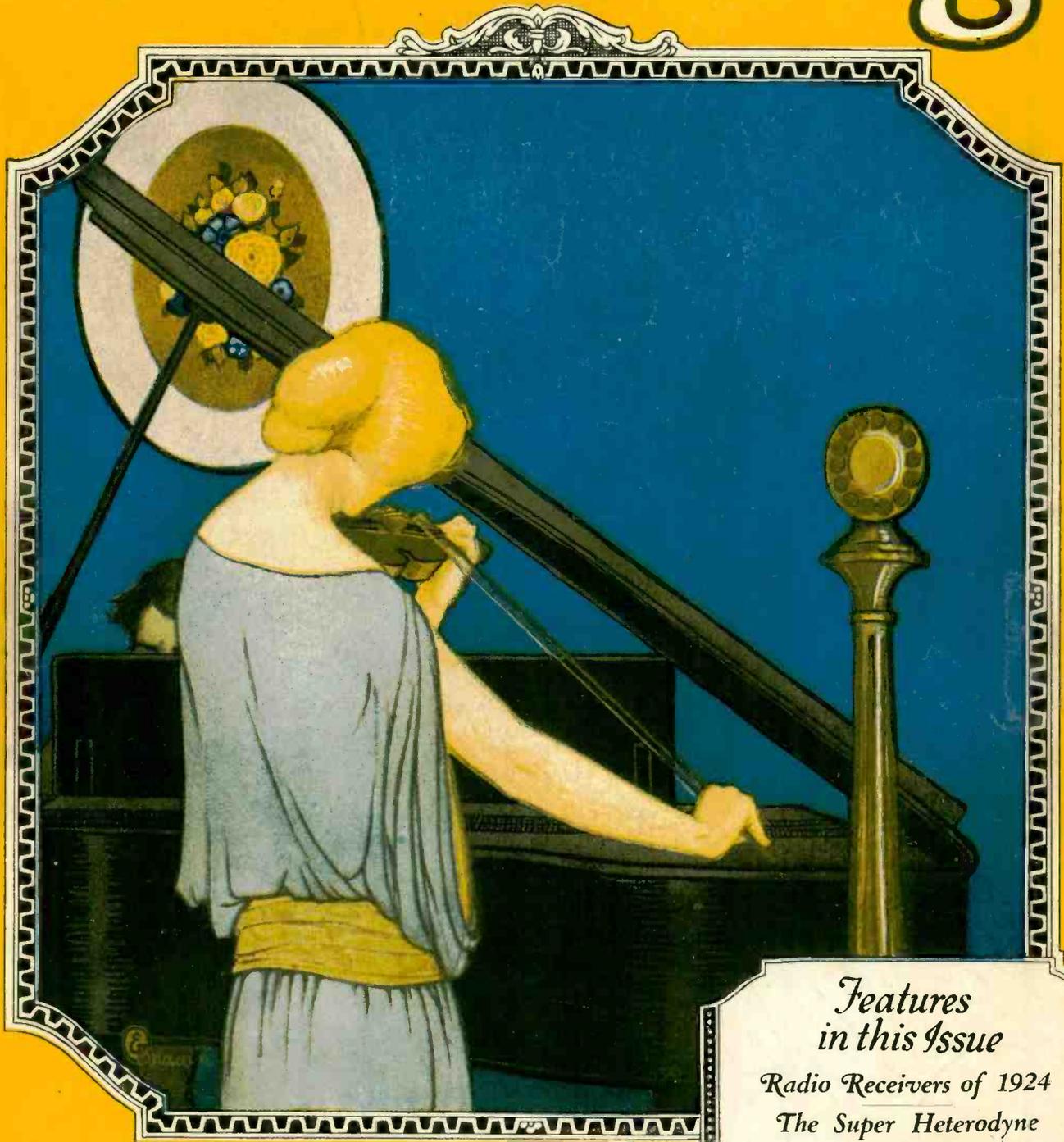


APRIL 1924

25 CENTS

The Wireless Age



Features in this Issue

Radio Receivers of 1924

The Super Heterodyne

Explained by
its inventor, Major Armstrong

Static

Professor Todd ties up Static
with Sun Spots

Broadcasters vs. Artists

and the
Broadcast Riddle

*"America's Foremost
Radiophone Review"*



Look for the name on the carton

Insist on Cunningham Radio Tubes—there is no higher Quality

THE primary purpose of a trade name is to identify a product or firm in the mind of the buyer. Ask the next Radio enthusiast you meet to state one of the best known names identified with Radio and he will say: "Cunningham." The presence of the word "Cunningham" on Radio Tubes tells the character and quality of this product—the ideals, engineering skill and service given to the Radio field since the year 1915 by E. T. Cunningham, Inc. It is the radio tube that has made possible the broad and far reaching application of radio tele-

phony, and that plays the most important part in the operation of your Radio Receiving Set.

Cunningham Radio Tubes, standard for all makes of receiving sets, built by one of the world's largest manufacturers with unlimited resources, are the product of years of manufacturing experience and the creative genius of the engineers of the Great scientific organization, the Research Laboratory of the General Electric Co.

Patent Notices Cunningham tubes are covered by patents dated 2-18-08 and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement

New Prices On Cunningham Tubes Now in Effect

- C-301A—5 Volts 1.4 Amperes filament\$5.00
- C-299—3 Volts .06 amp. Dry Battery Det. and Amp.\$5.00
- C-300—5 Volts Gas Content Detector\$5.00
- C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base\$5.00
- C-12—Similar to C-11 with standard base.....\$5.00

The care and operation of each model of Receiving Tube is fully explained in our new 40-page "Radio Tube Data Book." Copies may be obtained by sending ten cents to our San Francisco office.

E. T. Cunningham Inc.



HOME OFFICE
182 Second Street
SAN FRANCISCO

154 W. Lake St.
CHICAGO

30 Church Street
NEW YORK



Imported PHONES

You shall be the Sole Judge

A Most Unusual Offer

TEST N & K Phones on your radio set alongside *any other phones made*. If the N & K Phones do not reproduce both high and low tones more perfectly, if they do not give a clearer, more mellow tone, if they do not fit more comfortably on the head, send them back to the store within three days, and your money will be

promptly refunded. No obligation whatsoever will be incurred. *You shall be the sole judge*. The N & K Head Set, Model D, 4000 ohms, is the imported head set that the radio "fans" are all talking about. Larger diaphragms. Nicked brass sound chamber. Leather covered bands. \$8.50 at leading stores. Ask for descriptive folder.

TH. GOLDSCHMIDT CORP., 15 WILLIAM ST., DEPT. W4, NEW YORK CITY

Any of the Stores listed below or any other Store displaying this advertisement will send you an N & K Head Set to make this trial.

- Athol, Mass. M. Steinert & Sons Co.
- Atlanta M. Rich & Bros. Co.
- Baltimore Hochschild, Kohn & Co.
Little Joe Wiesenfeld Co.
Joel Gutman & Co.
Jones Electric Radio Co.
M. Steinert & Sons Co.
- Bangor, Me. United Cigar Store
- Bloomfield, N. J. Shepard Stores
- Boston M. Steinert & Sons Co.
A. P. Merchant Co.
Iver Johnson Sporting Goods Co.
- Bridgeport M. Steinert & Sons Co.
- Brooklyn Abraham & Straus
Frederick Loeser & Co.
A. I. Namm & Son
Royal Eastern Elec. Sup. Co.
- Chicago 20th Century Radio Corp.
United Cigar Store
Marshall Field & Co.
Radio Instruments Co. of Chicago
- Cleveland The May Company
H. Leaser & Co.
- Colorado Springs Kaufman & Co., Inc.
Teason Bros.
- Dayton The Anderson Piano Co.
- Denver Daniel & Fisher Stores Co.
- Des Moines Younker Brothers
- Detroit J. L. Hudson Co.
Crowley, Milner Co.
Detroit Electric Co.
- East Orange, N. J. United Cigar Store
- Elmira Barker, Rose & Clinton Co.
- Fall River M. Steinert & Sons Co.
- Fitchburg M. Steinert & Sons Co.
- Harrisburg Pomeroy's Inc.
- Hartford Sage, Allen & Co.
- Houston W. C. Munn Co.
- Indianapolis Alamo Sales Corp.
- Jamaica, L. I. Bangert Electric Co.
Royal Eastern Electric Supply Co.
United Cigar Store
Penn Traffic Co.
- Johnstown The Schmeizer Co.
- Kansas City Western Radio Corp.
J. W. Jenkins Sons Music Co.
- Long Island City Royal Eastern Electric Supply Co.
- Los Angeles Hamburger's
- Lowell M. Steinert & Sons Co.
Bon Marche D. G. Co.
Bry-Bloch Mercantile Co.
- Memphis J. Goldsmith & Sons
Gimbel Brothers
- Milwaukee L. S. Donaldson Co.
- Minneapolis L. Bamberger & Co.
- Newark, N. J. Edward Malley Co.
- New Haven M. Steinert & Sons Co.
- New Orleans D. H. Holmes Co.
- New York City Davega (11 stores)
Gimbel Brothers
John Wanamaker
Herbert & Huesgen Co.
United Cigar Stores (10 stores)
David Killoch Co.
Royal Eastern Elec. Supply Co.
J. L. Lewis, Inc.
Hanes-Zener Co.
Haynes-Griffin Radio Service, Inc.
- Oklahoma City J. W. Jenkins Sons Music Co.
- Omaha Onkford Music Co.
Richard M. Shlzes
- Paterson, N. J. Paterson Radio Co.
- Pawtucket M. Steinert & Sons Co.
- Peoria Block & Kuhl Co.
- Philadelphia Gimbel Brothers
John Wanamaker
Lit Brothers
- Pittsburgh N. Snellenburg & Co.
Boggs & Buhl
Kaufmann & Baer Co.
Ludwig Hommel & Co.
Holden & Stone Co.
- Pittsfield, Mass. M. Steinert & Sons Co.
- Portland, Me. Meier & Frank Company
- Portland, Ore. The Outlet Co.
- Providence M. Steinert & Sons Co.
Kelman Electric Co.
- Rochester The Emporium
- San Francisco Leopold Adler
- Savannah Frederick & Nelson, Inc.
- Seattle Davidson Bros. Co.
- Sioux City Radio Exchange
- Springfield, Mass. M. Steinert & Sons Co.
- St. Louis Famous & Barr Co.
Van-Ashe Radio Co.
- St. Paul Pioneer Electric Co.
- Syracuse Alexander Grant's Sons
- Tulsa J. W. Jenkins Sons Music Co.
- Washington Woodward & Lothrop
- Waterbury M. Steinert & Sons Co.
- Worcester M. Steinert & Sons Co.

Dealers: We authorize you to refund the price of any N & K Head Set returned under the conditions named in this ad. We will exchange or replace any sets that come back to you.

The Wireless Age

America's Foremost
Radiophone Review

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Your Authors

PROFESSOR DAVID TODD (Static) is an astronomer of wide experience. He has been Professor of Astronomy and Navigation and Higher Mathematics at Amherst College and Smith College, and has been the astronomer in charge of a number of scientific expeditions that have taken him pretty well around the world. He is a member of the Philosophical Society of Washington, a fellow of the American Association for the Advancement of Science, the Astronomical Society of America, the Royal Society of Arts of London, and corresponding member of other foreign scientific societies. He has designed and supervised the erection of observatories and has written many books and articles on astronomical subjects. His wide-spread activities and investigations mark him out as well fitted to study the relations between astronomical and magnetic phenomena and radio static.

DONALD G. WARD (Storage Batteries) is an old and valued friend of The Wireless Age readers, whose helpful technical articles gain general commendation. His article on Radio Frequency Amplification, which appeared in our January number, was listed in the Bureau of Standards library. Donald G. hails from Portland, Maine, and before becoming a radio instructor, he was a marine operator who counts among his experiences the sending of three S.O.S. calls from the same five-masted schooner on a single voyage, marked with fire and leaks (not grid) and other near-disaster.

J. C. ROSENTHAL (Broadcasters vs. Artists) for nine years an officer of the American Society of Composers, Authors and Publishers, and now the manager of that organization, has prepared for this issue a meritorious appeal for fair play in broadcasting. Mr. Rosenthal is a graduate of Cornell University. He was formerly Chief Special Agent for the New York State Tax Commission, and later, Assistant Chief Clerk of the New York State Comptroller's Office.

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Major Jerome W. Howe, Editor C. S. Anderson, Associate Editor

Because certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein. Printed in U. S. A.

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The Thompson MAGNAPHONE

Reg. U.S. Pat. Office

*Unmistakably Supreme
in Tone and Volume—*

Your receiving set can be no better, in delivered results, than the loud-speaker you use with it. The THOMPSON MAGNAPHONE is an instrument that brings out the best that is in your set—because it is specifically designed and built as a radio loud-speaker, not merely adapted from other purposes.

All that you've been seeking, and haven't found elsewhere in loud-speakers, is yours, with the MAGNAPHONE—the volume, the tone quality, the natural reproduction of the original performance unmarred by mechanical distortion. You'll notice the difference instantly, when you plug in a MAGNAPHONE.

Here are a few features that make the MAGNAPHONE different, and better:—cone-shaped special-composition diaphragm vibrating equally over its whole area; two-to-one driving armature, reducing the permissible air gap 50%; laminated magnetic pole pieces and generously large magnet. These combine in a structure which forms a loud-speaker giving results so incomparably superior that the MAGNAPHONE is the instant choice of those who demand the best.

Price
\$35.00
At Good Dealers,
Everywhere

Ask your dealer to demonstrate the MAGNAPHONE—compare it with any other loud-speaker, from any standpoint—and you'll admit that Thompson's 14 years' experience in radio manufacture has produced the radio reproducer that satisfies your every requirement.

Manufactured by

R. E. THOMPSON MANUFACTURING COMPANY

Sales Office

150 Nassau Street, New York

Factory

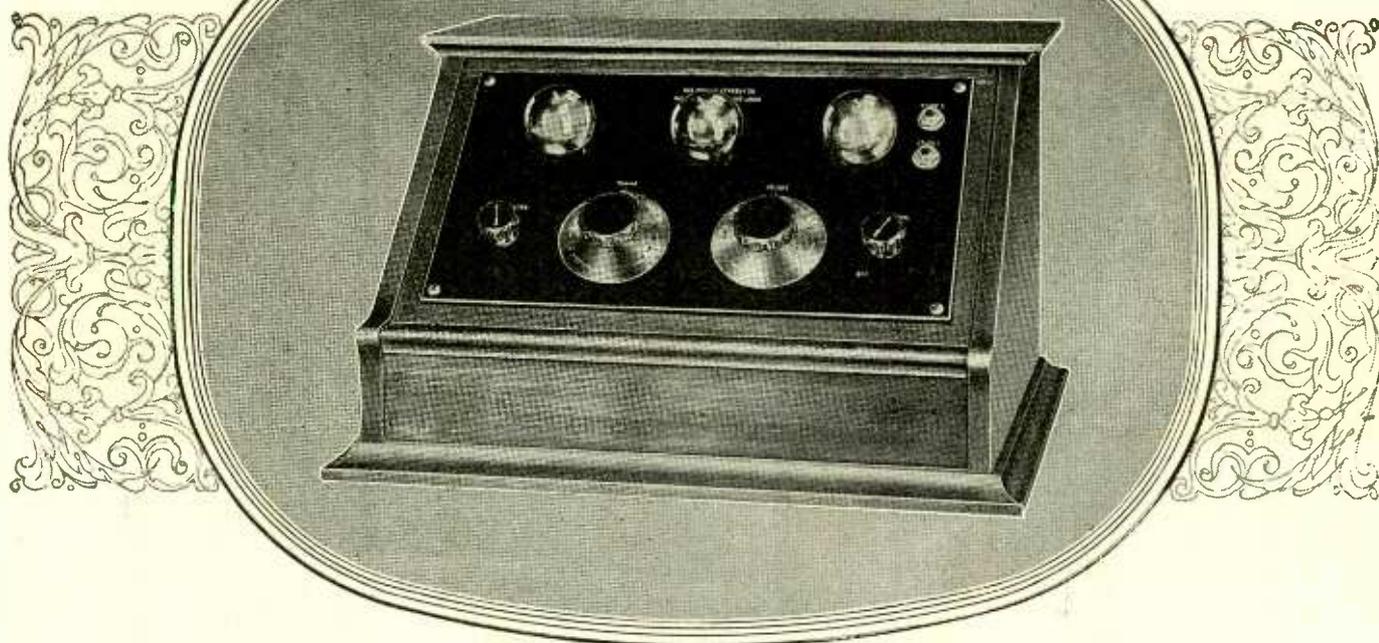
Jersey City, N. J.

Manufacturers also of the

THOMPSON NEUTRODYNE RADIO

Licensed under Hazeltine Patents

The Royalty  of Radio



KENNEDY MODEL V

Like the Artist Standing Before You

So pure, sweet and life-like is the tone of the new Kennedy Radio Receiver, Model V, that it really makes you feel the artist's presence—standing at your fireside—performing for you, in your own home!

And, with this new Kennedy, it is astonishingly simple to bring to your own living room the best broadcast entertainment in the country. You, your wife, mother, son or daughter—anyone—can operate Model V with an ease that brings its own form of fascinating pleasure. Only one dial is used to "tune in" a station—a slight regulation of a second dial controls the volume so you can bring in music or voice soft or pronounced as you wish.

Best of all, when once you have determined the dial setting for any station, that station (if it is broadcasting) will "come in" at its own dial setting—any night, anywhere, regardless of the kind of antenna used.

Think of the possibilities here! Many Kennedy owners make up their own station record—showing the dial setting for each station. How wonderfully simple—merely select the station you wish to hear and set the tuning dial to the number of that station.

Another feature about this new Kennedy is one that your neighbors will appreciate. It does not radiate to any appreciable extent—it does not throw

out whining, whistling noises that interfere with listeners living near you.

When you buy your Kennedy Model V, you will add an attractive piece of furniture to your home. The mahogany cabinet is hand-rubbed to a beautiful finish. The polished black Formica panel, in contrast with the mahogany cabinet, creates a pleasing effect. There is no confusing mass of wires dangling from the cabinet and all batteries are completely enclosed.

Model V is really the receiver for you! It is a permanent investment that will bring you years of pleasure. It is sold, completely equipped with all dry battery tubes, dry batteries and Kennedy 3000-ohm phones with plug, for only \$125.00 (\$127.50 west of Rockies). Other models range from \$285.00 to \$825.00 (slightly higher west of Rockies) completely equipped, including built-in loud speaker.

Try this new Model V in your own home—your dealer will gladly arrange this for you. If you cannot locate him, write us direct for fully-illustrated literature covering this and other popular Kennedy models.

All Kennedy Radio Receivers are regenerative.
Licensed under Armstrong U. S. Patent No. 1,113,149.

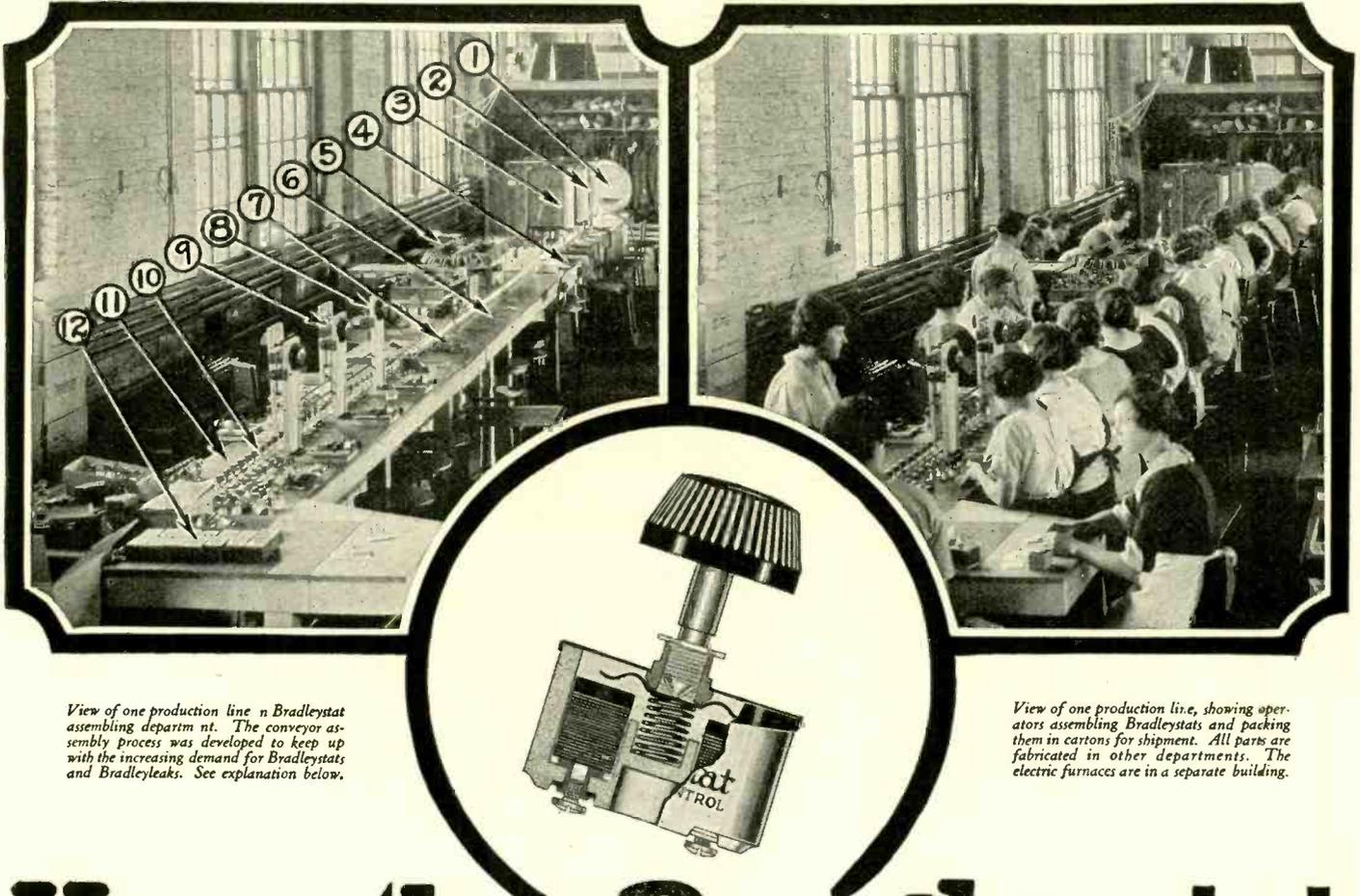
\$125
fully equipped
(\$127.50 west of Rockies)

THE COLIN B. KENNEDY COMPANY
SAINT LOUIS

K E N N E D Y

The Royalty  of Radio

When writing to advertisers please mention THE WIRELESS AGE



View of one production line in Bradleystat assembling department. The conveyor assembly process was developed to keep up with the increasing demand for Bradleystats and Bradleyleaks. See explanation below.

View of one production line, showing operators assembling Bradleystats and packing them in cartons for shipment. All parts are fabricated in other departments. The electric furnaces are in a separate building.

How the Bradleystat is made

FOR over twenty years the Allen-Bradley Co. has made graphite disc rheostats for battery chargers and motor starters. The experience gained during these twenty years is embodied in the most perfect filament rheostat used in radio, the Bradleystat.

Today, the Universal Bradleystat, with its two columns of graphite discs under adjustable pressure, provides unequalled control for radio tubes. Its control is absolutely noiseless, stepless and of exceedingly wide range.

Bradleystats are assembled by the most modern methods and tested rigidly before they are shipped.

The illustration above depicts the assembly process that guarantees a uniform product for the radio fan.

- | | |
|------------------------------|-----------------------------|
| 1—Cleaning porcelains | 7—Installing cover plates |
| 2—Riveting terminals | 8—Inserting adjusting knobs |
| 3—Threading terminals | 9—Six testing machines |
| 4—Inserting terminal screws | 10—Conveying Bradleystats |
| 5—Disc-filling machine | 11—Inspecting Bradleystats |
| 6—Inserting pressure springs | 12—Packing Bradleystats |

Bradleyleaks follow the same process, except for the use of different discs and the installation of condensers.

Install Bradleystats in your radio set, if you want the finest filament control obtainable. Try one, and experience new delights in radio reception.

Allen-Bradley Co.

