close to a powerful station.

The reason lies in the *Binocular Coils*—an exclusive Grebe feature. They have no external field to pick up interfering signals directly in the detector and intermediate stages. A tuning barrier is set up that prevents any but the desired station coming through.

Binocular Coils, with *S-L-F* (straight line frequency) *Condensers* and *Volume Control*, place the Synchronphase in the front rank of receivers.

Ask your dealer for a demonstration or write us for full information

A. H. Grebe & Co., Inc.

Van Wyck Boulevard, Richmond Hill, N.Y.

Western Branch: 443 So. San Pedro Street, Los Angeles, Cal.

This company owns and operates station WAHG

The GREBE SYNCHROPHASE

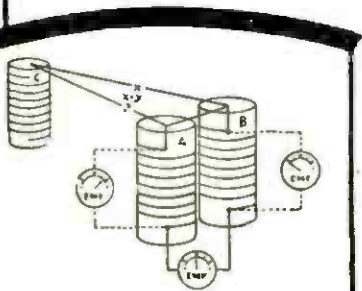
— TRADE MARK —

How the Binocular Coils Balance Each Other

A typical arrangement of Binocular Coils, as used in the Synchronphase receiver, is shown in the sketch

"A" and "B" are two similar coils connected in series or parallel in such a manner that their electromagnetic fields are opposing each other.

When a source of electromagnetic field is radiated from an exterior source, such as coil "C," we can assume that an E.M.F. of +2 units value is induced in coil "A" and an E.M.F. of -2 units is induced in coil "B". Therefore, "A" and "B" being connected in the proper manner, the +2 units and the -2 units will counterbalance each other and the resulting E.M.F. across the terminals of the whole inductance will be zero.

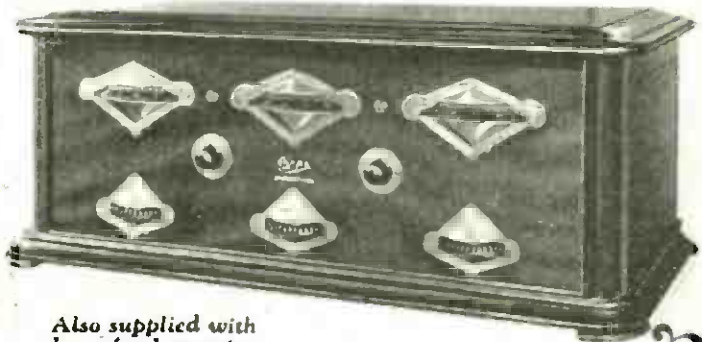


That which has inherent worth never loses its value.

Doctor W. H. P.



All Grebe apparatus is covered by patents granted and pending.



Also supplied with base for batteries

POPULAR RADIO

EDITED by KENDALL BANNING



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(Cover design by Frank B. Masters)

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

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Crosley Trirdyn — on the Sahara Desert at mid-day—brings in Radio-Paris on the loud-speaker!

Not only at mid-day, but in February—in Northern Africa and far hotter than any American summer. The picture above, a post card snapshot sent from Tunis to Mr. Crosley, by D. F. Keith of Toronto, Ont., tells this story on the other side:—

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 Accessories Extra

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Three tubes better the results of five or six

A highly efficient, non-radiating combination of tuned radio frequency, Armstrong regeneration and reflexed amplification.

New cabinet, sloping panel

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Exclusive Crosley 3-tube circuit

Tunis, North Africa, March 3, 1925

Dear Mr. Crosley:

Fishing here is rotten but radio is fine. On the Sahara, using three tubes on the Trirdyn circuit, reception from Paris came through on the loud-speaker. Along the south coast of the Mediterranean, using this set, six or eight high power European stations came in with good volume by day-light and all of them after dark. Can usually get a few American after 1 a. m. Can you fish with us this year?

Cordially,
 (Signed) D. F. Keith

Further details on the margins of the picture:—
 Sahara Desert, 250 miles south of Algiers, February, 1925. Receiving noonday concert from "Radio-Paris," Paris, using aerial and counterpoise.

Who said summer in America is a poor time for radio—if the receiver is a Crosley Trirdyn?
 Every radio fan—actual and aspiring—is invited to think this over and then act.

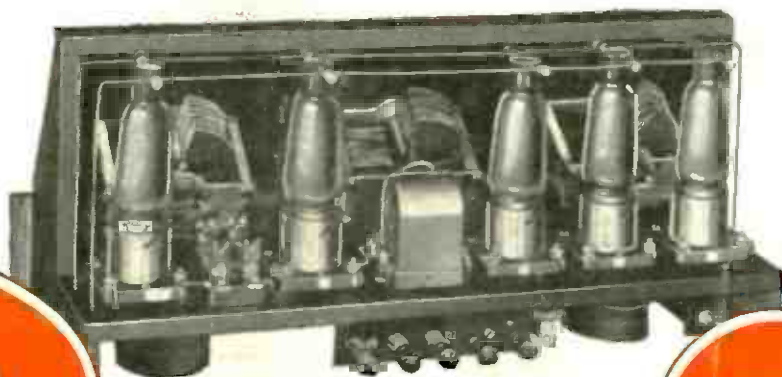
On the Trirdyn is the beautiful new Crosley Musicone, radio's most startling development. The Musicone's abilities and its beauty are so superior that we expect it to replace half a million loud-speakers this year. \$17.50.

The Crosley Radio Corporation, 616 Sassafras St. Cincinnati
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RADIO RECEIVER

The
MCCULLOUGH
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The Radio Set That Eliminates "A" Batteries
The Original McCullough A C Receiver

*Designed by LAURENCE M. COCKADAY, of the Popular Radio Laboratories,
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A new naturalness in tone quality. Clarity and tone quality maintained even with exceptionally loud signal.

Greater selectivity. Greater sensitivity.

A new enjoyment in radio reception. No "dying off" of signal as when "A" battery

strength diminishes. No sputtering or spitting, as following recharging of "A" battery.

Longer life tubes. No tube filaments to burn out.

Cost of operation only about two-tenths of a cent per hour for this 5-tube set.

Actually Radio's greatest advancement.

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