Electric Controlling Apparatus

283 Greenfield Avenue



MILWAUKEE, Wisconsin

For Sale at All Dealers
 BRADLEYSTAT \$1.85
 BRADLEYLEAK 1.85
 CONDENSER (.00025 mf.)35

THE ALLEN-BRADLEY CO. HAS BUILT GRAPHITE DISC RHEOSTATS FOR OVER TWENTY YEARS

San Francisco Hears Japan and Newark on the DICTOGRAND!

N. J. Radio Message Picked Up in Japan
Voice Crosses America and Pacific Ocean by Wireless.

Communication by means of radio telephony across the American continent and the Pacific ocean was accomplished yesterday morning by WOR, L. Bamberger & Co., Newark, N. J., broadcasting to Japanese, Australian and New Zealand stations, according to engineers here who intercepted the broadcast and state that a Japanese station made acknowledgment by voice.

FIRST TO REACH JAPAN
This is the first time that both continent and ocean have been spanned by the human voice and it is believed that the group at the Howard laboratory were the only ones in this vicinity to hear both stations.

The following sworn statement was issued yesterday by Thomas L. Kennon, manager of E. C. Howard Radio Co., Newark, N. J.
"We, the undersigned, swear that at 2:10 a. m., December 3, 1923, we tuned in on WOR, Newark, N. J., and heard a conversation between these two stations on a Dictogrand loud speaker and a 'Kennon-Croft-Martineau circuit' neutrodyne."

AFFIDAVIT MADE
The affidavit was signed by Count Christian. Lerche-Lerchenborg of Denmark. William J. Proud, L. F. Croft and T. L. Kennon.

The Master Instrument That Made the Record

1. Operates without extra batteries.
2. Adjustable dial controls volume.
3. Handsomely compact in construction.
4. Finished in a rich ebony; set off by a glistening silvered rim on the bell.
5. Fully guaranteed.

ONLY \$24.50
Ready to Operate

The "Aristocrat" Dictograph Headset

1. 3,000 ohms
2. 10 ounces (None lighter)
3. Head-fit headband
4. Cup-curved ear pieces
5. Finished in black and orange
6. Guaranteed fully



From the San Francisco Chronicle

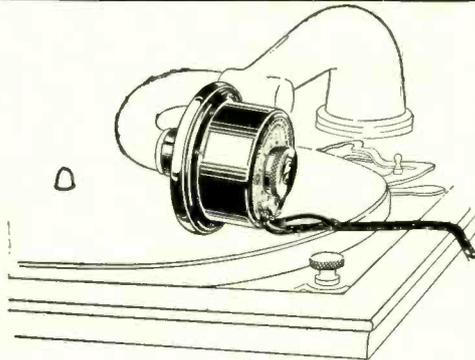
WHAT a superb loud speaker! The instrument that broke all records by reproducing faint signals from far away Japan with audible loud speaker volume!

Clearly! With such clarity that this communication between the ends of the earth was understood distinctly by the 4 listeners-in!

Why not get many more distant points on a loud speaker than you are now getting with your present equipment? Get a Dictogrand today. Tune in some distant point tonight. See your dealer.

The Dictograph "Phono-Unit"

- Makes a loud speaker of your phonograph!
1. Uses no extra batteries
 2. Has adapters to fit any make of phonograph
 3. Attached and detached in a moment
 4. Calibrated dial on back controls volume
 5. Finished in nickel
 6. Fully guaranteed
- \$10.00**



FREE

"Applause Cards"*

"—Station W-J-A-Z signing off. If you have enjoyed the artists' program, won't you write in and tell them!"

By all means! Quickly and easily with "Applause Cards."* They're handsomely printed mailing cards. All ready for you to fill in with your comments, sign, and drop in the mail box.

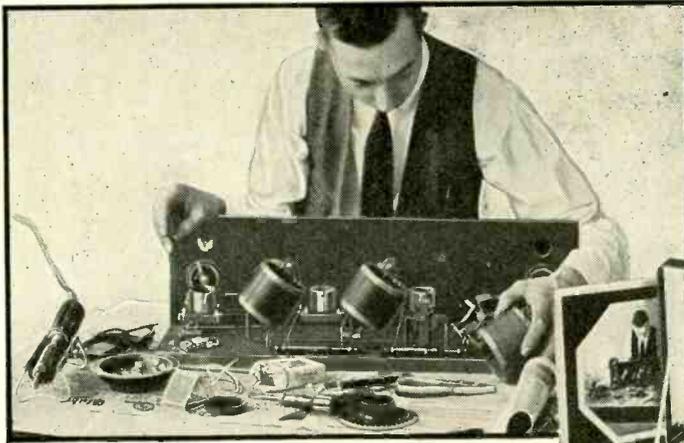
Keep a pack of them near your receiving set. You can use "Applause Cards" liberally because they are FREE AT YOUR RADIO DEALER'S.

"Applause Cards" were originated by this Company, makers of the popular Dictogrand Loud Speaker and the Aristocrat Dictograph Headset. The only "Applause Cards" are Dictograph Copyrighted "Applause Cards."*

A big FREE package of them awaits you at your dealer's. Or if he has not yet stocked, write us, and we'll ship you a generous supply of "Applause Cards" free, prepaid, direct, provided you give us your dealer's name. Dept. F-4.

DICTOGRAPH PRODUCTS CORPORATION
220 West 42nd Street, New York City

* Reg. U. S. Pat. Off.



The Neutrodyne parts illustrated below sell at \$25. The complete parts for a 4-tube set, everything included down to the last screw, sells at \$64. For those who wish to build a 5-tube Neutrodyne receiver the complete knockdown parts are sold at \$65.60.



FADA parts for NEUTRODYNE Radio Receivers

The Neutrodyne receiver has proved to be the most efficient yet devised for broadcast reception. In selectivity, distance getting, volume and clarity it has no equal.

To make a Neutrodyne receiver requires care in construction and the use of parts that are mechanically and electrically perfect. The electrical characteristics of the Neuroformers and Neutrodons are so exact in their requirements that their manufacture requires radio engineering knowledge and skill of the highest order.

FADA parts for Neutrodyne receivers

are made under the direction of experienced and expert radio engineers. Every part is mechanically and electrically perfect. Those who have used them testify to the wonderful results produced by sets made with FADA parts and following FADA instructions. Your dealer can furnish FADA parts for four and five tube Neutrodyne sets.

Our booklet, "How to Build Neutrodyne Receivers"

is included with each combination of FADA parts, or may be had direct or from dealers at 50 cents per copy.

F. A. D. ANDREA, INC., 1581 Jerome Avenue, New York City

FADA Radio



F. A. D. ANDREA, INC.
1581 Jerome Avenue
New York City

Gentlemen:

Enclosed find fifty cents
 Stamps P. O. Order
for which send me your book on
"How to Build Neutrodyne
Receivers."

Name.....

Street Address or R. F. D.....

City or Town..... State.....

Founded 1892

HENRY M. SHAW

President

FRANK H. SHAW

Vice Pres. & General Mgr.



Specialists
in
Moulded
BAKELITE
and
"Shawlac"

The Guarantee of Quality

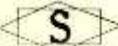
A Personal Message to Manufacturers

Numerous manufacturers have recently come to me to discuss their insulation problems and to ask what I am trying to do with the type of advertising I am running in this magazine.

Believing that the same questions are in the minds of many men with whom I have no opportunity to talk I am taking this means of giving such manufacturers the facts at my command.

During the 17 years this company has been serving radio manufacturers we have had the privilege of helping to work out the answers to many insulation problems. Because we honestly try to give service "the right of way" over the securing of orders, our relations with our customers are more than ordinarily friendly.

And it was with the idea of doing our share toward making this industry more stable and to help show all good manufacturers the way to realizing their ambitions of being recognized as quality manufacturers, that we started our advertising campaign.

To begin with, our advertising advocates that you use insulation bearing the  Mark because the public knows that it is a guarantee of 100% quality.

The manufacturer to whom you intrust the making of your insulation must have experience, skilled help, and facilities for quality production. He *must* use first grade material. And he *must* have adequate time in which to do the job.

Now, what does this all mean? Simply this:—you, who want your insulation to match up to the quality you build into your instruments must place your orders now for summer, fall and holiday delivery.

Then, your insulation manufacturer will have sufficient time to make serviceable molds! This is a job that takes time and extreme care if the product is to be right. During the summer months production can be maintained on an even schedule that gives the workman time to do his best work.

The defects due to haste will be eliminated and you and your customers will be better pleased.

RADIO THIS SUMMER IS NOT GOING TO EASE OFF AS IN PREVIOUS YEARS. The public knows that the static bugaboo is exploded. Two national conventions, big men on the air, universal sports broadcasting—these are only a few of the things that will make broadcasting as popular this summer as during the winter.

Portable sets will also contribute materially.

And the biggest reason of all for placing your orders now is to insure yourself against a repetition of the experience of having a lot of business on your books that you can't handle because you did not order your insulation till the last minute.

We are at your service. You can talk to our sales engineers without obligating yourself. A postal or phone call will place them at your disposal.

Sincerely yours,

HENRY M. SHAW.

SHAW INSULATOR COMPANY

150 Coit Street

Irvington-Newark,

New Jersey



"Products of Proven Merit"

The Transformer of Superior Performance

A WORD ON TRANSFORMERS

The efficiency of a broadcast receiver is often destroyed by poor amplification—due to inferior transformers.

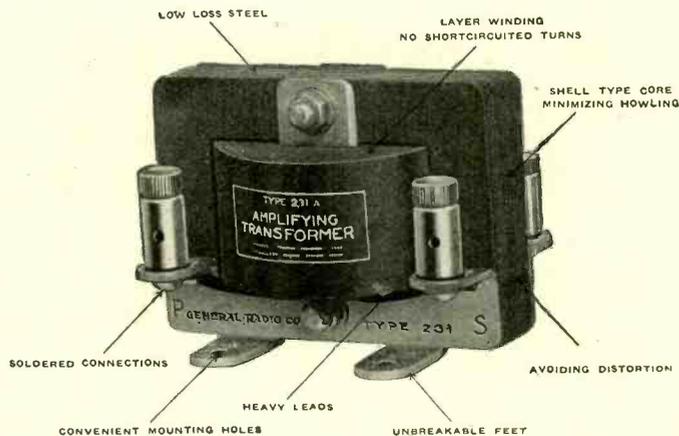
In buying transformers be sure to look well into the electrical and mechanical features, as well as appearance and price.

While many transformers are attractive in appearance their performance is disappointing.

It is performance which counts in successful broadcast reception.

More and more the radio public is insisting upon apparatus bearing the guarantee of a well established and thoroughly reliable manufacturer in the radio industry—it pays!

General Radio Co. Transformers are used by many of the leading manufacturers of radio broadcast receivers—because of their superior performance.



Type 231-A Audio F.A. Transformer

The features which have gained the GENERAL RADIO CO. Type 231-A Transformer its enviable position as a leader among Transformers are:

Low loss steel used in its core construction.
Layer winding prevents short circuiting of turns.

Air gaps in core avoid distortion.
Unbreakable feet with convenient mounting holes, make installation easier.

Soldered connections eliminate losses from poor contacts.

Not only has this Transformer a high amplification factor but the amplification is nearly uniform throughout the entire audio range, making it best for all stages.

Turns Ratio 3.7 to 1. Impedance Ratio 10 to 1.
Price \$5.00

Carried in stock by all good radio dealers.

Write TODAY for Instructive Folder—
"Quality Amplification" and Bulletin 917 W.

GENERAL RADIO Co

Manufacturers of

RADIO AND ELECTRICAL LABORATORY APPARATUS

Massachusetts Ave. and Windsor St.

CAMBRIDGE

MASSACHUSETTS

A *Freed-Eisemann* KNOCKDOWN NEUTRODYNE RECEIVER



Unassembled Model KD-50, Freed-Eisemann Neutrodyne Receiver

NOW the opportunity is presented to obtain a complete set of parts, recommended by the manufacturer, to work with each other in building your Neutrodyne set. An illustrated 32-page book on how to build the Neutrodyne with full-sized diagrams and templates included.

Complete with full instructions

\$80⁰⁰

DEALERS Write for Name of Nearest Distributor

NEUTRODYNE has taken the country by storm. It is *the* remarkable distance getting, powerful, non-oscillating and non-whistling receiver.

A 32-page book answers every question. The panel is accurately drilled. A baseboard is furnished; in fact, everything down to the very last screw and nut, including all necessary parts excepting the cabinet.

Besides the book there is furnished schematic blueprints and template for drilling the baseboard, also full-

size pictorial perspective wiring diagram, so that it will hardly be possible for the amateur with ordinary care and skill to make an error.

Remember that here are licensed parts—not a collection of apparatus trusting to luck that they will assemble properly. Each part is *designed* and fitted to work with each other part in this particular set. The instructions are so complete and the parts so accurately matched that you will be grateful for the manner in which we have eliminated guess work in the amateur construction of this receiver.

For sale by dealers of the better class throughout the country, for amateur and experimental building. Builders are cautioned against attempting to build a Neutrodyne Set with parts which are not recommended and designed by the manufacturer to work with each other.



Front View KD-50 Neutrodyne Being Assembled



32 page illustrated book of instructions on "How to Build the Neutrodyne" with full size pictorial wiring diagram and full size panel and baseboard templates, \$1. At your Radio Dealers.

Freed-Eisemann Radio Corporation

SPERRY BUILDING

MANHATTAN BRIDGE PLAZA

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When writing to advertisers please mention THE WIRELESS AGE

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The name to know in Radio



Table Talker - -	\$10.00
Navy Type Headset	8.00
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All Brandes Products are sold under a money back guarantee by reliable dealers everywhere.
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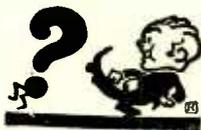
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When writing to advertisers please mention THE WIRELESS AGE

Editorial Chat

RADIO as an industry has acquired a permanent status and already compares very favorably with many of the important, long established businesses; this from Roger Babson, statistician and human business chronometer. He estimates that the American people will spend approximately three hundred and fifty millions of dollars for radio equipment during the present year, of which he allots two hundred and fifty million to sets and parts, fifty million to tubes and fifty million to batteries and accessories. This is twice as much as we are spending for carpets and rugs, twice as much as we are laying out in sports, a third of what we spend for furniture and a quarter of what we spend for boots and shoes. That such a huge business has been developed within a very few years and so developed as to contribute wide-spread benefit and satisfaction should be highly gratifying.

* * *



IS THE public getting value for this expenditure? Another question: is the payment going into the proper pockets? An affirmative answer can be given with assurance to both these pertinent questions.

The letters we receive in every mail, as well as much information through other channels, proves that uncounted numbers of people are receiving great and genuine enjoyment from broadcasting and that the benefits of broadcasting are immeasurable. Nor can we lose sight of the value to many of a new hobby or home-avocation,—that of radio construction. Which brings us to comment in passing upon the unavoidable disappointment of those who, unprepared by knowledge or ability, apply their perhaps slender means and misdirected energy to chasing what will be ever to them a will-'o-the-wisp. Unqualified radio amateurs and home-constructors pay dearly for their ignorance and lack of judgment. We can only get that value out of anything that our shrewdness and effort permit to us. In answer to the second question, observation of the radio industry, the radio trade and radio expositions convinces us that the billions are going into the pay envelopes of hundreds of thousands of workers and tradesmen of all degrees and capacities, and nowhere have we discovered a radio Dohenv.

* * *

IN THIS issue we introduce to the reader a fair assortment of the fine radio receivers that are now obtainable. Now and again we get a letter from some twelve-year-old (or a grown-up twelve-year-old) complaining of the high cost of good radio receivers and parts, and expressing the belief that perfect radio reception is the rightful heritage of all. Since radio is received through the free and untaxed ether it should be nearly as free as air and water and street-car fares and other relatively cheap commodities. Such puerile reasoning takes little stock of the elaborate, thorough-going and continuing research and development work upon which perfect radio reception depends,

nor the costs of manufacture and distribution, nor the increasing costs of broadcasting. Increased quantity production is bringing the cost down, as is apparent from reduced prices; but it is foolish to suppose that prices will drop to such a point that everyone who wants a fine radio receiver can satisfy his desire. What right has one to expect such a windfall? Radio is not yet of Heaven, it is one of the wonderful pleasures of earth, and for earthly pleasures we pay in earthly pains. When the twelve-year-old radio fan has paid his toll of a few years of productive effort, he too can have his fine radio receiver, if he still prefers it to a college education or a motor boat or something else of value.

* * *



BUT, it is objected, my neighbor's son has a radio set which he made; and it cost him only thirty cents! The common answer is that it probably gives thirty-cent results. Let us not discourage the home construction of radio sets. As a hobby, particularly as an educative home-activity for the American Boy, there are few possibilities comparable to radio. One can start with little knowledge and at little expense, in any locality and in almost any circumstances. It arouses interest quickly and develops skill and scientific knowledge. It gives early results. Yes,—but what results? Why, of course,—barring a little of the element of luck—results commensurate with the training, the skill, the patience, the labor and the pocket-book of the experimenter; results ranging all the way from the humble crystal set to the lordly super-heterodyne. But let not the eager fan whose talents and means measure only up to the crystal set essay the super, until he be ready to pay, in knowledge, ingenuity, patience, skill, labor and money.

* * *

A HEALTHY development of radio, in which America is leading the world, demands that those who are versed in radio and interested in its progress should disseminate a few fundamental ideas among the millions who are newly attracted by its possibilities. Let us point out the values fairly. It is not a service to delude the tyro with the notion that by the acquisition of a little cheap apparatus and a book of hook-ups he will shortly be able to get the finest concerts and hear from the Antipodes. Encourage who will to experiment to his heart's content. He will thereby probably derive much pleasure. To inspire him along his road he will get certain results that partially satisfy. And if he is technically talented he may, after the expenditure of much time and effort and money arrive at a result approaching that he might have obtained at the outset by the purchase and installation under expert supervision of a beautiful instrument, which, like other beautiful musical instruments, is designed and carefully manufactured by experienced craftsmen and costs and satisfies accordingly.

For Better Radio Reception—

FRESHMAN PRODUCTS

GUARANTEED to be mechanically perfect, scientifically accurate and built for unusual durability. Used by discriminating manufacturers and amateurs all over the world, who realize that a radio set is only as good as each individual part.

The Standard Unit for Every Tube Set FRESHMAN

VARIABLE GRID LEAK and CONDENSER COMBINED

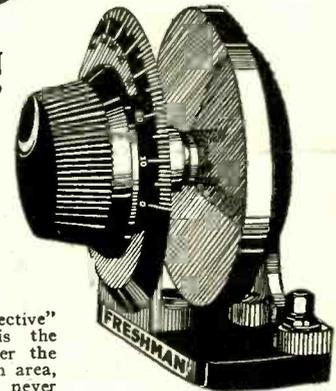


Permits you to adjust your circuit to any resistance you wish from zero to 10 megohms, in an unbroken range of 180 degrees.

It takes the place of a grid condenser, grid leak mounting and grid leak, and, in addition permits an adjustment to the correct amount of resistance. It is the most compact, the most efficient, the most adaptable to all grid circuits, and the only one which is entirely sealed and always remains unaffected by any climatic conditions.

Base or Panel Type complete with .00025 or .0005 Freshman Condenser, \$1.00. Either Type without condenser, \$.75.

“FRESHMAN SELECTIVE” Variable Condenser For Transmission or Reception



The “Freshman Selective” Variable Condenser is the only variable condenser the plates of which vary in area, in engineering feat never accomplished before.

The “Freshman Selective” is attractively compact, quiet in operation and will withstand 8,000 volts without leakage or danger of short-circuiting.

.0003 MF (Equiv. to 17 pl.)
.0005 MF (Equiv. to 23 pl.)
.001 MF (Equiv. to 43 pl.)
\$5 EACH

All moulded parts and dial of finest Bakelite.

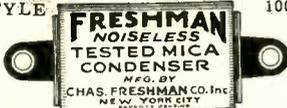
Double Adjustable Freshman Crystal Detector



for base or panel mounting. When mounted on panel only the knob shows on the front. No more searching for the sensitive spot. Merely turn the knob as you would a dial, thus adjusting the crystal instead of the cat-whisker. Best for both Reflex and Crystal sets. Price..... **\$1.50**

Guaranteed Capacities

STYLE 100



Capacity	Each
.00005	\$.35
.0001	.35
.00015	.35
.0002	.35
.00025	.35
.0003	.35

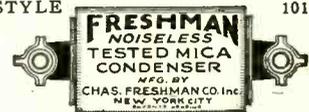
THE CONDENSER SENSATION OF MODERN RADIO FRESHMAN NOISELESS TESTED MICA CONDENSER

Every Condenser is individually tested on high voltage for capacity, break-down and leakage. Every piece of Mica embodied in the Condenser is individually tested and examined.

The new Style No. 101 is equipped with Freshman Soldering Terminals which allow 3 distinct connections with a very small amount of solder.

Capacity	Each	Capacity	Each
.00035	\$.35	.002	\$.40
.0005	.35	.0025	.50
.0006	.40	.003	.60
.0008	.40	.0035	.70
.001	.40	.004	.75
.0015	.40	.005	.75

STYLE 101



Capacity	Each
.006	\$.75
.007	1.00
.008	1.00
.009	1.00
.01	1.00
.015	1.50



FRESHMAN VERNIER DIAL

A Bakelite dial with Vernier adjustment. A small rubber tire wheel through the slot in the dial permits you to set the dial to the exact point and obtain the same dial setting every time. Just the thing for Neutrodyne and Heterodyne.

Price, 3 in., \$1.00
Price, 4 in., \$1.50

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

ANTENELLA NO OUTSIDE WIRES NEEDED

attached to any lighting socket eliminates the inconveniences in radio, such as unsightly outdoor aerials, insulators, lightning arresters, lead-ins, etc.

ANTENELLA

It is not only a real distance getter, but also overcomes static annoyances. The complete and efficient aerial;



ANTENELLA Price only \$1.25

FRESHMAN FIX-O

A fixed Grid Leak Combination, 4 in. l



Freshman Condenser Leak Mounting Freshman Grid Leak Safe-T Handle
Furnished in any value of resistance from 1/20 to 10 megohms.
PRICE 65¢

Write for free diagrams of Neutrodyne, Tri-Flex, Super Heterodyne and other circuits.

Chas. Freshman Co. Inc. Radio Condenser Products

106 Seventh Avenue
New York City

Crosley Again Astounds *the* Radio World

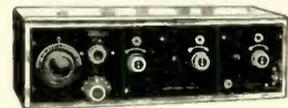
Greatly increased production allows lowered prices New Two Tube Regenerative Set at \$18⁵⁰



CROSLEY MODEL 51
New Two-Tube Arm-
strong Regenerative
Price Only.....\$18.50



CROSLEY MODEL VI
Former Price.....\$30
Present Price.....\$24



CROSLEY TYPE 3-B
Former Price.....\$50
Present Price.....\$42

Ever since we started making radio apparatus it has been our fixed policy to offer to the public the best possible receivers at the lowest possible cost. That this policy has been appreciated is proven by the fact that a shortage of Crosley radio apparatus has existed at all times, although The Crosley Radio Corporation has been producing more radio receiving sets than any other organization in the world. Heretofore constantly added improvements have forced us to maintain steady prices, but so great has been the response of the public for Crosley instruments that greatly increased production allows us to lower the price of the entire line and still maintain our constant research for improvements.

As an astounding example of the results of this research, we

now offer a new and wonderful two tube receiver consisting of Armstrong regenerative detector and one stage of audio frequency amplification, giving loud speaker volume on local stations at all times and on distant stations under fair receiving conditions. Otherwise head phones should be used for distant reception. This instrument, known as the Crosley Model 51, sells at the remarkably low price of \$18.50. It has been thoroughly tested in our laboratories, and its satisfactory performances have even surprised us.

Other Crosley instruments are well known. Their exceptional performances have given pleasure to hundreds of thousands of people in all parts of the United States. Note the following price reductions on these well-known Crosley receiving sets:

CROSLEY TYPE V, single tube Armstrong regenerative receiver, the same instrument used by Leonard Weeks in Minot, North Dakota, in his established communication with the MacMillan expedition at the North Pole, formerly \$20.00, now reduced to \$16.00.

THE CROSLEY TWO STAGE AUDIO FREQUENCY AMPLIFIER to match the Crosley Type V, formerly \$20.00, now \$18.00.

THE CROSLEY MODEL VI, two tube receiver incorporating radio frequency amplification and detector, formerly \$30.00, now \$24.00.

THE CROSLEY TYPE 3-B, a three tube Armstrong regenerative receiver, consisting of detector and two stages of audio frequency amplification, in a beautiful solid mahogany cabinet, formerly \$50.00, now \$42.00.

THE FAMOUS CROSLEY MODEL X-J, a four tube receiver, consisting of one stage of radio frequency amplification, detector and two stages of audio frequency amplification, probably the biggest selling radio receiver in the world, formerly \$65.00, now \$55.00.

THE CROSLEY TYPE 3-C, a three tube Armstrong regenerative consolette model with built-in loud speaker, formerly \$125.00, now \$110.00.

THE CROSLEY MODEL XL, a four tube set consisting of one stage of radio frequency amplification, detector and two stages of audio frequency, formerly \$140.00, now \$120.00.

It is our firm belief and hope that these new lowered prices will enable every family to enjoy the benefits in pleasure and education that only the radio can give. Take advantage of this astonishing announcement. Choose a Crosley Radio Receiver today.

FOR SALE BY THE BEST DEALERS AND JOBBERS EVERYWHERE

THE CROSLEY RADIO CORPORATION

POWEL CROSLEY, Jr., President

FORMERLY CALLED

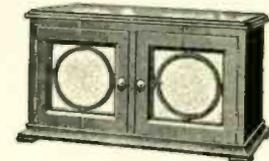
The Precision Equipment Company and
Crosley Manufacturing Co.

426 Alfred Street Cincinnati, Ohio

Crosley Regenerative Receivers are manufactured under
Armstrong U. S. Patent Number 1,113,149



CROSLEY TYPE V
Former Price.....\$20
Present Price.....\$16



CROSLEY TYPE 3-C
Formerly\$125
Now\$110
CROSLEY MODEL XL
Formerly\$140
Now\$120



CROSLEY MODEL X-J
Former Price.....\$65
Present Price.....\$55

CROSLEY

Better-Cost Less Radio Products

THE WIRELESS AGE

"America's Foremost Radiophone Review"

VOLUME XI

APRIL, 1924

NUMBER 7

The Radio Sets of 1924

Aladdin has lost his Wonderful Lamp,
And the Magic Carpet is gone;
The Singing Tree's leaves are withered and
dead,
And the Wishing Well is forlorn.

But what do I care for the things that are
past,
The dreams that are dead and no more?
For a Genii's asleep in my brown carved
box,
And will wake when I open the door.

He sleeps all day, through its toils and its
cares,
Through its rain and its sun and its sleet;
But at night, he rides out on the harp of
the wind,
To lay all the world at my feet.

The beauty of music, the rhythm of song,
And the jazzing blues of the air,
All are mine, for the Genii has brought them
to me,
As I sit in my easy chair.



The 1924 Offering of the C. D. Tuska Co.

I jostle with grandeur and elbow with pride,
And meet all the great of the earth;
I weep with the sad at the parting of ways,
And laugh with the glad in their mirth.

The man on the stage, and the man in the
church,
Give to me of the best that is given;
The poet, that lifts up the soul from the
clod,
And the saint, with his message of heaven.

The silver-tongued orator speaks but to me,
As the eager crowd surges and clings.
Though I've never a plume nor a velvet
gown,

I sit at the table with kings.

Aladdin has lost his Wonderful Lamp,
And the Magic Carpet is dyed;
But what should I care, with my brown
carved box,
And the Genii that lives inside!

—VIRGINIA FRAZER BOYLE.



COME with us, reader, into the next few pages in which we have collected some of the interesting radio receivers that 1924 is offering to radio fans.

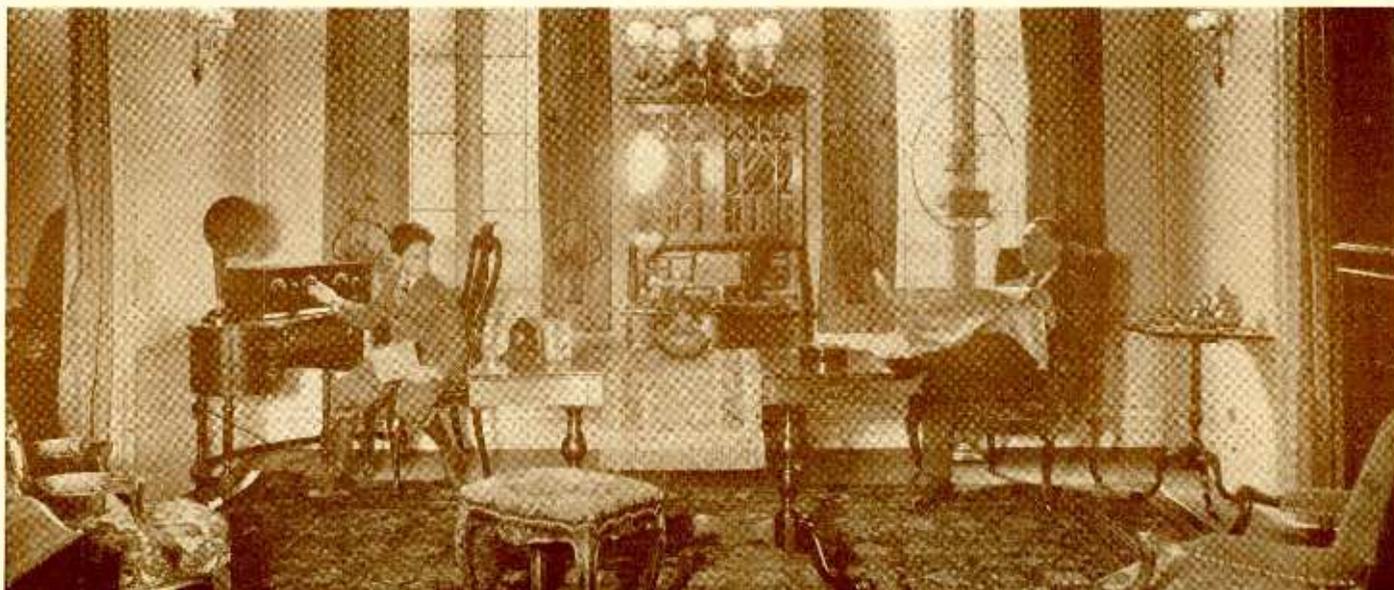
Past research and engineering skill is all embodied within attractive cabinets. In fact, this four-page presentation of the year's offering has suggested to us the splendid possibility of artistic photographs of sets IN THE HOMES OF OUR READERS.

Whatever the set, however it may resemble a laboratory model, it ought to be a part of the furnishings.

So we challenge you to a contest!

Can you do better than we have done here?

Prizes will be awarded for the best photographs illustrating The Beauty of Radio in the Home. See page 47 for full instructions.



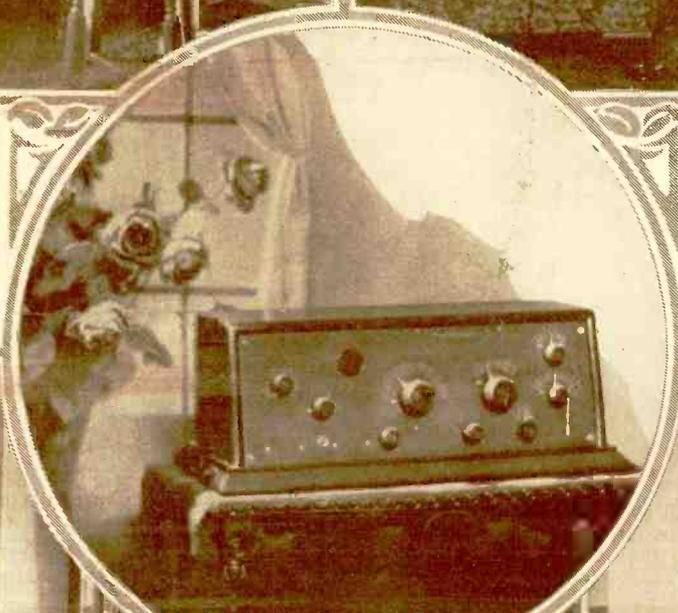
The Eagle Neutrodyne has found its way into the homes of many discriminating folk. This home setting exemplifies the offering of the Eagle Radio Co.

The Radio Sets of 1924

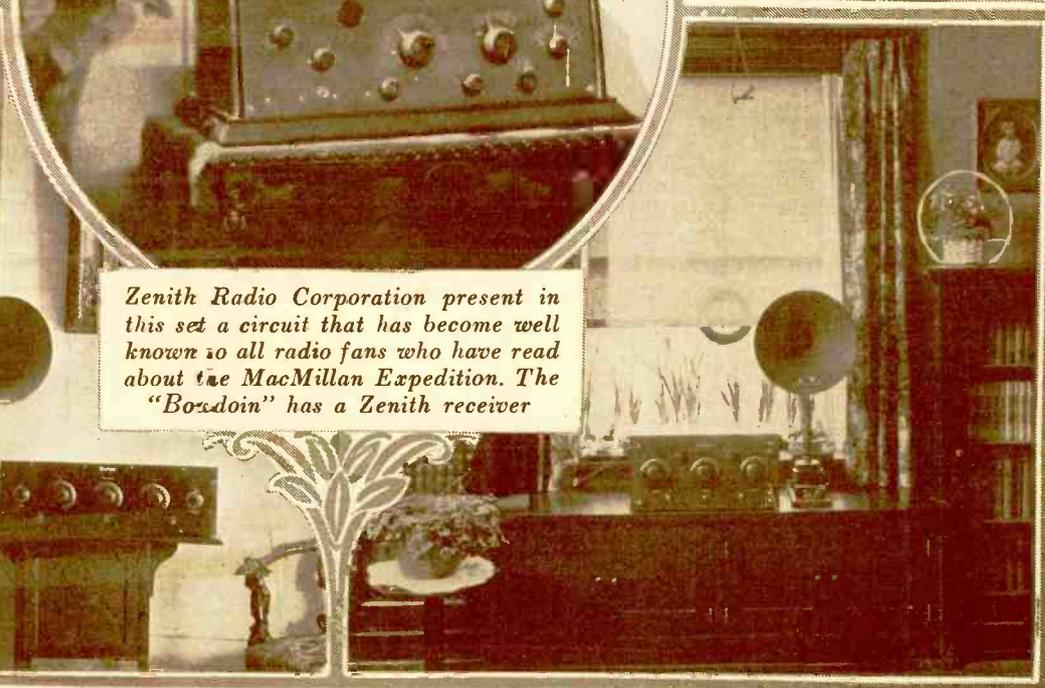
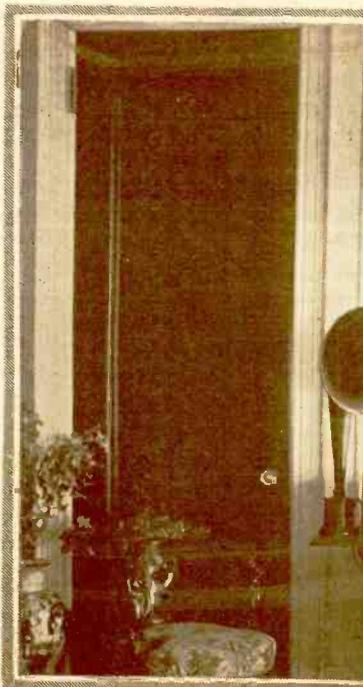


American Radio & Research Corp. offer the Amrad Jewel as an enlarged copy of an old Italian Jewel Casket with Grecian dancing figures in bold relief on the doors and sides

R. E. Thompson Manufacturing Co. embody their reputation in their Neutrodyne. Mr. Thompson is an old timer in the radio field, formerly manufacturing for the Government



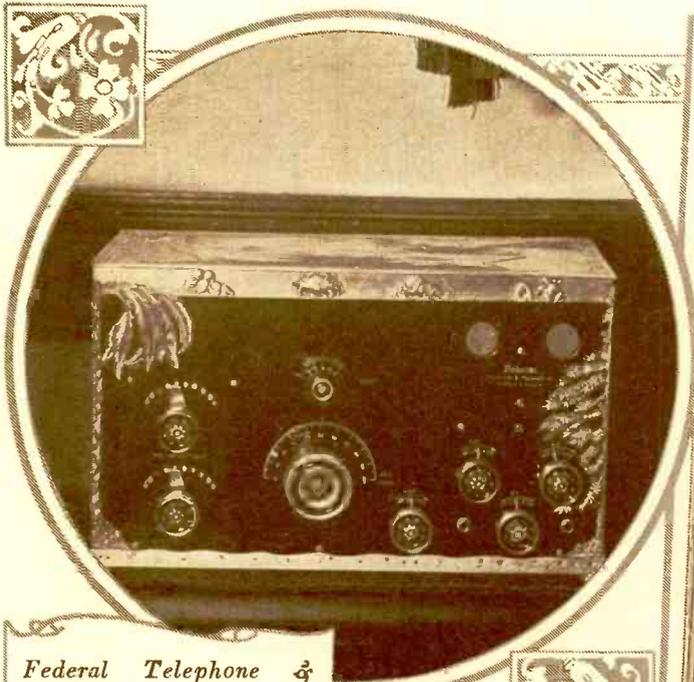
Zenith Radio Corporation present in this set a circuit that has become well known to all radio fans who have read about the MacMillan Expedition. The "Bordoin" has a Zenith receiver



This Freed-Eisemann NR-5 Neutrodyne indicates the advance made by Joseph Freed who was prominent in the early rush to supply the huge demand for receiving apparatus when broadcasting was first established, and whose popular receivers are well known

Garod Corporation has been able to boast of many Garod Receivers in attractive homes such as is pictured here, the home of Mr. G. M. Payne, Kansas City, Missouri. Mr. Davidson of the Sterling Radio Co. installed the set making it accord with the furnishings

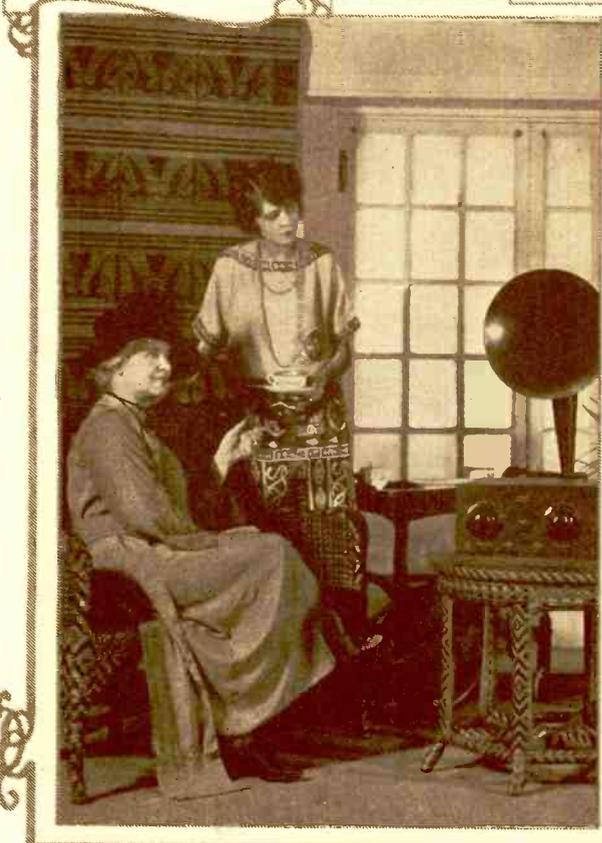
The Radio Sets of 1924



Federal Telephone & Telegraph Co. Set De Luxe, in mahogany, trimmed with sterling silver



Adams-Morgan Co. embody in this Paragon Model 3, the same circuit that made the Paragon RA-10 famous, and still is hanging up records

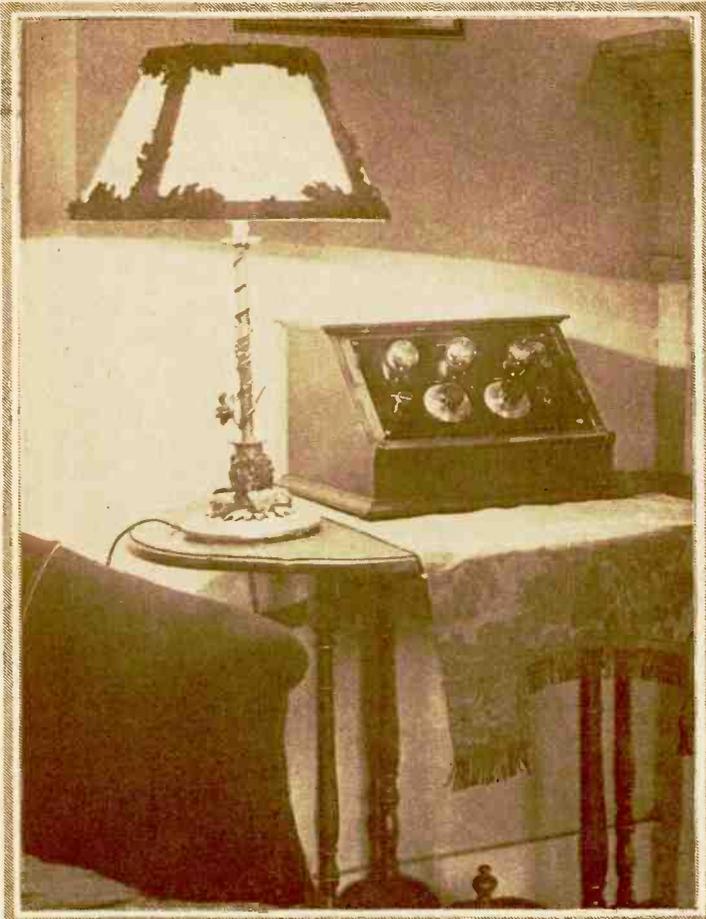


A. H. Grebe & Co. offer in this Grebe Broadcast Receiver the product of their development of the original set which was built for amateur use before the advent of broadcasting



The RCA, Radiola X is an ultra refined receiver designed to be in accord with the practical and aesthetic requirements of a living room setting and still afford clear and selective reception

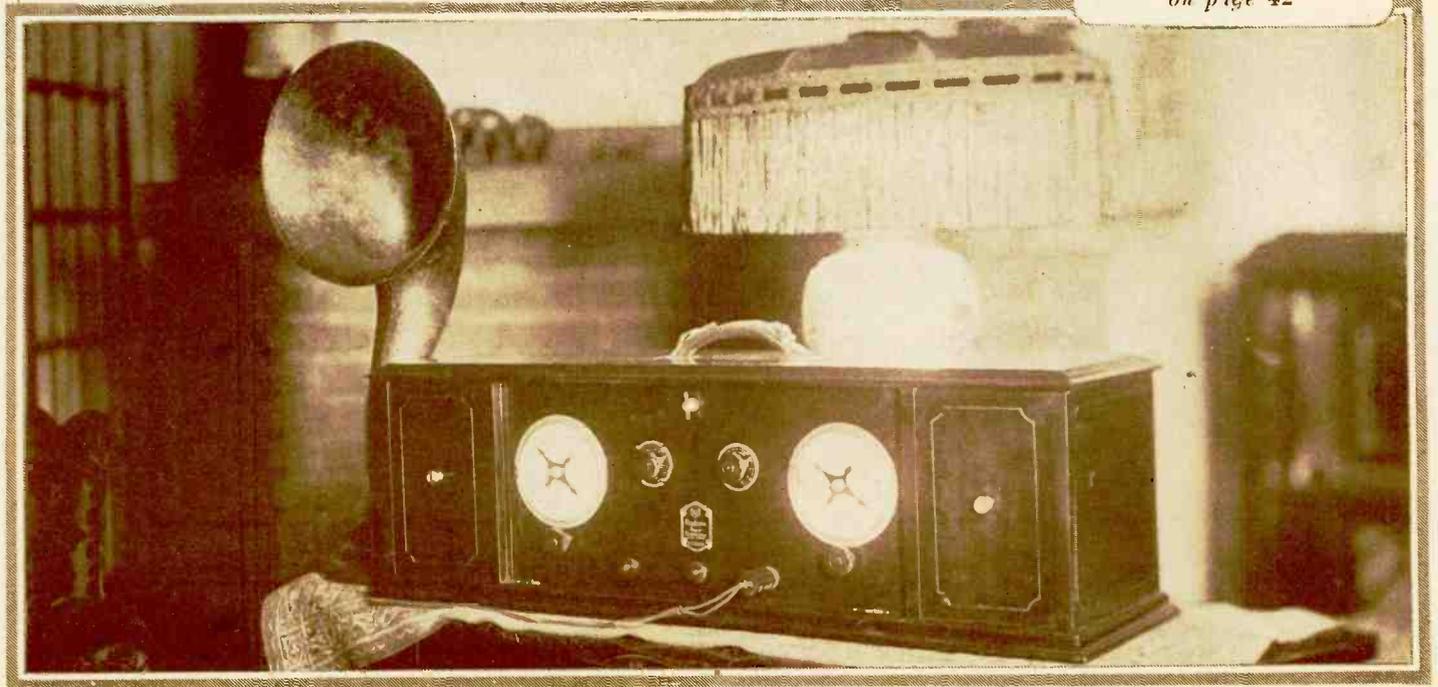
The Radio Sets of 1924



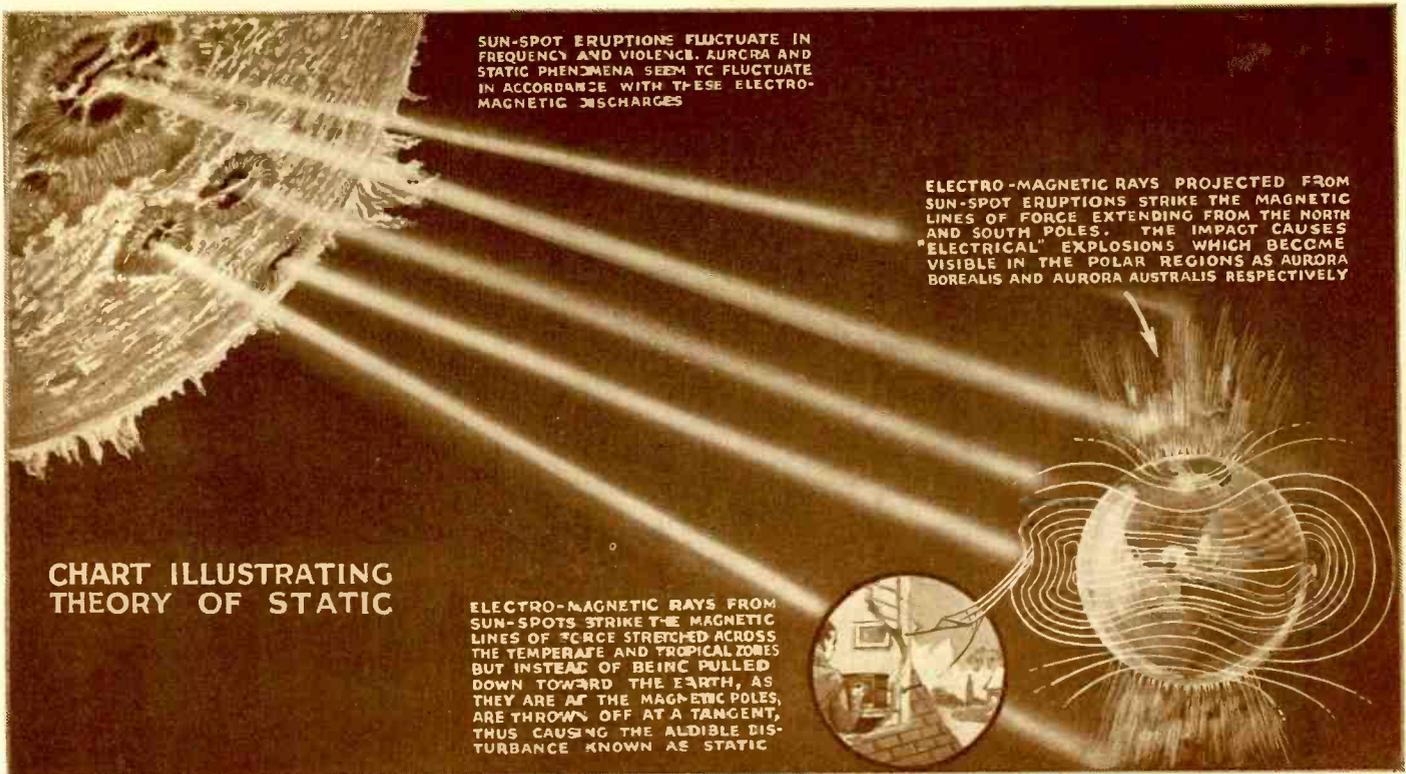
Colin B. Kennedy Co. offer this self contained set, Kennedy Model V, with trimming and dials done in gold. It lends distinction to the furnishings of any home.



This set has been so successfully embodied in a book-case that the storage batteries are not evident. The description of this unique camouflage will be found on page 42.



The Radio Corporation of America has presented in the Radiola Super-Heterodyne a semi-portable mahogany cabinet with ornamentation and lines that relates it definitely to the setting of any room in the home. This set is completely self-contained, housing loop aerial, batteries, etc., thus lending itself admirably to any surrounding, whether home or office.



STATIC

Heavy Static Predicted This Year

Astronomer Believes Static Is Caused By Sun Spot Eruptions; Technical Advances In Reception, However, Will Offset This

By David Todd,

M.A., Ph.D. Emeritus Professor of Astronomy and Navigation and Director of the Observatory of Amherst College, Author of "New Astronomy," and Foremost Authority on Cosmogony, Mathematical Astronomy and Related Sciences

FOR over forty years I had been following and studying the phenomena of the polar lights with a faint hope that some day some development would take place in the world which would relate this extraordinary natural phenomena to the business world, so that it would be considered of use to make a thorough investigation of the cause and effects of the polar lights.

The progress of radio and its increasing application to every-day life has, at last, realized this hope, and when the Aerial League of America, close to two years ago, asked me to become the chairman of a committee to study the causes and effects of the auroral phenomena and their solution to the problems of increasing radio traffic, I undertook this work with great pleasure and interest.

I had for a long time seen a relationship between sun spots and auroral displays, but I could not ascertain their actual relationship until I found I could do so by watching for static and

fadings in radio transmission and reception.

The radio instruments gave me the



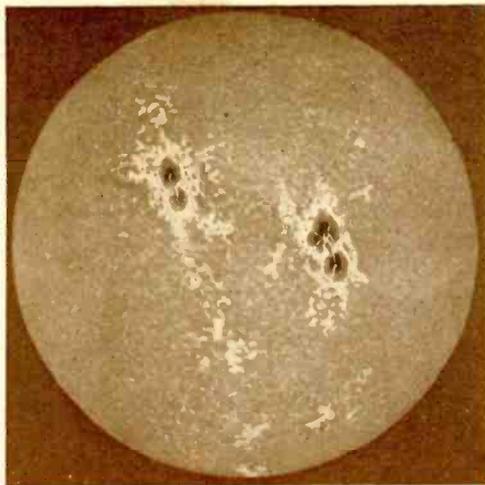
David Todd, M.A., Ph.D.

means with which to solve this most difficult problem of ascertaining the relation between sun spots and polar lights. Fortunately in doing so the radio instruments also made it possible to secure data which, I believe, will greatly assist in solving some of the most difficult problems of increasing radio traffic, by removing obstacles in the way of better transmission and reception which are due to purely natural phenomena.

Experiments during the past winter have revealed a relationship between sun spots, the aurora borealis, static as we know it in radio reception and telephone and telegraph interference.

For instance, on December 20, 1923, I discovered a sun spot near the eastern end of the sun and predicted that it would extend and would cause violent auroral displays, which would interfere with wire transmission as well as with radio.

By noon the observations showed that the spot had developed into a group, and at 3 p. m. so violent was the



Actual photograph of sun spot eruptions

solar activity that observers counted five engulfed in a cyclonic area, the diameter of which would stretch twice around the earth at the equator.

This was similar to the unexpected solar outburst that my party caught at Coral Gables, Miami, in 1922.

As anticipated, heavy static was reported by radio experimenters.

It will also be recalled that during the transatlantic broadcasting test the checking up was delayed because the auroral disturbances disrupted for a while the wire service while it apparently did not interfere with the broadcasting test.

The fact seems to be that at times the auroral discharges interfere only with the wire service and actually appear to help radio transmission, while at other times both are affected.

The auroral trouble experienced by the cable service, during the transatlantic broadcasting tests was due to the sun spots, which caused heavy electro-magnetic discharges and correspondingly heavy auroral displays probably all over the earth.

A number of check-ups and observations were then conducted for a sufficient period to reveal the relationships between sun spots, the aurora borealis, which is actually visible static, and the audible static, known to all radio fans as natural interference in wireless transmission and reception as well as telephonic and telegraphic communication.

One of the sun spots observed was 9,000 miles in diameter, or greater than the diameter of the earth, while the area on the sun covered by the spots is about 45,000 miles.

While only less than one-third the size of the greatest sun spot observed on record—observed in 1858, which was nearly 150,000 miles in breadth—this is a large sun spot, visible to the trained naked eye as a minute black spot on the sun without telescope.

Many years of observations have taught me that sun spots are not always equally numerous on the surface

of the sun. At times they may be counted by hundreds and again days and weeks may elapse without a single spot being visible. Then sudden solar eruptions would be observed.

Heretofore it required constant observations to follow what was happening on the face of the sun. Henceforth the radio experimenters will tell us about it before the astronomers have had the opportunity to find it out.

In saying henceforth I may add that my observations have revealed a series of new solar outbreaks, from which we may expect during the year 1924 constant heavy eruptions and corresponding heavy electro-magnetic discharges, with accompanying frequent and brilliant auroral displays.

I predict that during this coming year, radio reception will be most difficult because of heavy static dis-

Northern Lights

By Eugene C. Dolson

The Northern Lights
Flicker and flame
Over weird Polar snows
On these late nights
When there is no moon.

I think they are dancing girls;
For I catch the gleam
Of their loose golden hair,
And I see their slim forms
Flitting about, here and there,
On the wide floor of the sky.

—From *Town & Country*.

charges. This checkered reception will be attributable, of course, to the unusual solar disturbance.

But the exact effect on radio transmission and reception, the radio world will tell us six months hence, and their reports may be the most accurate and valuable contribution yet made to the study of solar phenomena in a century.

What Is Static?

Professor Todd says:

THAT form of static which is due to electro-magnetic discharges and is audible to the radio is no doubt the result of aurora phenomena which are invisible to the astronomer, therefore radio, the latest development of science, has become the means of aiding astronomy which is the oldest branch of science and making it possible to solve mysterious phenomena which have puzzled the scientists for ages.

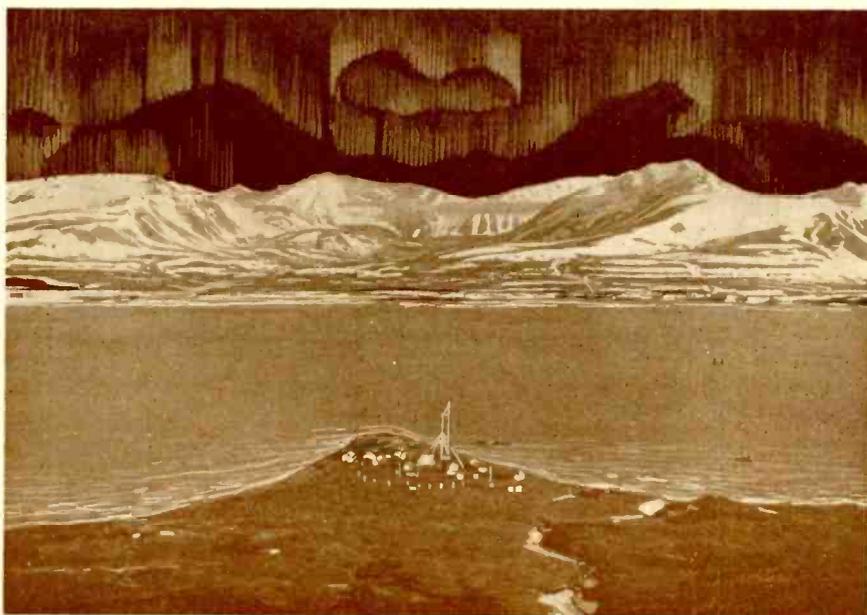
WHAT IS THE AURORA BOREALIS?

While we have no definite knowledge of the construction and composition of the ether or medium that fills space at different heights above the earth we can experiment and seek to reproduce the auroral effects.

The simplest assumption justified by the phenomena is that the auroras are caused by solar discharges or vagabond electro-magnetic discharges; the term "electro-magnetic" being used here in the broadest interpretation, to include electric rays and magnetic phenomena.

There is a great similitude between the polar lights and the Lenard Rays, which are produced by directing a stream of cathode rays against an orifice in the vacuum tube closed by a thin aluminum window. A transformation takes place and instead of traveling in bundle shape as cathode rays will, the transformed rays will now diverge in all directions from the aluminum window, to be quickly absorbed by the air, just as polar light displays seem to be.

It would seem logical that if highly magnetized metals absorb less X-rays than the same metals unmagnetized—demonstrating that magnetism resists penetration—the magnetic polar re-



Spitzbergen Radio Station located on a group of islands in the Arctic Ocean. Beyond the water, in the background, are mountains covered with ice throughout the year. Above is a glorious display of the Aurora Borealis



Admiral Robert E. Peary, discoverer of the North Pole. In the course of his Arctic explorations, he observed hundreds of auroral displays and many from his island in Maine. He stated that the auroras were not the exclusive privilege of Arctic explorers, adding that he had seen Northern Lights of greater beauty in Maine than he had ever seen beyond the Arctic Circle



At the point of maximum aurora display in the polar region



Raold Amundsen, discoverer of the South Pole, and now trying to reach the North Pole. He says that he formerly believed that auroral displays are accompanied by audible noises. While walking on the deck of his ship he heard a crackling, rushing noise. He stopped, held his breath and listened. No noise. He resumed his breathing, and again, the noise. He then discovered that his breath, frozen by the intense cold, was the real cause of the crackling, rushing sound!

gions, where the earth's total magnetic forces are centered, should be the zones of most intense auroral displays.

The electrician and the physicist can assist by trying to duplicate the auroral, phenomena in the laboratory by passing electricity through magnetic fields and rarified air and in other ways.

If Professor Stoermer is correct in his deduction that the auroras are made up of cathodic rays, then the magnetic polar regions would be the best laboratories for the study of the phenomena of atmospheric electricity, about which we are still ignorant, because the cathode ray particle appears to be the real electron, and the real electron is the basic unit of electricity.

Data compiled from the reports of many authorities indicate direct relationship between the polar lights and the magnetic, electric, and atmospheric disturbances which affect radio transmission.

The fact that the number of auroral displays often is over one hundred annually, and the phenomena that prevail during the displays affect radio transmission, make it advisable to make available to radio experimenters the data given me by the famous ex-

plorers, the few who have lived close to the centers of auroral displays.

Professor Carl Stoermer, the Norwegian scientist who has been awarded



Henry Woodhouse, president Aerial League of America, demonstrating magnetic phenomenon

the Jansen medal by the French Academy of Science, after living for twenty years in arctic regions studying the northern lights says that the aurora borealis consists of cathodic rays, which are analogous to radium or to Roentgen rays. They are composed of electric particles emitted by the sun at a speed of many thousand miles per second, and so small that several millions placed side by side would not cover an inch.

It is the magnetism of the earth which draws these electric rays to the dark regions of our planet, hence they are only to be witnessed near the arctic and antarctic regions, the maximum zone of frequency being 70 degrees of latitude. The large majority of auroras occur from 60 to 75 miles from the ground.

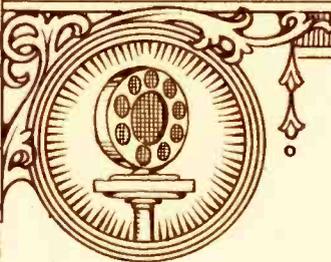
Were it possible for radio fans to view the entire earth when the receiver registers the clicks and rattlings of "static" and "atmospherics" they would probably find that polar lights are flashing their dazzling streamers from points ranging from 60 to 100 miles above the north and south polar

(Continued on page 64)





The Broadcasters



The Public Pays Does It Get the Radio Music It Pays For?

By Paul B. Klugh

Executive Chairman of the National
Association of Broadcasters

IT seems a great pity that in these comparatively early days of what is destined to be the greatest industry in the world, there should be an attempt on the part of a small organized group—the American Society of Composers, Authors and Publishers—to commercialize the broadcasting of music. This American Society of approximately three hundred, of a known list of 6,500 composers, authors and publishers, insists that the Radio Public be denied their music, unless expensive license fees be paid to their organization by broadcasting stations. As the broadcasting stations are not being paid to broadcast, many of them naturally feel that the demanded payment is an imposition and will not pay it.

The main issues have been confused and camouflaged to such an extent, that a plain statement of facts about broadcasting is needed.

Radio is absolutely dependent for its maintenance, nay, its very life, upon public interest, and if the public continues to be denied any music that it wants, radio will suffer, not only from an entertainment angle, but from the commercial standpoint as well. If any group is permitted to attempt to corner the market, to dictate terms, to say what should, or should not be broadcast unless certain sums are forthcoming, the time will assuredly arrive when many broadcasting stations will be compelled to shut down. This has already happened in several instances.

Not only does the group which

1. Organized group arbitrary about music rights.
2. Radio popularizes music.
3. Broadcasting advertises talent.
4. Broadcast publicity pays performers well.
5. Broadcast-stations operate without profit.

would rule and control the broadcasting of music, attempt to dictate to broadcasting stations, and through them to the public, but it also seeks to stir up dissension among unions to which musicians belong, going so far as to distribute propaganda among vocalists, instrumentalists, and other performers that they demand payment for broadcasting.

Further than this an organization of actors has advised its members that they shall not broadcast unless payment be forthcoming, and the larger vaudeville circuits have advised all actors playing on their circuits that they must not broadcast whether they get paid or not! So from every angle efforts are being made to hamper broadcasting in America, and in connection therewith to dictate terms. In the final analysis, it is the radio public which is being deprived, and which would further be deprived, if it were not for the active steps already taken by the National Association of Broadcasters.

After all, it is the public which pays. The public has paid for its music—and should get it. The public has already invested \$200,000,000 in radio apparatus, a sum that should be bringing to them \$8,000,000 interest at 4 per cent., or its equivalent in entertainment value! And the public will continue to invest in radio apparatus, in accessories, batteries, tubes and other paraphernalia to an even greater extent, providing they get some returns for their money.

The stability of radio therefore depends not only upon the entertainment furnished, but the quality of that entertainment, and it does not seem possible that any group will be allowed to upset, by dictatorial methods, a business that will undoubtedly reach a yearly aggregate of half a billion dollars.

Untrammelled, an avaricious group

To Our Readers:

The American Society of Composers, Authors and Publishers and the National Association of Broadcasters were each invited to present their own case in the music copyright controversy.

THE WIRELESS AGE now invites public opinion on this issue. If the response warrants further debate, the same organizations will be asked to again present their cases. They can then answer the public, and each the other.

THE EDITORS.

would not only interfere with a full return on the great amount of money already invested, but would also endanger the commercial interests of many firms who have large sums invested in manufacturing plants. It would have a decided tendency to cause a horde of small dealers and others who make a living from radio, to suffer. So, from many angles, no group should control the situation.

Propaganda advanced by the American Society of Composers, Authors and Publishers is to the effect that it would be ridiculous for a café to hire a well-known orchestra without salary, under the suggestion that playing at the café would further popularize the orchestra, and cause a greater demand for its services elsewhere. They say it is just as ridiculous for broadcasting stations to suggest the same thing.

An old dodge to prove an argument is to assume a false hypothesis. If at the outset, you state something that is not true, you may prove anything. The conclusion sounds correct, but is just as untrue as the premise assumed in the first instance. The fallacy of the café argument is that radio broadcasting stations have nothing to sell; the café has. Furthermore, we find that the café does not pay the orches-

(Continued on page 75)

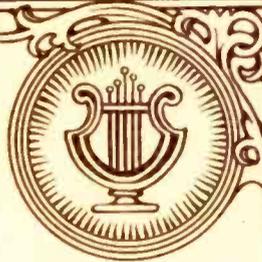
vs. *The Artist*

Despoil the Composer?

Clear the Air of "Music Static"

By J. C. Rosenthal

General Manager, American Society of Composers,
Authors and Publishers



FAIR Play From Radio—that is the appeal which I make in the name of composers and authors whose lives are devoted to writing the music of the world, confident that when the true facts are brought to light the radio public will readily agree that our position is sound, our cause righteous, and our demands reasonable.

In this brief article I shall endeavor to clear the air of the "music static" and remove the misapprehension which has been created between the members of the American Society of Composers, Authors and Publishers and certain broadcasters, in reference to the restrictions placed upon broadcasting copyrighted musical compositions.

First, I shall discuss the basis upon which the copyright owner of music claims the right to control the public performance, for profit, of his work.

In this country the protection of intellectual effort to authors and composers is found written into the Constitution by the provisions of Article I, section 8, which provides that "the Congress shall have power * * * to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

As early as 1856, Congress recognized the necessity of protecting creators of music by granting to the owners of dramatical works, the exclusive right of public performance; in 1897 similar protection was extended to musical works and the existing Act of 1909 vests in the owner of musical compositions the exclusive right to perform publicly for profit.

It is an incontrovertible fact that broadcasting stations, operated by commercial institutions, are engaged in business for profit, and that unless permission is secured from the owner

of the musical work they may not lawfully broadcast any copyrighted music. Further, the Federal Court has so held in a test suit brought by a member of our society against L. Bamberger & Co., of Newark, operating station WOR.

Radio is undoubtedly indebted to music, in a large measure, for its rapid progress. To sustain this contention requires no extended argument. The recent voting contests held in New York and Chicago demonstrated that an overwhelming majority of the radio audience desires a varied program of music. Let it be emphatically understood that there is no desire or intent to deny them their wish, or to in anywise impede or restrict the development of radio; on the contrary, we recognize the important part that radio plays in the advancement of civilization, and we are willing to contribute the music of the foremost composers and authors of the world, asking in return a remuneration grossly incommensurate with the value of our offering.

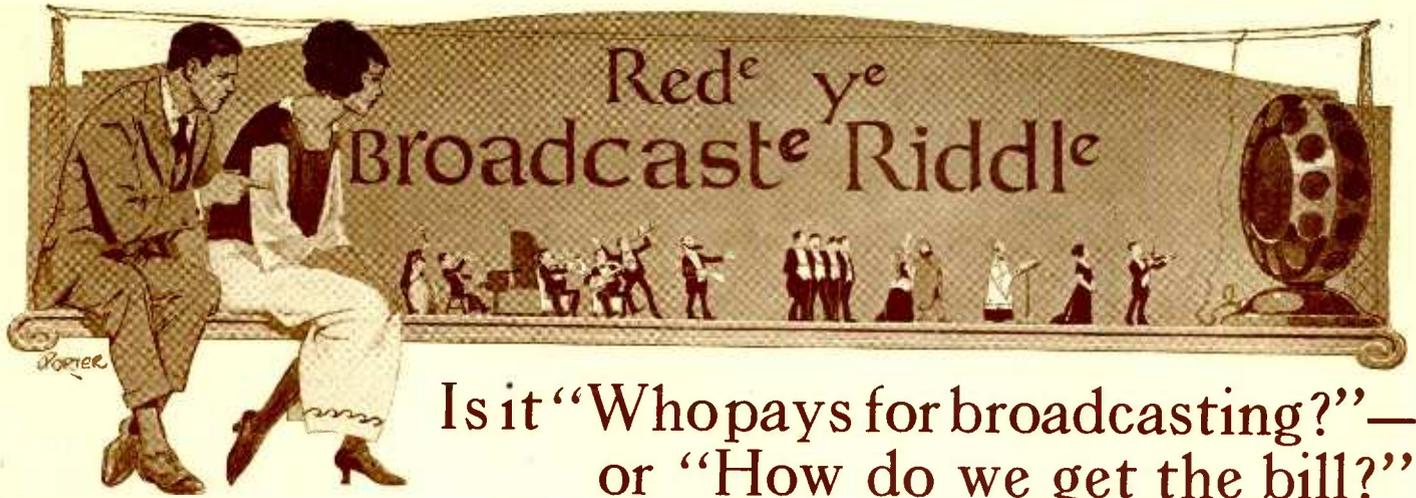
Notwithstanding opinion to the contrary, radio is seriously diminishing the earnings of composers and authors whose livelihood is derived from royalties from the sale of sheet music, phonograph records and music rolls. Since the advent of radio these royalties have been materially reduced—the reason must be obvious to every fair-minded person. The life of a popular song is short. Before radio came into existence, to become familiar with the latest tunes it was necessary to buy the song, the record of the word-roll. Now radio saturates the air with constant broadcasting of these melodies; the former purchaser has become a free consumer, the demand for our products has decreased, and our incomes seriously affected. Is it right and fair, that we should be compelled to suffer without any reward?

Do you know what we ask radio to pay for the privilege of using our creations? In the first place, as to the stations operated by educational, religious and charitable institutions, and amateurs, we have granted permission to use all the works of our members without any charge whatsoever. Do you know that commercially operated stations (excepting those operated by the Radio Corporation of America, Westinghouse Co. and General Electric Co.) are licensed at an average rate of not more than two dollars per day? Do you know that for this two dollars per day, these stations can broadcast the musical numbers written by the foremost composers of America, England, France, Italy, Germany and Austria? Think of it—two dollars per day. Does not this answer the unfounded charge of those opposing our rights, that we are extortioners, that we are trying to "hold up" broadcasters, that we are demanding exorbitant fees?

The American Society of Composers, Authors and Publishers is a bona fide non-profit organization to which all qualified song writers are eligible for membership. The purpose is to assert the rights of the individual members in connection with the public performance for profit of the works which they have created. They ask nothing and expect nothing, from the performances of their works, in public or otherwise, if there be no profit intended by the one giving the performance. They control only a small por-

(Continued on page 74)

1. Federal Constitution recognizes music rights.
2. Radio indebted to music.
3. Earnings of talent injured through broadcasting.
4. Broadcast stations ought to pay performers.
5. Broadcast stations operate for profit.



Is it "Whopays for broadcasting?"— or "How do we get the bill?"

By William A. Hurd

PRIMEVAL man was a rover. His curiosity ever led him over the hill to explore a distant land. But he was a gregarious animal. The need of communication with his kind was inherent.

Oral communication was basic and comparatively simple. But it was limited in range.

Fire beacons and smoke signals, limited in range, were likewise inadequate. A heavy membrane was then stretched across the end of a hollow log, which when struck, would emit sound vibrations capable of traveling to a distance of twenty miles. The membrane of another drum, stretched to the same tension, would vibrate in sympathy with the transmitted sound waves. But the need of a more flexible system for thought transmission and reception became evident.

And it was the discovery of movable type that marked the greatest stride forward in social development. However, while literature progressed toward the era of periodicals, runners and travelers still constituted the principal means of distant communication.

Then the nineteenth century. Magazines and newspapers ran abreast, with steam and gas engine locomotion. Civilization hurried.

Morse's telegraph threatened to annihilate space. Bell's telephone bridged the gap between distance and simple, oral communication.

Civilization paused, breathless, for a moment, and then resumed its mad pursuit of long distance communication, urged on by the discovery of wireless.

And finally, the advent of broadcasting!

* * *

THE WIRELESS AGE installed and operated in the 71st Regiment Armory, New York City, in September 1921, the first broadcast station to transmit a scheduled program by artists.

At that time, KDKA, the pioneer

ACKNOWLEDGMENT

The authorities for statements, opinions, and conclusions of this story are:

W. E. Harkness, assistant vice-president of the American Tel. and Tel. Co.

David Sarnoff, vice president and general manager of the Radio Corporation of America.

H. P. Davis, vice-president of the Westinghouse Electric and Manufacturing Co.

Martin P. Rice, director of broadcasting for the General Electric Co.

C. B. Popenoe, manager of Station WJZ.

J. A. Holman, manager of Station WEAJ.

J. C. Rosenthal, general manager of the American Society of Composers, Authors and Publishers.

Paul B. Klugh, executive chairman of the National Association of Broadcasters, and

Austin C. Lescarbourea, managing editor of the "Scientific American," who interviewed the officials of the principal stations throughout the United States during a recent survey of the broadcast situation.

The writer compiled this wealth of material which actually represents an understandable story of broadcasting. In effect, the writer has attempted to do little more than take his reader by the hand, lead him into the heart of the broadcast situation, and there, together, comprehend the real development of this thing which has grown too rapidly for casual, and at the same time, accurate observation.

broadcast station of the Westinghouse Electric and Manufacturing Company, at Pittsburgh, had not yet launched a definite program on the air.

In the early days of broadcasting, the transmitting apparatus was usually confined to some remote corner of the laboratory, and programs, in the main, consisted of records played on a phonograph.

Letters from listeners were important. The suggestions volunteered by letters were most helpful during the early chaos that ushered in the great

vehicle of entertainment and education. They were tangible evidence of applause from an audience, so vast, that even the most sophisticated artists were inspired to go before the microphone. And artists then were hard to obtain.

Originally, broadcasting was partly experimental; the stations first in operation worked on a thousand-watt power output that naturally covered a tremendous area. The deluge of letters following each program spurred the directors on to greater effort. Suggestions that appeared desirable were followed. Each new success encouraged further embellishments.

And so broadcasting developed to the point where program directors found it necessary to determine just what the public wanted.

HOW PROGRAM DIRECTORS KNOW THE PUBLIC WANTS

Radio has outgrown the whim of any one organization. It has irrevocably insinuated the roots of its service into the heart of the public welfare. It has become a public service.

Broadcasting, as a service to the public, must function as entertainment and education.

Were it possible to establish a definite line between entertainment and education in broadcasting, the attempt to do so would not be justified. Instruction should be presented in such a manner that it entertains. And whatever amuses surely educates in some respect, however obscure it might be. Program directors never forget their obligation to the radio audience, the responsibility of presenting what the public wants without offending, and yet including all the features desired by groups with specific interests.

Program structure, contrary to current belief, is an orderly, systematic gauge of just what the public wants. When broadcasting first staggered to its pinnacle of unique diversion, letters from enthusiastic fans suggested new stunts, and the personnel of broadcast

stations, with youthful vigor and plastic imaginations, added, modified and adapted innovations to enhance the presentation of their features.

Then followed an appreciable slump in the volume of correspondence as well as a marked change in the character of applause. Letters seldom suggest, today, but invariably criticize or commend.

One feature elicits response from a purely cultured class. Another brings forth a hearty response from people of education and breeding who apparently favor the less subtle renditions, but still hold themselves somewhat aloof from strictly popular features. And always, programs of jazz numbers arouse applause from the great mass that includes the several groups ranging from indifferent patrons of the muses down to illiterates.

Such letters can be classified according to the letterhead, quality of the stationery, the composition, or even the grammar of the writers. Extreme care is exercised in discounting the natural tendency of some classes to write prolifically. That precaution is necessary to accurately gauge the representation of the class to which the writers belong.



THE STUFF PROGRAMS ARE MADE OF

Programs are never settled. Even those features that

have long since become a definite routine are subject to constant modifications.

Directors of programs have generally accepted the fast rule of religious services on Sunday with any departure restricted to the positive canons of dignity. But even so, variety by



Martin P. Rice, director of broadcasting for General Electric Co.

way of debates, choir singing or organ recitals marks the restless demand of the public for digression from the academic and prosaic.

Bedtime stories constitute another generally accepted feature. But again, the pressure of public censorship necessitates some change in the presentation. The sandman or sandwoman of one station accompanies her stories with a ukelele. Others resort to innovations of a different sort.

Sports must encompass an increasingly greater field. The managers of broadcast stations seek new varieties of sport-interest with a practical thumb on the public's pulse. Either the quantity or character of response will serve the purpose of guiding their conduct.

Talks, lectures and debates must



David Sarnoff, vice president and general manager of the Radio Corporation of America

furnish ever new material and the broadcast manager must gauge accurately the interest aroused. A stamp collector wants to broadcast a talk on the collection, assorting, testing and mounting of stamps: a new feature, but worthy of trial. Forthcoming letters determine the fate of further talks on the same subject or other talks of a similar nature. Travel lectures are tried, proved successful and accepted by all stations. Dancing instructions, moving picture reviews and a conglomerate mass of unique stunts are all tried and judged, providing that they are not propaganda for questionable societies, or subjects that have met with public disfavor through other channels of publicity, or do not injure the jealously guarded reputation of the station itself.

A speech delivered by an important



H. P. Davis, vice president of the Westinghouse Electric and Manufacturing Co.

figure in public life is sought at a tremendous expense to the broadcast stations involved.

Women's interest programs are arranged with organizations in close touch with feminine movements and are scheduled for hours most convenient to women with household duties. From four to five-thirty o'clock has been set aside, in several large stations, as the most propitious time for broadcasting those topics.

Because theatrical productions are arranged to be seen, program directors have focused their attention on radio plays that can be written and cast for an audience that can only hear the lines spoken. Radio personalities are developed as an end to supplementing the so-called stage personalities.

Music in any phase is certain of approval. Philharmonic concerts and classics never receive the volume of applause accorded to popular and jazz numbers, but the enthusiasm rings with the same genuine approbation in either case. Most of the larger stations employ music critics who pass judgment on requests for time on the air, and also accompany soloists. Whistlers, violinists, pianists and singers may apply for appearance on future programs, the only requisites being that they surpass a fixed standard and acquiesce to any time best suited to the equal distribution of such numbers. Solos, duets, quartets, glee clubs, club orchestras and all other amateur or semi-professional performances are likewise tested and distributed evenly throughout the programs.

Professional numbers, whether classic or jazz, are usually solicited by the station at considerable expense.

HOW TO GET THE PUBLIC WHAT IT WANTS

Determining what the public wants is one thing; next comes the question of how to get it. Program managers have confessed to some difficulties here.

The American Society of Composers, Authors and Publishers, a very powerful organization maintained by its members for the mutual protection of copyrights, has forbidden the use of any and all copyright music in broadcasting unless the station doing so pays to the League a royalty exceeding what the broadcasters believe to be right. The broadcast stations have revolted en masse. The station managers claim that the broadcasting of pieces increases the sales of phonograph records and sheet music for such numbers, and that this has been proven by an elaborate system of checking music dealers' stocks before and immediately after the broadcast program. Broadcast managers, therefore, logically conclude that sales commissions are due them if the controversy warrants an issue. In the meantime, music not copyrighted has been discovered that is equally good and as readily popularized.

Radio has undeniably injured the sale of phonographs. In fact, the phonograph industry faces a collapse unless the executives can resort to a combination unit employing radio or discover a better alternative. So the phonograph industry has opposed the appearance of its artists before the microphone. One manufacturer has conceded the reciprocal benefit of broadcasting to the extent of allowing some of his artists to perform for the radio audience.

Few of the theater managers who have produced plays that were adaptable to radio transmission have admitted the increased box-office sales directly attributable to broadcasting selections from their productions. But program directors have been able to convert enough producers to satisfy the radio public for the time being.

Unknown artists will always be procurable for very little consideration be-



W. E. Harkness, assistant vice president of the American Telephone & Telegraph Co., in charge of broadcasting

cause of their need of publicity. But the successful artists who command a following will surely demand and probably get satisfactory remuneration for their performances before the microphone. Likewise, popular orchestras, symphony concerts, opera, lecture hall programs and similarly successful enterprises must be solicited on the basis of adequate financial return. All this means a heavy expense.

Another heavy toll on the finances of broadcast stations is the cost of operation. A survey of the twelve principal stations throughout the country discloses the startling figures of \$25,000 up to \$100,000 per each station annually, for little beyond the actual operating and maintenance costs. The payroll is seldom less than \$18,000 a year for the station personnel alone. The reception rooms, studios, and control and transmitting rooms all require enormous floor space in centrally located buildings which invariably lease their available space at a premium. The erection of a first-class broadcast

station requires an expenditure of approximately \$150,000.

Most of the popular features such as world series, prize features such as sermons, symphony concerts, important lectures and addresses by public figures, are relayed to the broadcast stations direct from the point of delivery.

The American Telephone and Telegraph Company employ their land wires for direct connections. Frequently, they lease open wires to their contemporaries. But that form of relay entails a personnel of rather wide scope and is very costly. The two hours consumed in broadcasting President Coolidge's address to Congress required 31 hours of testing and the tie-up of two lines throughout at a cost of nearly \$20,000.

The relay tubes along the line require expert supervision and an emergency line must be held open against serious mishaps. A single telephone or telegraph line is used for the regular transmission of not less than eight service connections. The two lines reserved for broadcasting any one event, therefore, means an actual loss of sixteen lines which represent a huge revenue to the telephone company.

And still another cost is involved in carrying broadcast features over lines that were originally intended for only voice transmission. Vocal and orchestral music both have wave vibrations that far exceed the natural voice period; this necessitates special apparatus supervised by skilled operators for successful carriage into the station.

The Westinghouse Electric and Manufacturing Company have erected a relay broadcasting station at Hastings, Nebraska, to which programs from KDKA, Pittsburgh, are broadcast on low waves and retransmitted almost simultaneously. However, they still face the direct wire costs from points to the station at Pittsburgh.

The General Electric Company have endeavored to side-step the costly telephone line connections by actually broadcasting from the point of enter-

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The best in entertainment and culture

Broadcasting Makes a Giant Stretch

M. I. T. Dinner Speeches in New York Go by Radio East Over the Atlantic and West to the Pacific. This Demonstration Marks the Development of Short-Wave Broadcasting

By Jerome W. Howe

NEW York Radios London and Frisco" was the style of leader by which millions of newspapers apprised their readers of a significant forward step in broadcasting. At the dinner of the Massachusetts Institute of Technology held recently in the Waldorf-Astoria hotel in New York City, the speeches of Major General J. G. Harbord, President of the Radio Corporation of America, Dr. S. W. Stratton, President of the Massachusetts Institute of Technology, Calvert Townley, Assistant to the President of the Westinghouse Electric and Manufacturing Company, Frank A. Vanderbilt and David Sarnoff, Vice President of the Radio Corporation of America, as well as several musical numbers, were transmitted from the microphones in the ball-room to WJZ, from WJZ to WGY in Schenectady, thence to KDKA in East Pittsburgh whence they

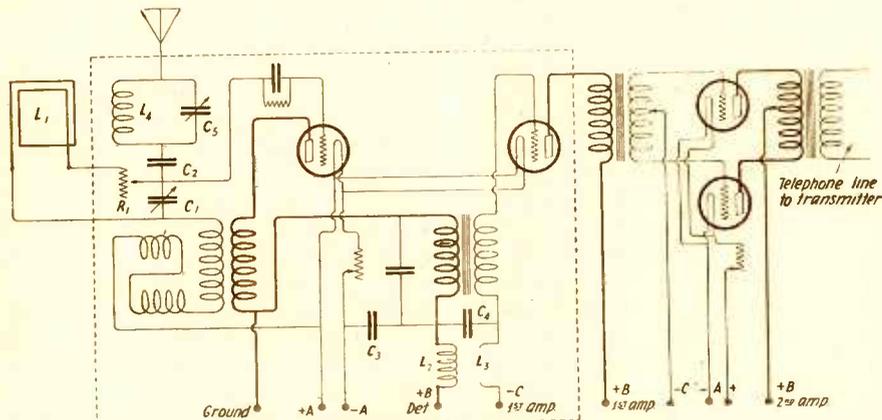
In the March issue of *The Wireless Age* was described the new use of short-wave broadcasting in relaying programs from a primary station to another distant station for simultaneous retransmission. In this April number it is possible to follow up with an account of a remarkable demonstration of this feat on a far greater scale. Not only do we have here an example of the rapid advance in radio progress, but also an episode which strikes home upon the popular imagination and compels prophetic speculation as to the effect of International Broadcasting. Also in the March issue of *The Wireless Age* attention was called to the notable accomplishment of the Telephone Company in combining wire and radio transmission in such a manner as to bring in to radio receivers all over the country a conversation carried on between persons in such widely separated points as New York, San Francisco and Cuba. On this page is recorded a still more interesting chapter of radio progress.

Pittsburgh and Cleveland, Ohio, and these were quite satisfactory and promised ultimate commercial success of this application of radio. Later it was decided to try to reach out over a still greater distance and the engineers of the Westinghouse Electric Company made investigations to discover the maximum distance from KDKA at which might be located a relay station whence the signals could be rebroadcast as far as the Pacific Coast. Thus KFKX was established in Hastings, Nebraska, and the installation of this unique station, almost a thousand miles from Pittsburgh and 1,200 miles from Los Angeles, was pushed forward.

On November 22, 1923, this station gave its first program, partly originating at the studio at Hastings and partly relayed from East Pittsburgh. It was received on loud speakers in Washington, New York City, and Salt Lake City.

When a program from East Pittsburgh is to be repeated at Hastings, KDKA transmits on its regular frequency of 920 kc. (326 meters) and at the same time sends out the program on a carrier wave frequency of 3200 kc. (94 meters). It is this carrier wave

(Continued on page 47)



Circuit diagram of the Westinghouse (Hastings) KFKX Receiver

were retransmitted on short-wave so that they could be picked up thousands of miles away in Hastings, Nebraska and in Manchester, England, to be further broadcast. It was estimated that this event was broadcast over a total area of 1,500,000 square miles.

General Harbord, in happy allusion to Jules Verne, the imaginative fiction writer and forerunner of much modern scientific chronicle, remarked, "It used to be a feat to traverse the globe in 90 days, but what you have participated in tonight has made the distance a matter of seconds."

The stations operating in this demonstration were WJZ in New York, WGY in Schenectady, KDKA in East Pittsburgh, KFKX in Hastings, Nebraska, KGO in San Francisco and the stations of the British Broadcasting

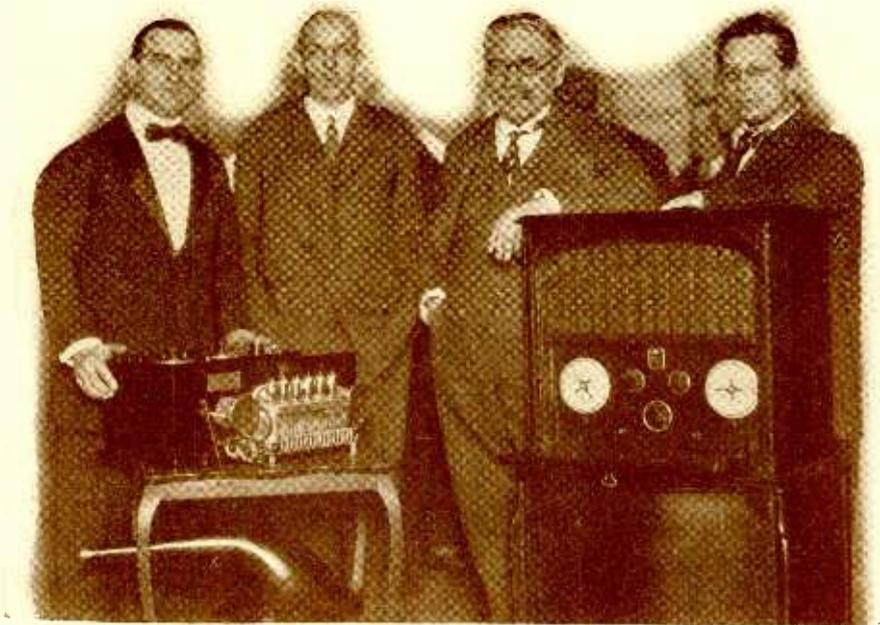
Company located in Great Britain.

It has been impracticable to broadcast successfully over extremely long distance by means of the usual frequencies. But about two years ago efforts were made to transmit over a considerable distance on a high frequency carrier wave for the purpose of retransmission at ordinary frequencies. It was found that fading, which affects transmission at the customary broadcasting frequencies, is reduced at high frequencies to a negligible degree. Moreover, day-time transmission by this means was proved to be almost as satisfactory as by night, a marked advantage. Also, high frequency transmission was found to be less affected by static interference.

Preliminary tests were commenced in September, 1922, between East



The Westinghouse 100 meter high frequency transmitting apparatus which is making the game of radio broadcasting an international sport. This Westinghouse set sends out KDKA's signals strong enough for English stations to rebroadcast



This interesting picture might well be entitled

RADIO PINNACLES

The group shown here includes the leaders of radio design, (from left to right) Dr. Alfred N. Goldsmith, B.S., Ph.D., Fellow I.R.E., Director of Research, Radio Corporation of America; Major Edwin H. Armstrong, radio inventor and designer; Professor Michael I. Pupin, Ph.D., Sc.D., LL.D Professor of Electro-Mechanics, Columbia University and Professor John H. Morecroft, E.E., President of the Institute of Radio Engineers. In the foreground are to be seen the Armstrong super-heterodyne (second harmonic) and the new Radiola Super-VIII, premier of radio receivers

The Super-Heterodyne

Major Armstrong, Its Inventor, Traces Development and Explains Principle—Full Report of Major Armstrong's Address Before the Institute of Radio Engineers Written Expressly for The Wireless Age

By Abraham Ringel

Member Institute of Radio Engineers

ON the evening of March 5th, in the Auditorium of the Engineering Societies Building in New York City, Major Edwin H. Armstrong presented a paper entitled: "The Super-Heterodyne, Its Origin, Development, and Some Recent Improvements," before a meeting of the Institute of Radio Engineers. The Auditorium was barely sufficient to hold the enthusiastic throng of radio engineers and their guests. On the platform, in addition to Major Armstrong and Professor Morecroft, President of the Institute, who presided, were Professors Pupin and Goldsmith, names to conjure with in radio. In the audience was practically every important engineer in the country. The gathering was also considerably augmented by the presence of many radio amateurs from all over the country, who were simultaneously attending the Second District Amateur Radio Convention at the Hotel Pennsylvania.

Professor Morecroft opened the meeting with a few brief remarks and then introduced Professor Pupin, who has been Major Armstrong's mentor and counsellor in all his work. Professor Pupin dwelt on the fact that it was now up to the professor to seek knowledge from his former pupils, and enumerated them, all prominent in the

radio fraternity: Armstrong, Morecroft, Goldsmith, Vreeland and many others. It was indeed a proud moment for the dean of American electrical engineers when he introduced Edwin H. Armstrong, one of the most outstanding of his flock of students.

Major Armstrong, with his usual modesty of manner, disclaimed any unusual genius in his inventions, declaring that he believed he had been so fortunately placed by Divine Providence as to be just a little ahead of somebody else in making these discoveries. He then traced the gradual development of the Super-Heterodyne from the first crude model built while in the A. E. F. in France, with its multitudinous controls and at least nine or ten tubes to the present Radiola Super VIII, which is the last word in modern broadcast receivers.

Most of the wireless communication of the Signal Corps in the days of the Great War was on very short wave lengths. There was urgent need, therefore, for a radio frequency amplifier which would work efficiently for these frequencies. After exhaustive experiment with all the vacuum tubes then available, it was soon evident that, because of their high grid to plate capacity, their high filament to grid, and filament to plate capacities, not

much amplification could be obtained for even moderately high frequencies such as 500,000 cycles (equivalent to a wave length of 600 meters). These capacities were of the order of 8 micro-microfarads and in general tended to act as short circuiting paths for currents of extremely high frequencies—in effect, short circuited the radio frequency amplifying transformers. The action of these capacities may be demonstrated by the reader to his own satisfaction at audio frequencies in the following manner: Connect a fairly large condenser, say .01 microfarad or more, across the secondary winding of an audio frequency transformer; the resulting volume of sound obtained from the amplifier will be very greatly reduced. The phenomenon is explained by the fact that the voltage in the windings, instead of passing to the grid of the amplifying tube, is short circuited by the large condenser.

Since it is impossible to greatly reduce these tube capacities, which are so harmful to radio frequency amplification (and which are also likely to set up oscillations in the amplifier), the problem resolves itself into working at some frequency at which these capacities will not act as short circuits. At a frequency of 1,000,000 cycles (300 meters wave length) a capacity of 8

micro-microfarads is equivalent to approximately 100,000 ohms reactance; at a frequency of 50,000 cycles (6,000 meters wave length) this capacity would give a reactance of about 2,000,000 ohms—which is very high. It is then quite apparent that an amplifier for 50,000 cycle frequency will not be affected by this capacity. This is borne out by actual practice. Amplifiers for such frequencies are quite efficient and stable—in fact they are as simple and easy to control as ordinary audio frequency amplifiers.

APPLYING THE HETERODYNE PRINCIPLE

Major Armstrong realized this. The problem of converting the very high radio frequency to some lower frequency was relatively simple. It consisted merely of applying another frequency at the receiver, which was slightly different from the received signal and detecting it. After the detector will be obtained a beat note, whose frequency is exactly equal to the difference in frequency between that of the incoming signal and the local oscillator. By varying the frequency of the local oscillator, this beat (or heterodyne) note may thus be varied at will—and then amplified in a suitable intermediate frequency amplifier. After it is amplified here, it is detected once more, which restores the original low frequency sound—and amplified at audio frequencies. [The beat or heterodyne phenomenon is only too familiar to present day radio fans—it is only too evident when some neighbor with a regenerative receiver has his set oscillating. The “birdies” that you hear is nothing but the beat note, produced by the broadcast station and oscillations from your neighbor’s receivers. Whenever he changes his tuning slightly, you hear the note change in pitch—since he is changing the frequency of his oscillations.]

Whenever beats are produced, there is quite a deal of amplification obtained. The beat note may be several times as loud as the signal which is obtained with ordinary detection. In case the beat note is set at some frequency which is too high to be heard, say

50,000, the above may be stated in somewhat different wording: the voltage produced after the detector by this 50,000-cycle beat note may be many times greater than the voltage produced by the incoming signal alone after being detected. So that ampli-

actual amplification at an intermediate frequency, but also amplification due to the heterodyne or beat phenomenon, as explained above. Its simplicity of operation is unrivaled. Only two controls are required, neither of which is dependent on the other; one controls

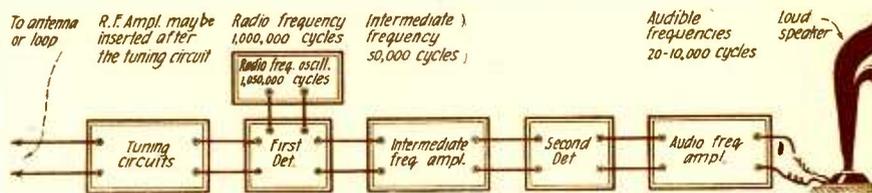


Figure 1—Principal elements in the Super-Heterodyne Receiver showing the tuning unit, first detector, intermediate frequency amplifier, second detector and finally the audio frequency amplifier.

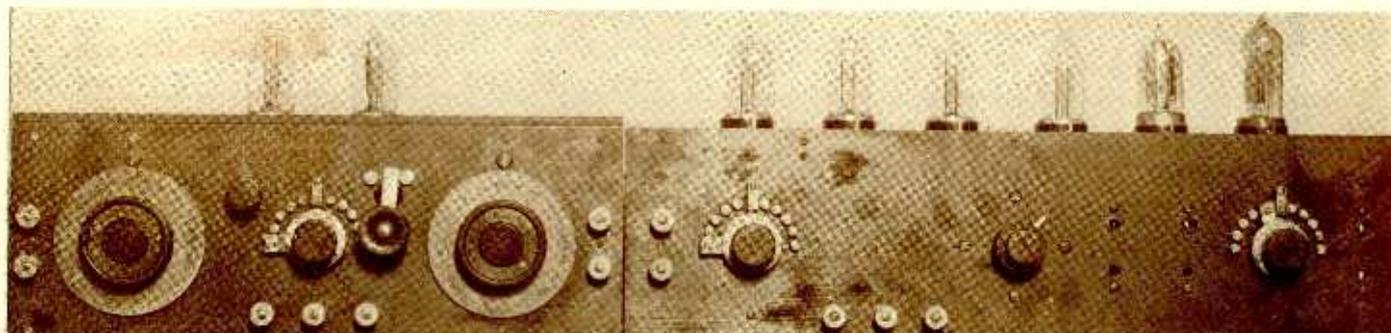
fication results merely from heterodyning the incoming radio frequency. After detection the 50,000-cycle beat note is picked out and amplified in a suitable amplifier. This amplifier may be made of as many stages as is desired. Here lies the main advantage of the super-heterodyne. It is much easier to amplify at these intermediate frequencies, than at either radio frequencies or audio frequencies; three, four, five and even six stages of amplification have been employed successfully. Voltage amplifications of 10,000 times can readily be secured at intermediate frequencies, as compared with 400 times for the average audio frequency amplifier. This amplification can be made to give a uniform response over a sufficiently broad band of frequencies to give excellent quality of music or speech (something which cannot be said for the average audio frequency transformer-coupled amplifier).

WONDERFUL RESULTS FROM SUPER-HETERODYNE

After suitably amplifying this intermediate frequency, a second detector is required for obtaining the original sound. An audio frequency amplifier may be added to this. The general principles involved are illustrated schematically in figure 1. The super-heterodyne receiver is far superior to any other type of radio receiver in every respect. Its sensitivity is unequalled, for we have here not only

the frequency of the local oscillator, the other tunes the loop, which is all that is necessary for reception. It cannot be approached in selectivity. In order to emphasize these points, Major Armstrong gave a few specific examples of actual reception of station 2LO in London by an old lady in Massachusetts who had had no previous experience with radio receivers whatever—and of reception at the same time of Los Angeles, with himself at the tuning controls. Near-by locals were broadcasting at the time too. Later Dr. Alfred M. Goldsmith, in a New York apartment, had no difficulty in receiving KGO, of Oakland, California, while four powerful local stations, all well within a radius of 5 miles, were operating—and one of them was only about a meter off in wave length from KGO.

The super-heterodyne as originally built by Major Armstrong, with the capable assistance of Sergeants Houck and Lewis, was not exactly practicable. It used nine storage battery tubes—and required at least a 200 or 300 ampere-hour storage battery. The wire required to safely carry the filament current was as thick as a man’s thumb. Several similar sets were built later in the United States on his return here. One of these, it is rumored, was built for Mr. John D. Rockefeller, the oil magnate; this is quite probable, as Major Armstrong pointed at one containing nine tubes which he had built



The original super-heterodyne set constructed in France during the war

about two years ago. with the remark: "The trouble with these sets was, that it required a millionaire to buy and operate them. The average man's income was not enough to support a super-heterodyne."

MAKING THE SUPER-HETERODYNE PRACTICABLE

With the advent of dry battery tubes and storage battery tubes using low filament current, the problem of bringing the super-heterodyne down within means of the average man was somewhat simplified. But it was too much to expect dry cells to supply nine tubes

been Armstrong's able assistant all these years. It is well known to all who have worked with radio, or for that matter, audio frequency oscillators, that if the circuits are adjusted so as to secure a given frequency, we not only obtain the frequency, but also a whole series of others, which are exact multiples of it. If, for example, the oscillator is tuned to 275,000 cycles per second, we will in addition get the following frequencies: 550,000 cycles, 825,000 cycles, 1,100,000 cycles, etc., etc., which are called second, third, fourth, etc., harmonics, respectively; these harmonics correspond to two,

the incoming frequency, that there is no noticeable change in the tuning of one, when the other is adjusted. This is but one of the steps in the gradual reduction of the nine-tube outfit.

The next step in compressing the set to reasonable proportions was in the reflexing of the radio frequency amplifier with the intermediate frequency amplifier. The method involved here is illustrated in figure 3. The incoming oscillations are picked up on a small loop, which may be so small that it is readily concealed within the box containing the receiver. These are applied to the grid of the first tube

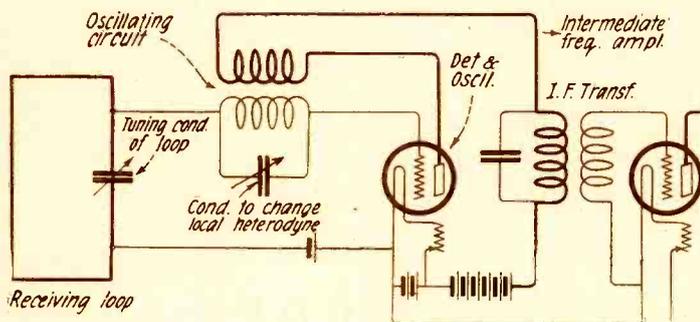


Figure 2—Application of principle of self-heterodyne to super-heterodyne

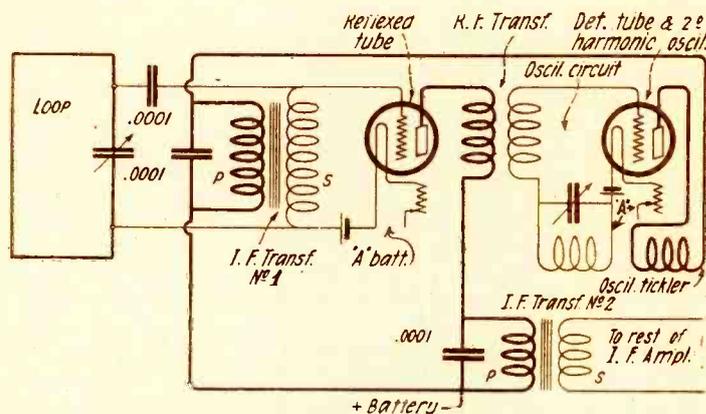


Figure 3—Principle involved in reflexing radio frequency and intermediate frequency amplifier and in using detector as second harmonic oscillator

with filament current. Besides, the construction was still too costly. There was undoubtedly need for having some of the tubes do double duty. The most practicable step was to combine the radio frequency oscillator with the first detector, i. e., employ the self-heterodyne effect. The trouble with this, however, was that on adjusting the frequency of the oscillating circuit portion, we are likely to detune the receiving circuit, and vice versa, because the two frequencies are so close. Such a system is all right for receiving telegraph signals, where the beat may be made a fairly high audible note; but in receiving telephony and music, we must make this beat frequency above audibility—and keep it there. Probably the most suitable region is in the neighborhood of 50,000 cycles per second. In the super-heterodyne receiver, if the self-heterodyne were adjusted to give a beat note of 50,000 cycles, the receiving circuit would be detuned to so great an extent from the frequency of the station it is desired to receive, that the results would be worthless. Besides, any minute change in the adjustment of one would react on the other.

After three years of experimentation in an effort to discover a means of combining the first detector and oscillator, a solution was at last found. A great share of credit for this discovery belongs to Mr. Harry Houck, who has

three and four times the fundamental frequency of 275,000 cycles. This production of harmonics is due to certain asymmetrical characteristics of the vacuum tube and is not at all difficult to understand.

It is precisely similar to the production of overtones in musical instruments—where, when a certain note is sounded, we have present, not only the fundamental tone, but also a whole series of harmonics or overtones, which give the instrument in question its peculiar characteristics by which we recognize it. At any rate, in the super-heterodyne receiver, in combining the detector and oscillator, we have the oscillator work at some frequency below that which we desire to receive and select the second harmonic to produce the beat note. Thus, if the loop in figure 2 is tuned to say 600,000 cycles (500 meters), the oscillating circuit is adjusted to 275,000 cycles. The second harmonic of the oscillator is 550,000 cycles, which on heterodyning with the received 600,000 cycles, will give a beat note in the detector of 50,000 cycles. The local oscillator may also be tuned to 325,000 cycles, the second harmonic of which is 650,000 cycles—and the resulting beat note is also 50,000 cycles. Thus we will obtain results at two different tuning points of the oscillator in the super-heterodyne receiver. The frequency of the oscillator is so far from that of

through a condenser of .0001 microfarad capacity, which does not oppose the flow of currents of high frequency. These oscillations are amplified by the tube and then applied to the grid of the detector and oscillator tube (the second tube) by means of an ordinary radio frequency transformer. Note that no grid condenser or grid leak is required here, since we are detecting a frequency which is extremely high, and must rely on the curvature of the grid current and plate current curves in order to produce rectification, rather than on the action of the discharge of a grid condenser through a very high resistance.

The second tube also functions as an oscillator, which is tuned to a little less (or a little more) than half the frequency of the incoming signals. The beat note which results between the second harmonic of the locally generated oscillations and the received oscillations is obtained in the process of detection. This beat note, which is in the neighborhood of 50,000 cycles, is passed through the primary winding of an intermediate frequency amplifying transformer, the secondary of which is in the grid circuit of the first tube, which is also the radio frequency amplifier. A condenser of .0001 mfd. capacity, or even less, is connected in the grid circuit as shown, so that the secondary winding will not be short circuited by the loop circuit. In series

with the radio frequency transformer in the plate circuit is connected another I. F. (abbreviation for "Intermediate Frequency") transformer, the secondary of which leads to the rest of the I. F. amplifier, which is made in the usual manner and has been described several times in past issues of THE WIRELESS AGE. The .0001 microfarad condensers shunting the primary windings of the I. F. transformers are inserted in order to allow the comparatively high radio frequencies to bypass the high inductance windings of the I. F. transformers. No filament or B batteries are indicated in the diagram—but these are connected in the usual manner.

With such combinations as these, Major Armstrong was able to reduce the original super-heterodyne to six dry cell tubes—and obtain even better results than with the nine storage battery tubes used previously. He then pointed out a number of such receivers, built within the past year, of surpris-

has ever been done. Major Armstrong pointed with no little pride to a number of beautiful cabinets, which housed the new line of super-heterodyne receivers, now being marketed by the Radio Corporation of America and embodying his new discoveries described above.

In regard to selectivity, sensitivity and ease of tuning, they are without peer; local stations do not interfere at all with reception of far distant ones; only two controls are required for tuning, one for the loop and the other for the "second-harmonic" oscillator, the principle of which is illustrated in figure 3. The intermediate frequency amplifier is adjusted at the factory and sealed up, so that the set is not only simple, in its controls, but absolutely fool-proof. The only limit apparently to its sensitivity in receiving distance is static. Major Armstrong stated that the average inexperienced broadcast listener can easily receive from stations 3,000 miles away, any time

convinced of the undoubted superiority of the new super-heterodyne over any other receiver that has hitherto been produced.

More About Inductance Coils

Editor, WIRELESS AGE,

Dear Sir:

I read with interest Mr. Miller's article on "How to Design Inductance Coils," in the February issue of THE WIRELESS AGE.

I would like to suggest the following method as being more direct in the calculation of single-layer coils from Professor Hazeltine's formula:

$$L = \frac{0.0002 N^2 A^2}{3A + 9B + 10C}$$

Data given:

L = 0.08 milli-henries.

A = 2 inches; 10C is negligible.

Size of wire, No. 22 D. S. C.

Latest Radio Developments

WHEN asked if the average broadcast listener could build the set, Major Armstrong said that the second harmonic super-heterodyne is a piece of apparatus which can be built only by an experienced radio engineer and that the exact dimensions of each wire and part must be known.

He said: "Radio sets are likely to become more complicated year by year and to give a person a copy of the super-heterodyne circuit and detailed instructions relative to construction would be like giving the average mechanic a complete set of blueprints of an automobile. Efficient and complex radio sets of the future will not be home-made any more than the automobile. It will be less expensive and results will be far more satisfactory if the set is purchased complete. I should not advise any one to attempt to build a home-made super-heterodyne operating on the second harmonic principle because I know the results would be extremely disappointing."

Dr. Alfred N. Goldsmith, head of the RCA Research Laboratory, said: "The set cannot be built by the average radio follower. It consists of a heavy casting called a catacomb box in which shelves are arranged for mounting the apparatus. All of the parts are mounted and then the catacomb is filled with wax, making the set practically a solid block. The instruments are so designed that they will not function the same in air as they will in the wax block. This is a new practice in construction of radio sets. If an experimenter took one

of the sets apart and attempted to build a duplicate I am afraid he would experience great difficulty. A hook-up or blueprint of the second harmonic super-heterodyne would be about as useful in building the set as a map of Asia."

The slightest deviation from the exact wiring, such as moving a wire a fraction of an inch out of its proper position or making a wire a trifle too long, will change the capacity effect and make the entire circuit inoperative. A slight variation in wiring would cause distortion which, in a single tube set would be unnoticeable, but in a six-tube super-heterodyne outfit this distortion is highly amplified and howls dominate the incoming music.

Dr. Goldsmith said that the ordinary type super-heterodyne receiver, as built experimentally by some radio enthusiasts, using from eight to ten tubes, was difficult to operate and radiated energy continuously, although the operator was not aware that his set was squealing and interfering with his neighbor. With the regenerative circuit the operator can tell when his set is disturbing near-by receiving sets, but in the case of the old type super-heterodyne only the neighbor can tell that the set is howling.

The new set has a new principle called the "regenoflex," and by the use of a special muffler tube circuit radiation from the set is eliminated.—The New York Times, Sunday, March 16, 1924.

ingly small dimensions. A box, about 6 inches by 8 inches by 20 inches, using six UV-199 Radiotrons was complete in every respect; it contained a loop, A-batteries, B-batteries, C-batteries, to say nothing of the super-heterodyne equipment itself, such as tuning condensers, transformers, oscillator coils, etc. It was with such equipment that that old lady received stations 3,000 miles distant!

This did not mark the end of the development. It was only the beginning! Mr. David Sarnoff, Vice-President and General Manager of the Radio Corporation, visualized its importance and immediately concentrated the forces of the Research Laboratories of the Radio Corporation, General Electric Co. and Westinghouse Co. on continual day and night work for almost a year. And the result was the finest job in radio engineering that

atmospheric conditions are right, when using the super-heterodyne.

With a few brief words, promising new developments for the future, Major Armstrong relinquished the floor. Professor Pupin, in the discussion, took occasion to compliment the speaker for his manliness in giving credit, where due, to his associates and then pointed out that we had already outstripped European nations in scientific development because of our diligent application to research work, both in the universities and in our large industries. In the case of radio, there is no doubt of it at all. At the close of the meeting, little groups of the members of the Institute gathered round the various receivers on display and listened to broadcasting from stations more than 1,000 miles distant, while WJZ, only a quarter of a mile away, was going full blast—and came away

Substituting:

$$0.08 = \frac{0.0002 \times 2^2 \times N^2}{(3 \times 2) + 9B}$$

The total number of turns, N, divided by the number of turns per inch is equal to the axial length, B. The number of turns per inch of No. 22 D.S.C. wire is 32 (see table II, page 56).

Then B = N/32
 Substituting in above:

$$0.08 = \frac{0.0002 \times 2^2 \times N^2}{9N}$$

$$(3 \times 2) + \frac{9N}{32}$$

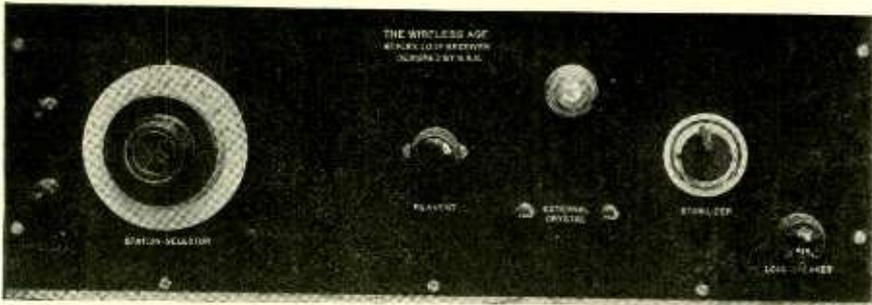
Simplifying: $N^2 - 28N - 600 = 0$.

Solving the above quadratic:

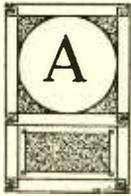
$$N = 43 \text{ turns.}$$

Very truly yours,

Manchester, N. H. A. H. CASTOR.



The Wireless Age Reflex Loop Receiver



Four Tube Set With Crystal Detector

3 Stages of Radio Frequency
2 Stages of Audio Frequency

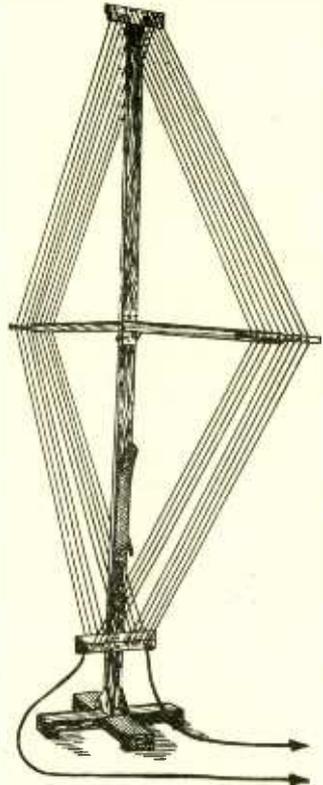
Designed by R. A. Bradley
with the collaboration of Samuel C. Miller
Member of the Institute of Radio Engineers

WITH the steady increase in the number of broadcasting stations there has naturally come an increased demand for a receiver which can successfully separate two or more powerful stations closely approximating the same wavelength. Then, too, the broadcast enthusiasts, located in very congested districts such as New York, Chicago, Philadelphia and other large cities are in many cases prevented from erecting an aerial on the roof, and must resort to some other collector of energy. The loop receiver has fulfilled these two issues admirably, but heretofore has required so many tubes that the cost was prohibitive. It is necessary to use at least three stages of radio frequency amplification before the detector, in order to amplify the small amount of energy that a loop is capable of collecting to such an extent that the detector will respond and carry to the headphones an audi-

NOTE—Certain patent owners permit amateurs to make up their own radio devices for their own use and not for sale. Relying on this policy this article gives suggestions to aid amateurs in their experimentation, but no license under patents is to be inferred from the publication of these suggestions. The license rights exist only through the generosity of the patent owners and if any owner should object, the amateur should refrain from using the particular invention involved.

ble signal. Then it is necessary to build up this signal by means of at least two stages of audio frequency amplification in order to have sufficient volume to operate a loud speaker. This, in all, means that we must have six tubes. Too much, too much!

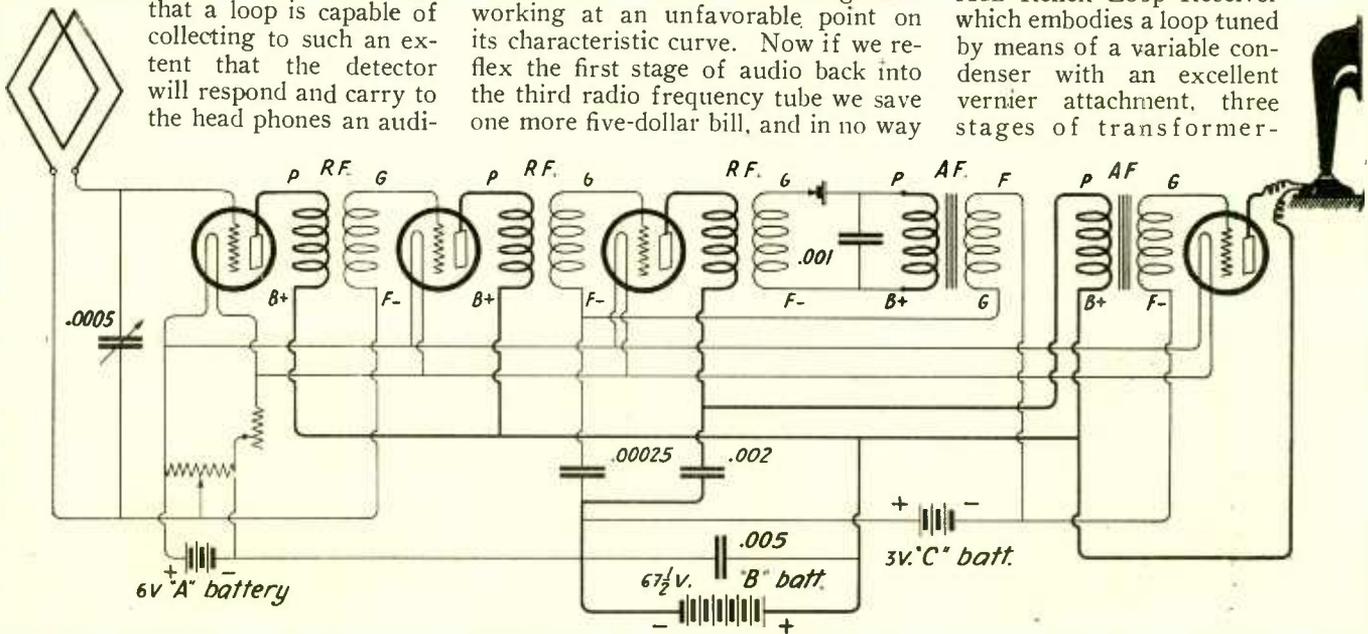
Now, if we use a crystal detector in place of a vacuum tube we have saved one tube and improved the tone quality of our reception! A crystal rectifies with little or no distortion while such cannot be said of the average tube working at an unfavorable point on its characteristic curve. Now if we reflex the first stage of audio back into the third radio frequency tube we save one more five-dollar bill, and in no way



The type of loop used

sacrifice our tone quality, sensitivity, or ease of control.

With these ideas in mind we have developed this month THE WIRELESS AGE Reflex Loop Receiver which embodies a loop tuned by means of a variable condenser with an excellent vernier attachment, three stages of transformer-



The diagram layout. Note the manner in which the small fixed condensers are connected in the circuit

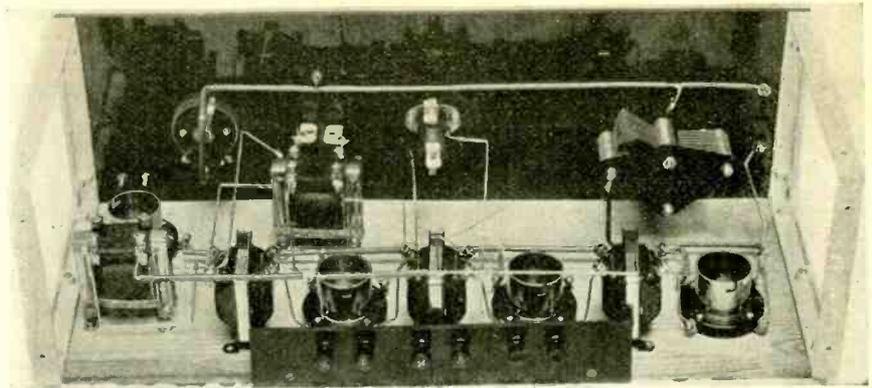
A Thoroughly Tested, Practical and Proved Receiver

coupled radio-frequency amplification, a crystal detector and two stages of a.f. using four UV201-A's!

THE PANEL LAY-OUT

The Radion panels were used because they are easy to work and present a very pleasing appearance. First of all locate the hole for the condenser shaft four inches from the left end and center it up and down on the panel. Next, mark out the holes for the rheostat in the exact center of the panel, then the potentiometer four inches from the right end, using in each case the templates furnished with each instrument by the manufacturer. The two holes for the crystal detector are now located two inches apart between the rheostat and potentiometer and two inches from the bottom of the panel. The Eby phone block may then be placed two inches from the right end and one and one-half inches from the base. Next drill the holes for the Quinby aluminum frames three-eighth inch from the ends of the panel so that the tops of the frames come flush with the top of the panel. This will leave a space at the bottom to fasten the baseboard.

Follow closely the photographs in mounting the rest of the instruments on the baseboard as the arrangement shown represents much experimentation in providing shortest leads and general all-around efficiency. The radio frequency transformers and tube sockets are mounted flush with the rear of the baseboard, placing them approximately 3 inches between centers. This provides for the shortest possible grid and plate leads at the same time keeping as low as possible capacities between these leads. If you attempt to hook up a radio-frequency amplifier with wires running helter-skelter you create high capacities between the grid and plate of each tube causing them to oscillate beyond the control of a potentiometer which of course is a highly undesirable feature. The first audio - frequency transformer is



Rear view of baseboard layout affording a good idea of the general arrangement of instruments

List of Materials

One .0005 mfd. variable condenser (Pacent). This condenser must be a good one as it is highly important that losses in your collector circuit be kept very low. One 400-ohm potentiometer (Pacent) and one Filkostat. These instruments are well made and add to the appearance of any set.

Four sockets (Paragon standard).

Three radio frequency transformers (Jefferson). Very satisfactory results were obtained with these.

Two audio frequency transformers (Jefferson). Ratio 6 to 1 and 4½ to 1.

Eight binding posts (Eby).

One Accuratune dial. This instrument is very satisfactory as its vernier adjustment is all that could be asked.

Two Quinby Aluminum Frames for seven-inch panel.

One Radion panel, 7x21x3-16 inches.

One hard rubber strip, 2x14x3-16 inches for mounting binding posts.

One .001 mfd. Dubilier fixed condenser.

One .00025 mfd. Dubilier fixed condenser.

Two .002 mfd. Dubilier fixed condensers.

Eight lengths of round bus wire. The round bus wire is much easier to handle and presents quite as good an appearance.

Four lengths of yellow cambric tubing.

Two dozen assorted lengths wood screws for mounting instruments on baseboard.

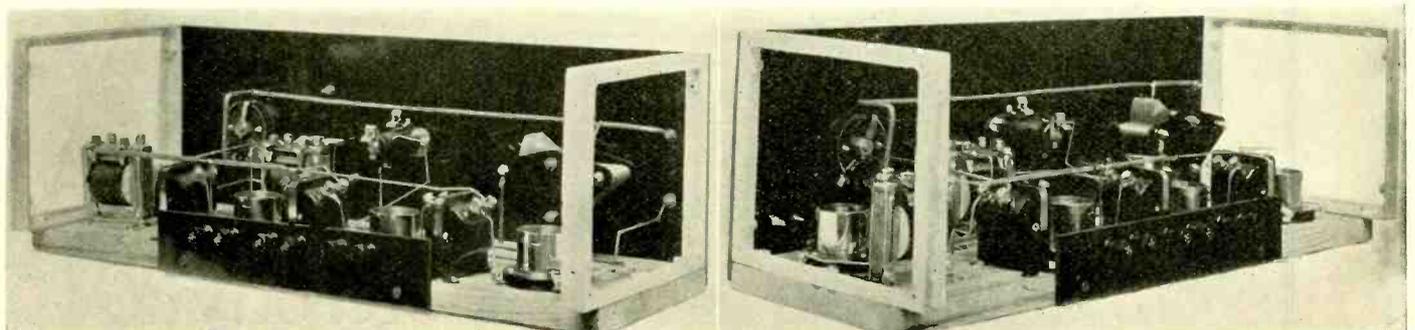
One baseboard 7x21x¾ inches pine or soft wood.

One Grewol fixed crystal detector.

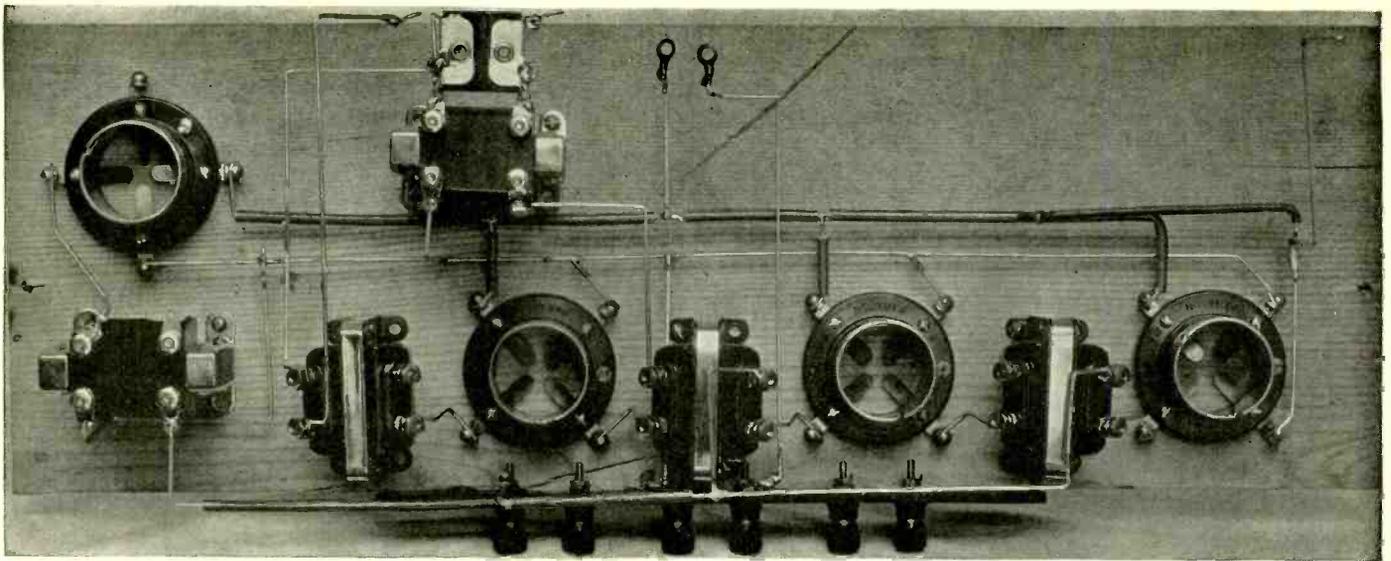
mounted between the third tube socket and the panel. This is the most natural arrangement since the output of this transformer goes back into this third tube for the reflexed stage. The second audio-frequency transformer is mounted flush against the rear of the baseboard at the extreme right, where its output may be conveniently fed into the last tube socket placed between the transformer and the panel.

The first connections to be made after placing all the instruments are the filament leads. These connections are plainly shown in one of the illustrations. Run one of these leads to the rheostat and from there to the binding post on the sub-panel in the rear of the baseboard. Connect the other lead direct to the other A battery binding post. Now before going further connect up your storage battery to these terminals and place all four tubes in their sockets and make sure that they all light properly. If this is done now it will obviate retracing your filament connections in case of an error later on. Now connect up your transformer leads. If the transformers are mounted correctly, that is, primary left, secondary right, the grid and plate leads will probably be less than two inches long which is what we have been striving for.

Be sure not to omit the small fixed condensers shown in the diagram. The



The various connections can be plainly seen in these two views. Note the short leads from transformers to tube sockets



Top view of the baseboard showing in detail the placing of each instrument in relation to the others. This arrangement proved to be the most satisfactory. The .001 mfd. fixed condenser is mounted directly upon the posts of the audio transformer

.005 mfd. fixed condenser is shunted directly across the B battery binding posts on your terminal strip and acts as a by-pass condenser around the B battery. The B battery with its long leads and inherent high resistance must have some sort of by-pass for the radio-frequency currents. The .002 fixed condenser serves the same purpose with respect to the primary of the second audio-frequency transformer. The .001 fixed condenser acts as a by-pass condenser across the primary of the first audio-frequency transformer, performing the same function as a phone condenser in an ordinary hook-up.

The loop is connected to the two binding posts on the left of the panel. Leads from these two posts go then to the variable condenser. Be sure that the potentiometer is connected to the rotor plates of the variable condenser and the grid of the first tube to the stator plates. This will practically eliminate any hand capacity effects, as there is practically no difference between the potential of your hand or body and the filament circuit.

There is a point on the plate current-grid voltage curve of every tube where that tube will amplify to its greatest extent with a minimum of distortion. That is, in order to make our amplifier work most efficiently we must use at least 67 volts on the plate of the tubes and at the same time keep the plate current low by making the

Accessories

- Four UV201-A tubes.
- One 6-volt storage battery.
- One 3-volt C battery.
- Two 45-volt B batteries.
- One loud speaker.
- One loop antenna.

grid negative with respect to the filament. In order to do this easily we have embodied in the set a "C" battery of three volts, thus preventing distortion, lowering our plate current, and lengthening the life of our B battery. The leads from the audio frequency transformer posts marked F or A, are brought to the negative C battery binding post on the terminal strip. A connection is then made from the positive C battery binding post to the negative filament lead.

THE LOOP

Several types of loop antennas were used with this receiver and the one shown proved to be the most satisfactory. It is well to note that a loop receiver with a non-directional loop is well-nigh useless in highly congested districts as the selectivity of the receiver rests entirely with the loop and tuning condenser. With a directional loop you can, by swinging its planes into the direction of the station, eliminate all stations except those in a direct line with this plane. Now

here is an important thing to remember: A loop antenna in order to be directional must have roughly speaking a total length of wire equal to ten times the distance from the top of the loop to ground connection. So if we are to have a directional loop we must arrange to use a total length of wire at least ten times its height from top to bottom. Such a loop can be constructed of two pieces of wood $1\frac{1}{2} \times \frac{3}{4}$ inches joined together at right angles at the center, and braced securely on the ends of each piece are mounted hard rubber strips 5x1 inches slotted every half-inch to take eight turns of wire. In winding the loop you may use ordinary lamp cord or No. 16 D.C.C. copper wire. The former is more flexible and is easier to wind while the latter is more rigid and will stand more rough treatment.

OPERATION

The actual operation of this set is as simple as can be—as we promised you. Turn on the filament rheostat until the tubes burn at their proper brilliancy. Set the potentiometer at about the middle. Then swinging the loop, turn the variable condenser knob until a signal is tuned in. Now gradually increase the potentiometer until maximum volume is secured. If the potentiometer is turned too far the set will oscillate. The most sensitive adjustment is just before the oscillatory or "squealing" point.

Next Month We Will Give You a
Non-Radiating Super-Heterodyne

I Am Broadcasting to Form Character

A Broadcaster With a Purpose:

Peggy Albion

Tune in to WRC about six of an evening and hear one of Aunt Peggy's stories. It will be worth your while

By Geoffrey Ames

"WE must educate through the emotions." The accumulated earnestness of ten years and more of work as a leader in the field of child-education spoke through eye and voice and gesture. Mrs. Marietta Stockard Albion, premier bed-time story-teller, is such not by any trick of suddenly acquired inspiration or cleverness, not because of any urge to fill a newspaper column each day. She tells the finest bed-time stories in the finest manner because this has been her study for years. She is an experienced teacher of child-training and has been in charge of child-work in such institutions as the University of Virginia, The Wilson Normal School and George Washington University.

"Story-telling has been my laboratory for kindergarten training. And my experience has taught me that it is through the story that the young developing mind is to be reached. Lessons will make anyone a dullard. The story arouses a quick interest and the interested mind grasps new ideas without effort.

"I have seized eagerly upon radio-broadcasting as a means of extending my work. It is wonderful—this radio. Have the people in the radio industry any idea, I wonder, what a tremendous agency for good—or otherwise—they control? Think of the influences that can be brought right into the home by this wonderful means!

"I am so glad that my bed-time stories over the radio have become so popular! For my stories are doing more than merely entertain. Do you realize that it is character we are forming by these stories? Yes. By telling stories to children—the right stories—we form and mould their character."

Mrs. Albion has studied the stories of all nations. She has collected the best stories of the world into a splendid anthology which she draws upon for her message delivered each evening to the little folks from WRC. Hers is no experiment, no hit-or-miss performance. She knows that her

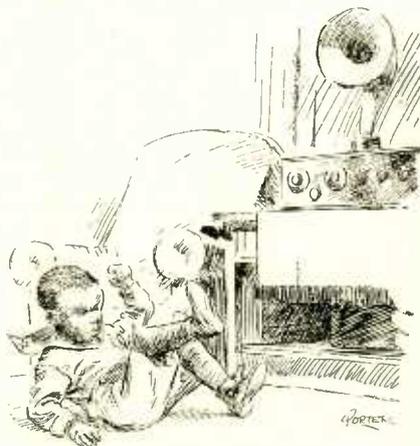
When Aunt Peggy gets home after telling her stories to her radio audience she tells the same beautiful tales to her own young son Master Norwood



stories are good. They are the cream of the world's story-telling through the ages.

"But are you sure that the children—the children themselves—enjoy your stories? Without the visualized personality, the attraction of facial expression and of gesture, can little children be effectively reached by radio? Can their restlessness be controlled by the voice alone?" I have heard these queries and doubts expressed with regard to the value of bed-time stories, and I repeat them.

It was an eager, enthusiastic "Peggy" Albion, as she is known to her radio audience, who replied.



"This little boy-pickanniny throws himself on the floor"

"Yes, yes and yes! You should see some of the letters I receive.

"I have one from a negro doctor. He says that when, at about the bed-time story hour, some other voice than mine comes through the loud speaker,

his little boy-pickanniny throws himself on the floor in a rage, feet in the air, and kicks and howls."

Mrs. Pickett, well-known society editor of the Washington *Evening Star*, tells how her little granddaughter listens eagerly to "Aunt" Peggy's stories and how when she is interrupted and takes the phones from her ears she says "Scuse me, please, Mrs. Albion."

Naturally, since letter writing is the proclivity of the elders, some of the most interesting letters tell of the reception of the bed-time stories by older children and grown-ups.

A retired general in Virginia excuses himself from his company every evening at bed-time story hour by announcing that he has a date with Mrs. Albion.

An elderly couple whose children have all flown from the old nest and upon whom rests the weight of great loneliness, listen in together and are made less lonely by Peggy Albion.

A Christian Science practitioner writes to commend Peggy's stories and states that she uses them in her work because they are full of the message of love and strength and courage.

"On New Year's Day," remarked Mrs. Albion, "I selected that wonderful story by Tolstoi, 'Where Love is there God is also.' Before I was off the air a man phoned in to the station to ask what story it was and where he could find it."

A fan in the back country of Maryland writes to tell how the people of his community are shut off from the

(Continued on page 51)

Peeps Into Broadcast Stations



"Cow-Bells, That's All"

Cow Bells on the Air

THE jingle of the cow bells to millions of fans throughout the North American continent—and beyond, has come to stand for "WBAP," the broadcaster of The Fort Worth, Texas, *Star-Telegram*.

The first old-time square dance ever broadcast was introduced to Radio fans by WBAP, something over a year ago.

One of the features of this station is the droll humor of the Hired Hand, the boiler room functionary of the *Star-Telegram* who manages to leave his fires long enough to get before the microphone twice a week. Otherwise he is president of the Truth Society and has built up a membership of 150,000 throughout the country.



Roberta Beatty, mezzo soprano, broadcast from WEAJ recently

Those eligible for membership must first tell a "truth" of sufficient proportions and swear to prevent abuse and overwork of the "truth." They are then sent a handsome, embossed certificate of membership in good standing.

Portable Broadcast Station

WTAT is at the present time operating as a portable station which is something very unusual in the radio broadcasting line. The equipment is installed upon a Reo speed wagon and is entirely self contained, including operating board, monitoring system, battery charging and the receiving set required in broadcasting stations. This truck is moved to any desired location and the announcer's panel is installed in the building and lead covered cables carried from there to the truck. The antenna is on the roof of a neighboring building or sometimes strung up between two poles.

This station has been operating at various electrical community shows held in the suburban towns adjacent to Boston. When there happens to be no show they operate from the Edison Service Building.

Community Station of Twin City

UP in "The Land of Ten Thousand Lakes," WLAG popularly known as the Twin City Radio Central, broadcasts alternately from Minneapolis and St. Paul. It was recently adopted by merchants' associations and business concerns of Minneapolis and St. Paul who created a "community fund" to help cover program expenses and help aid this "biggest of civic assets."

WLAG operates on a subscription basis with a view to overcoming the economic problem of broadcasting.

Eleanor Poehler, who, so far as is known, is the only woman in complete charge of a radio broadcasting station in the country, is the manager of WLAG. She hires, fires and inspires the entire staff. She organized and developed her entire staff of musicians, including her orchestra which is now on tour in the South. Charles Corday, leader of the "Slowpokes" orchestra, is a song writer, who, whenever the studio feels the need of new material, lays aside his baton and composes something.

The Minneapolis studio and



Eleanor Poehler, managing director of WLAG, one of the few women in complete charge of a broadcasting station

WLAG'S antenna are at the Oak Grove hotel overlooking the business section of the city. The St. Paul studio, just completed, is on the top floor of the St. Paul Athletic Club building. Programs from the latter are broadcast by remote control through the Minneapolis plant. This gives the Twin City Radio Central extraordinary possibilities for rebroadcasting important programs and talks from other stations, besides a flexible studio equipment for handling large organizations.

New Broadcasting Studio for Station "WBZ" in Boston

WBZ, located on the roof of the Hotel Brunswick, Boston, broadcasts regularly from the station, one hundred miles distant. Although broadcasts have been made by other stations at various times at distant points from the station, this is the first time in broadcasting annals that a studio is permanently located at such a distance from the station for every night, all-the-year-round broadcasts.

This broadcasting system has been jointly worked out by the *Boston Herald-Traveler*, the Westinghouse Electric & Mfg. Co., and the Brunswick Hotel. On the top of the Brunswick Hotel has been built a studio that



The "Call of the North" orchestra of the St. Paul Athletic Club which made its first bid for fame from WLAG

measures up to anything that has been done in the past for convenience and beauty. In the building that has been constructed on the roof of the hotel is the studio, thirty by forty feet in size and the ample reception room with a rest room for the ladies.

Since the radio microphone is the most sensitive thing possible for picking up sound and extraneous noises not audible to the ear might injure the quality of the broadcasting, the building was built of heavy gypsum block supported on steel girders and the inside was lined with a sound-deadening lath designed to prevent the outside sound from getting into the studio. After this was done successfully, the studio walls and ceilings were covered with a flannel draping trimmed with old rose silk.

The ceiling draping is done in Egyptian fashion with the drapes from the longer sides coming together in the center to form a shape similar to a tent. The part usually designated as the ridge pole is covered with the old rose silk. At each corner similar strips of silk hang from the ceiling for a distance of about two feet.

The studio is furnished with a Steinway Concert Grand Piano, a davenport and chairs of appropriate coloring. Exquisite piano lamps complete an artistic setting.

In the corner of the room opposite from the piano, is the operating desk upon which are mounted the control switches for the microphones in the studio and in the theatres and concert halls. There is a roll-top desk completely covered to prevent reflection of sound from the hard

wood which might create distortion.

In order to make the project successful it was necessary to have constructed an entirely new line from Boston to Springfield. This line is slightly over one hundred miles in length and connects the studio at Brunswick with the Radio Station at East Springfield.

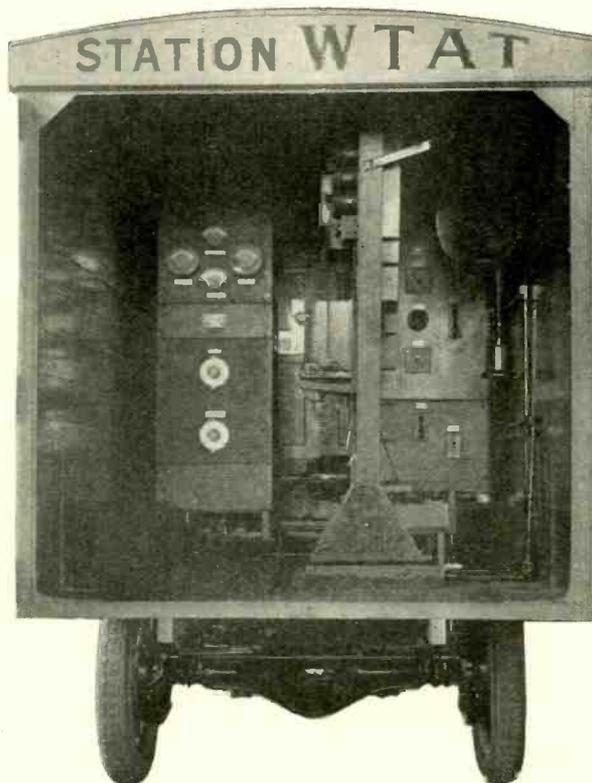
Sears-Roebuck Again

A NEW type of forensics for radio is to be developed by Sears-Roebuck Agricultural Foundation for the new broadcasting station which is being erected by the Foundation to

broadcast exclusive agricultural programs.

Samuel R. Guard, Director of the Foundation said that this new type of forensics for radio, which is different from any now in use, will adapt the speeches to the medium. It will be developed specially for radio, because one cannot talk into a microphone as one would talk from a stump or a stage.

The programs broadcast by this station will be balanced agricultural programs, which will challenge the farmer's attention and hold it. Facts of real value to the farmer will be broadcast. Theatrical stars will bring the stage to the farmer's parlor, and there will be bedtime stories for the country kiddies. An interpretation of market trends and a current events feature, explaining what is going on in agriculture all over the world, will be given according to Mr. Guard. This new station, which will be the only one in the United States broadcasting exclusive agricultural programs, was completed recently.



A broadcast station that is really "up and going"

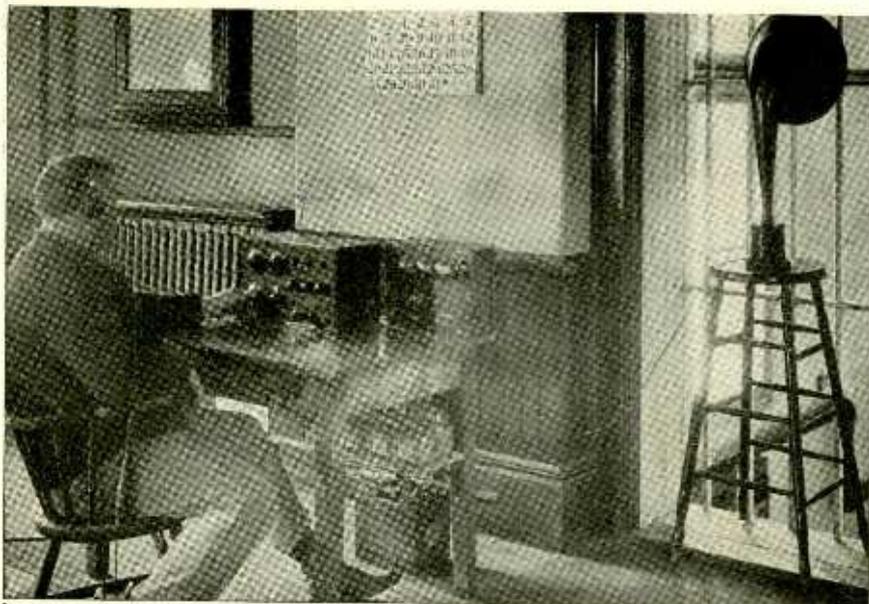
Health Talks Now Broadcast by CKY

The Manitoba Telephone System's station at Winnipeg has inaugurated a new series of short talks to be delivered at the studio on Tuesday evenings by a number of doctors representing the Manitoba Dental Association. The talks will consist of a scientific presentation of the subject of dentistry with details of mouth anatomy, ills and remedies and general care of the teeth.

The World Within a Prison Cell

Prison Walls Are No Barrier to Radio

As told by No. 186, a "Lifer," at New Hampshire State Prison



New Hampshire State Prison. The loud speaker is placed at the head of the hallway leading down between the tiers of cells. The prison set is operated for all prisoners between seven and nine o'clock

"RADIO" A VOICE FROM BEHIND THE BARS

DID you ever "do time"? No? In most all prisons the Silence Rule is in force. (Thank Heaven it is slowly being abolished here!) If you have maintained "silence" for over six years and then are given the opportunity to express a few of your ideas on paper you will appreciate how I feel about being able to tell here to the readers of *The Wireless Age* how Radio has brought the world to those of us whom the world has shut away.

Please, reader, bear in mind that a prisoner is not a special sort of a human being. We are no different from the majority of people. We are, most of us, just like you! But Radio means much more to us than it can ever mean to you. So I hope you will read about my efforts to enjoy Radio.

Yours truly,

Number 186.

DO you want to know just how I came to have the rather remarkable outfit I own? It's a bit extravagant for a person "doing time" and solely dependent on what little money he earns in the prison shop and by his work during his spare time in his cell.

Last August I bought the Westinghouse RC unit from one of the department stores of Boston. It was bought

on the installment plan. After I purchased it I wrote to the manager, or buyer, of the book department of this same store and succeeded in selling him quite a good order of Christmas cards that had been hand-colored by me personally. I have been doing work of this kind for several years. This order helped me out considerably in meeting the monthly payments. The remainder of the cost was met ahead of time through the sale of similar cards to other people.

Last November I wrote to a corporation in New York and asked if I could obtain a discount on the antenna coupler, Radiola RT. Much to my surprise, and also delight, I received as a gift this coupler, and from another concern I received the radio frequency amplifier, Radiola AR. I had been thinking that sometime in the far distant future I might be able to save up the \$80 necessary to purchase this unit. I also received four UV-201A tubes, three "B" batteries, and a "C" battery. That made it necessary for me to have a storage battery, as I had been running WD-12 tubes with dry cells. I began to count my money and soon after Christmas decided I had enough from the sale of cards to pay for a storage battery. I sent for our local radio dealer, who has been extremely kind to all of "us radio fans." He came on a Saturday afternoon, but just before he arrived I received another letter advising me that a storage battery was on its way. What luck!

My own money went for two more tubes, a loading coil and voltmeter.

At Christmas time I received from a "radio friend" in Connecticut (a real friend, for he keeps me constantly supplied with all the latest radio magazines) a gift of five dollars. From another friend I received another five dollars! From an unknown friend a gift of one dollar. I also was given a "Short-Cut Radio Antenna" which I have not yet had time to try out. It has been used on the main prison set and works very well. It was really the most enjoyable Christmas that I have had for many years. Usually the Christmas season is very hard to bear. It reminds one so much of the things he is forced to miss!

For an antenna I use a piece of copper screen, thirty inches wide and six feet long. For a ground, my bed! I have received from over fifty different broadcasting stations. This number includes such stations as PWX and WOC; also WOS, WLAG, WPAH and many of the nearer stations.

I have heard Lloyd George, Woodrow Wilson and Calvin Coolidge; also Nina Wilcox Putnam and William J. Burns. I "went to" all of the Harvard football games last Fall. Some afternoons I "attended" as many as three different games in places as far apart as the Harvard Stadium and the field of the University of Pennsylvania. I enjoyed the World Series at the Yankee Stadium and at the Polo

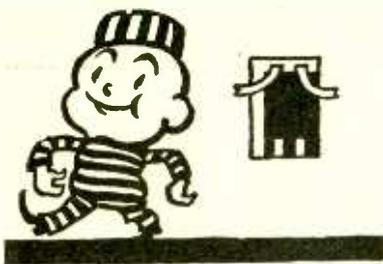
THE COUNT OF MONTE CRISTO

EDMOND DANTES, a French sailor, was cast into prison where he was destined to rot in a cold, damp and oppressively dark dungeon. His romantic contact with the Abbé, a fellow prisoner, gave to Dantes a knowledge of the world replete in its wealth of learning and vision. When he finally managed his escape, Alexandre Dumas was pleased to send him back to France as the M. Le Comte de Monte Cristo. We have all come to know the exploits of the Count of Monte Cristo, which were possible because the sailor, Edmond Dantes, had been able to absorb the vast scope of the Abbé's learning.

The letter to *The Wireless Age* from prisoner number 186 would indicate an analogy between radio and the remarkable Abbé; radio can bring the world's knowledge to the prisoner of today just as the Abbé imparted it generations ago to the poor sailor boy in the dungeon of Château d'If.

Grounds. I didn't pay any outrageous sum for a ticket either! Just turned a dial and there I was! In fact I have been having a real good time and look forward to many more good times. I had almost forgotten such things existed.

But after all, the greatest thing radio has done for me has been the restoration, in part at least, of my former belief in the "goodness" of the human race! The many kindnesses that I have received have shown me that there are still certain men who really do believe in doing a "good deed" to one less fortunately situated than themselves. My faith in my fellow men has been restored and perhaps that is the greatest thing that could have been done for me.



The set maintained by the prison runs only from 7:30 to 9:00 in the evening unless there is some special program, like the Dempsey-Firpo bout. In a case of that kind the main set runs later and the lights in each cell are not turned off until the program is finished. Usually they are turned off at 9:00 P. M. The men that have sets of their own are permitted to run as late as they wish provided they do not disturb their neighbors and are able to do their share of the work the next day in the shops.

Personally I have been very much interested in radio for some time. I never had the necessary money to purchase a good set until the Westinghouse RC unit was placed on the market last Summer at \$59.00. I jumped at the chance to own one of these sets and you may be assured that I have never regretted my purchase.

* * *

My set is not complete and never will be. There are several things that I am going to add to it when I have saved the necessary money. I have already ordered a crystal detector that I wish to experiment a bit with, also the loading coil that attaches to the back of the RC unit. This coil will permit me to receive the code that comes in on the longer wavelengths. Then I wish to try a "B" storage battery. And I am quite interested in the Finch relay! I shall evidently have to wait quite a while before I can

afford all of these articles, but it's nice to have something to look forward to!

I shall never be satisfied no matter how good results I get!

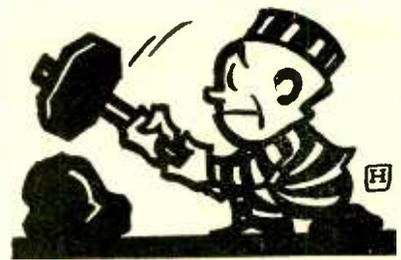
I want to get "California" and I shall get it when I get completely "hooked-up!" After "California" I shall try for England! Then for Hawaii! And then—well, I may try to find out just what these mysterious waves are that seem to be coming from Mars! Perhaps some of Edgar Rice Burroughs' weird creations are trying to communicate with us by radio!

The programs as they are at present are very good indeed. I have enjoyed nearly everything that I have heard, including "Bed Time Stories!" I listened in on Santa Claus, who was at WGY one night, and I could very easily imagine the delight with which the youngsters heard him call them by their own names and promise to bring them the presents they had asked him for! I almost wrote to him myself!

I am rather inclined to believe that it might be an advantage if certain stations were limited to a certain kind of program. For instance, WGY some night might send out a lecture while KDKA was sending out orchestra selections and some other station was broadcasting a play or musical comedy. It would be an advantage to have the stations limited in number also. Personally I would like to hear more lectures and speeches by prominent men and women.

* * *

In my humble opinion, offered for what little it may be worth, radio can be of the greatest possible help to those raised in environments such as to make them enemies of society, as



well as to those who are already so-called "enemies of society."

Since I came to prison I have read every book on criminology that I could get my hands on. I have talked with nearly all of the men that have passed through here in the six years that I have been an inmate. I have come to the conclusion that nearly all crime can be traced to the conditions in the homes when these fellows were children. Many of them have been in so-called Reform Schools. The prison "term" for a Reform School is "Prison Kindergarten!" Many of the fellows ran away from home and no boy runs away from a home where he is understood. If we really wish to diminish crime we must tackle the problem at its very roots, and that means the home. Make every dwelling place a real home and crime will be cut 90 per cent.!

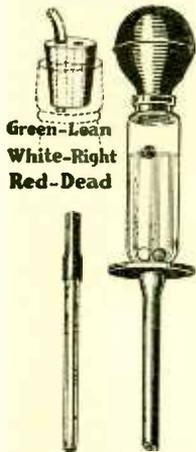
Who can at present imagine a more successful way of making a better home than by installing a radio set for the youngsters as well as for the "grown-ups"? It seems to me that as things are nowadays nearly all young people get away from their home just as much as possible. But a radio in

(Continued on page 51)



THE CELL OF PRISONER 186

A copper screen is stretched above the bed for an aerial. Back of the set is a map of the United States, with stations received, marked. On the left is part of his library collection



STORAGE batteries and rechargers with their connections need not be unsightly as is seen from this photograph of a bookcase in which the receiver reposes on the upper shelf and the battery equipment is stowed away in the bottom compartment.

To left is shown one type of hydrometer, the Chaslyn Ball Battery Tester, for which the legend runs:

Float all three—charge fully.

Sinks the white—charge still right.

Sinks the green—charge is lean.

Sinks the red—charge is dead.



How To Install and Maintain the Storage Battery for the Radio Receiver

Your Radio Storage Battery

By Donald Gordon Ward

Associate Member, Institute of Radio Engineers

AS the storage battery plays such an important part at the present time in connection with the operation of the average radio receiver it seems fitting that more attention should be paid to the rules which, if observed, will insure the efficiency that should be expected.

The storage battery is a chemical generator of electricity. During the so-called "charging process" a current of electricity passes into the storage battery. Then during the "discharging process" a current of electricity is drawn from the battery.

However, in between the charging and discharging processes there is no electricity in the battery. This last statement would seem absurd on the face of it. But electricity cannot be stored up, that is, in the form of electricity. The storage battery stores up electricity in the form of electrochemical energy. When the current of electricity flows into the battery a certain chemical action takes place which "charges" the battery.

For any chemical action there is an equal and opposite chemical reaction. The current of electricity passing into the battery causes the chemical action to take place. Then after the battery has been disconnected from its charging source and has been connected to some device, such as a radio receiver, which utilizes electricity, the reverse of the first chemical action takes place and the battery generates another or second current of electricity, which

YOUR Storage Battery is an important part of your radio set. If you handle it properly and intelligently it will be efficient. If you do not know how it should be cared for it will fail you and involve also needless expense. Mr. Ward tells you what you should know about storage batteries. Moreover, he shows how the storage battery may be properly cased along with the receiver in a handsome piece of furniture.

flows from the battery. But this current is not the same current that passes into the battery during the charging process.

KEEP YOUR BATTERY CHARGED

A storage battery should be maintained in a fully charged condition whenever it is standing idle. This means that it should be placed in charge almost immediately after being used. For the man who carries his battery to the nearest charging station this becomes rather a nuisance and about the only remedy is to have a battery charger in the house, so arranged and connected that it will only be necessary to throw a switch in order to place the battery on charge and then reverse the switch in order to use the battery with the radio receiver.

The photograph figure 1, shows the

appearance of such a set-up in combination with the receiver. The top section of the bookcase holds the receiver, the middle section is filled with books and the lowest section contains the storage battery, of 80 ampere-hour capacity, the rectifier, and "B" batteries. When the doors of the bookcase are closed there is no visible indication of the presence of a radio receiver as the loud speaker is in a cabinet type phonograph and all visible connections are made with white silk lamp cord which blends in with the finish of the room and therefore is practically invisible.

A tube rectifier is to be preferred to any other type. A chemical rectifier is of course absolutely out of the question in a living room, as the chemicals would very quickly destroy the finish of any piece of furniture. These chemicals would be "given off" while the battery is charging owing to the fact that the rectifier gasses at this time, and the gas carries a small amount of liquid with it. A vibrating rectifier was not chosen for the reason that the writer of this article has had several lamentable experiences in the past with rectifiers of this type sticking at the contacts and thus sending an alternating current through the battery, which action to say the least is undesirable as it is liable to damage the battery. The vacuum tube, on the other hand, opens and closes the circuit by an action corresponding to that which takes place inside of the tube used in the receiving set and it is

therefore not subject to the possibility of sticking contacts and damaged batteries. When this rectifier is placed in the bookcase and the door closed there only comes from it a gentle hum, indicating that the battery is being charged.

The diagram, figure 2, gives the scheme of connections. The double pole, double throw, charging switch has its center points connected to the battery. One end of the switch is connected to the charger and the other end to the receiving set. Great care must be taken when making these connections, to have the connections properly polarized as indicated in the diagram. With the wrong connections the battery might be discharged instead of charged or else the wrong polarity would be applied to the receiver, thereby decreasing its efficiency. The two leads from the charger are colored, one red and the other black. The red lead is the positive and the black the negative. The battery will either be marked in a similar manner or else the symbols for positive and negative will be marked on the battery.

There is provided inside of the bookcase, a porcelain socket containing a double socket or two-plug adapter. The plug on the rectifier is connected into one of these positions and into the other there is screwed a small green light. From this porcelain socket runs a double silk covered wire to the nearest baseboard plug. In order to place the battery on charge the switch is thrown to the charging position and the plug is placed in the baseboard socket. The small green light is then lighted and the rectifier commences charging the battery immediately. The green light indicates that the battery is on charge and prevents us from going away and forgetting it.

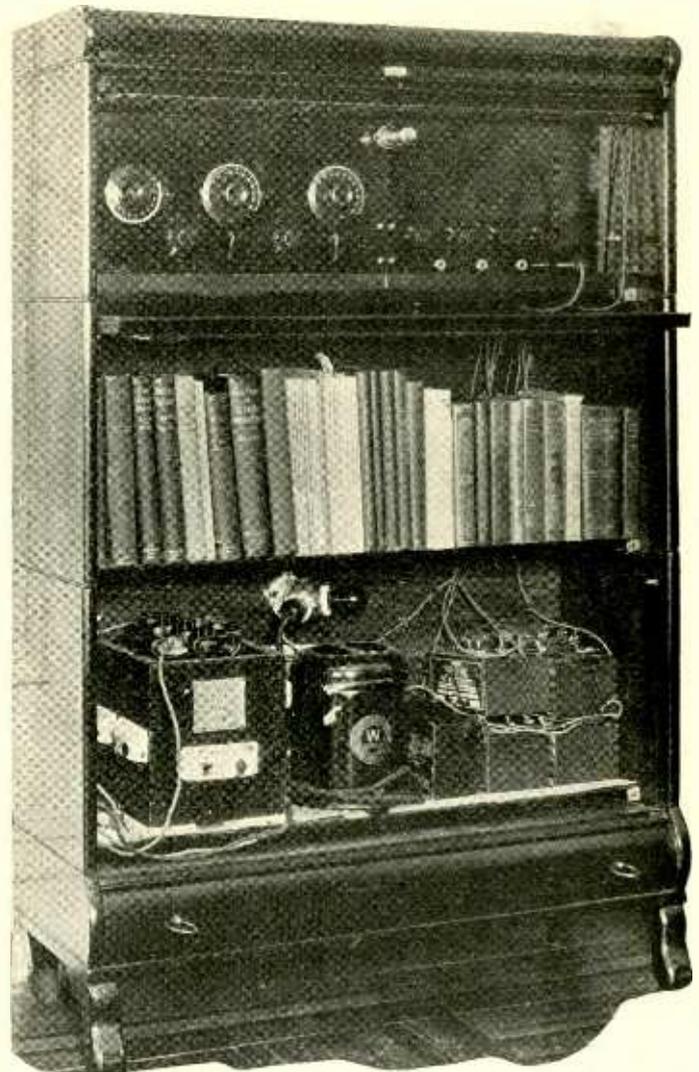
One reason for maintaining the battery fully charged is because the battery will last much longer under those

conditions and another is because of the fact that a battery which is discharged consumes a greater amount of power to bring it up from a state of very low charge to full charge than it would to maintain it at full charge by charging slowly and often.

THE HYDROMETER

The instrument best suited for determining the state of charge of the storage battery is the hydrometer. This is the only really reliable instrument for use by those who have not had a great deal of experience with storage batteries, though there are other devices which may be used after one has gained experience. The instructions for the use of the hydrometer will be found contained with that instrument and it is then only necessary to charge the battery until the reading on the hydrometer corresponds with the reading specified by the manufacturer.

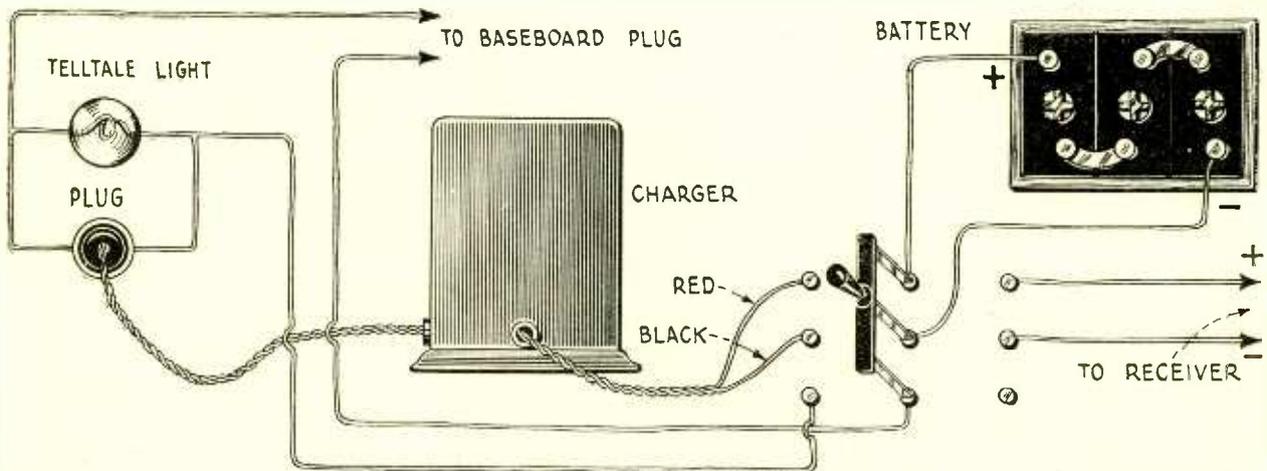
When the hydrometer is of the commonly used syringe type the lower end is inserted into the solution, the bulb is squeezed and then again released, allowing the liquid from the battery to flow upward into the bulb carrying



The electric light in the bottom compartment warns that the battery is recharging. This compartment is kept covered by the sliding curtained glass door

the hydrometer float. The beginner very seldom takes care that his hydrometer is in an exactly vertical position and as a result the float sticks to the side of the containing tube and therefore does not rise as high as it should, thus indicating partial charge when the battery may be fully charged.

(Continued on page 78)



No bother about recharging! If the battery and charger are connected to switch as shown in this diagram the battery is set for recharging by a simple throw of the switch



RADIO NEWS FROM ALL OVER THE WORLD

Marconi Improves Directional Control of Radio Waves

GUGLIELMO MARCONI in a recent statement declares he has accomplished directional or "beam" radio transmission. He says:

"I have been experimenting for the past two years in new methods of transmission by which energy, instead of being scattered all around, is concentrated in one direction.

"By my device waves would go in a straight line from one station to another. One advantage is that a smaller amount of power is necessary and the stations would be less expensive to construct and to operate.

"I have made successful experiments in sending messages from Cape Verde to Cornwall on a beam, a distance of 2,200 miles, and I am about to experiment with messages from here to South America, 5,000 miles.

"The new methods would enable stations to be directed and worked much more efficiently and economically than now. It allows greater speed in transmission and the secrecy of the wireless would be greatly increased, with the risk of interception small.

"You could have a station in the United States broadcasting to England and only to England with much more efficiency and clearness than at present. In time we might send messages to Canada and elsewhere in the empire without any danger of their being received by other nations."

Broadcasting in China

RADIO development is taking place at a rapid pace in Hongkong. There are two transmitting stations and 500 receiving sets in use in that city and it is estimated that this number will be increased fully 100 per cent. within the next twelve months. Radio telephony makes a strong appeal to the Chinese, who have a love of anything mysterious, and there is little doubt that South China, for which Hongkong is the distributing center, is a good potential market for radio equipment.

No definite action has yet been taken by the colonial authorities in regard to the use of radio sets in the colony.

Broadcasting and receiving sets are operated subject to the approval of the Executive Committee of the Hongkong Radio Society. Private individuals are permitted to set up wireless receiving sets, on the condition that due precautions are taken to prevent reradiation by receiving apparatus.



RADIO IN POLITICS
Senator Hiram W. Johnson tuning in at Presidential Campaign Headquarters. The possibilities of radio in politics offer a wide scope for speculation

Correcting a Statement on Major Armstrong

IN the pictorial section of our March issue there appeared a statement to the effect that Major Edwin H. Armstrong was "one of the foremost radio engineers of the Radio Corporation of America." This statement was incorrect. The RCA is licensed to use Major Armstrong's inventions, but he has never been in the employ of the Corporation. During the past ten years, Major Armstrong has been connected with the Marcellus Hartley Research Laboratory of Columbia University, where he is still conducting his experimental work.

Canada's Largest Broadcast Station

THE largest and most powerful radio station in Canada, located in Ottawa and operated by the Canadian National Railways as the first of a chain which it is hoped will be extended across Canada, went on the air February 27, with a program of musical selections and a talk by Sir Henry W. Thornton, chairman and president of the board of directors. The new station expects to have a range beyond that of any station in Canada.

The new station will sign CKCH and will broadcast on a wave of 435 meters.

Broadcasting will take place Wednesday and Saturday evenings with occasional church services on Sundays.

New York Schools Use Radio

WHEN the Board of Education, in co-operation with the Radio Corporation of America, broadcasts its daily school program more than eighty schools in the city can listen in through receiving sets erected in the auditorium or the principal's office.

With official school programs being broadcast almost every day it is expected that it will not be long before every school in the city will have a radio receiving set.

McAdoo Plans Campaign by Radio

WILLIAM G. McADOO'S plans to capture the Democratic Presidential nomination includes the expenditure of \$30,000 in the construction of a broadcasting plant at his home in Los Angeles.

Mr. McAdoo announced that he would make use of the radiophone broadcasting station instead of undertaking extensive speaking tours, if a permit of the Department of Commerce was granted. He added that he would speak at varying hours of the day and night and that the apparatus would be powerful enough to reach all parts of the country.

Radio Beacon Aids Aircraft

RECENTLY an airplane flew to Dayton from a point a hundred miles away, the pilot depending for guidance entirely upon the signals received from a new type of radio beacon. In his receiver he heard the letters A and T transmitted in telegraph code and repeated over and over. As long as he flew along the correct course both letters were equally loud, but the moment he got off the course to one side or the other one letter became noticeably louder than the other and showed him which way to turn to get back. An ordinary airplane receiving set was used.

This radio beacon station consists of two coil antennas placed so as to cross each other at an angle of 135 degrees. Each consists of a single turn of wire 100 feet long and 50 feet high. The transmitting set is automatically connected first to one and then to the other, one letter of the signal being sent over each. The signal from an antenna of this type varies from a maximum in the plane of the coil to almost zero at right angles. A receiving set located along the line bisecting the angle between the coils will therefore receive signals of equal intensity from both, and the ship or airplane carrying the receiving set can thus be guided along this line in either direction, and without regard to conditions of visibility.

Radio in Greece

SOME months ago the Revolutionary Government forbade by legal decree the operating of private wireless apparatus in Greece. This measure was taken largely to prevent the Greek public from being reached with propa-



Steering the steamship "Alberta" by radio directions without the aid of the usual navigating instruments

ganda unfavorable to the Revolution, it is reported.

According to unofficial advices, the Ministers of Finance and Marine of the present Government have prepared a law to be submitted to the National Assembly for ratification, by which the operation of private radio sets belonging to Greek individuals will be permitted under certain restrictions and subject to the payment of a license tax.

Radio on Illinois Farms

REPLIES from 73 Illinois county farm bureaus in a radio survey just completed by the Illinois Agricultural Association revealed that there are 20,845 radio receiving sets on farms in these counties. The survey would indicate that between seven and ten

per cent. of the rural population of the state have installed receiving sets.

Only about 25 per cent. of the farmers owning radio sets make their own, the rest being manufactured sets, the survey shows.

One point that was stressed was the necessity of having farm programs early in the evening, since the ten o'clock programs are rather late for farmers. "Make it snappy," was also the advice given regarding farm programs. Plenty of jazz music, and talks that are short and to the point. It is as easy to tune out a tiresome speech as it is to tune it in, they said.

Radio Wave Phenomena

THE long accepted explanation of the blueness of the sky as being due to the well understood action of the sun's rays upon particles in the atmosphere is challenged, according to the *Daily Mail's* Copenhagen correspondent, by Prof. Vigard of Christiania University.

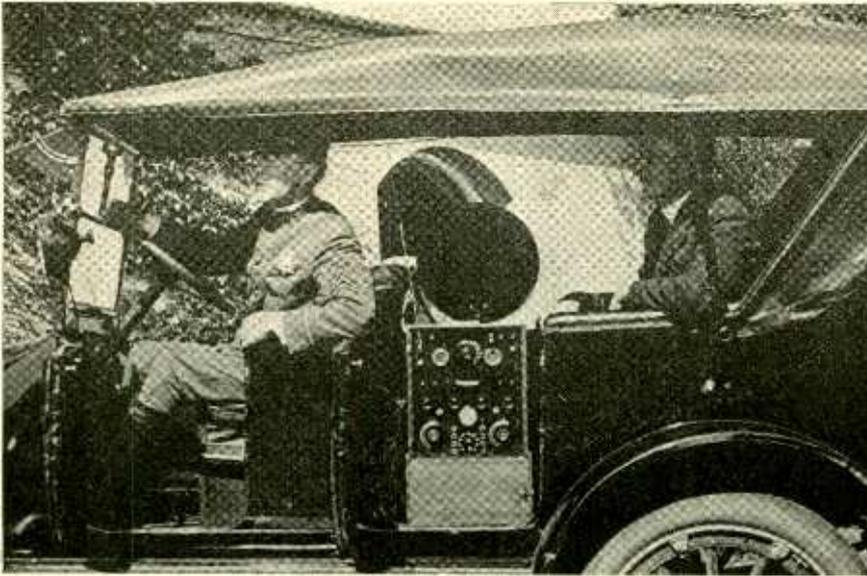
Prof. Vigard claims a discovery suggesting that the atmosphere of the earth outside the air stratum is shut up as if in a balloon whose wall consists of a solid mass of crystalline particles of nitrogen. It is this, he says, which gives the sky its blue color and it also accounts for several other phenomena, including the fact that radio waves follow the contour of the earth instead of flying from it at a tangent and losing themselves in the ether.

A scientific commentator says the discovery may prove of immense value, helping toward an understanding of radio phenomena. Incidentally, he adds, it would if proven true show that radio communication with other planets was impossible.



NEW WIRELESS STATION

New radio station at Monte Grande, Buenos Aires, Argentine Republic. In the foreground are seen the tops of the great high frequency alternators that stand higher than a man's head. They generate a 6,000-cycle current of 1,000 amperes with a voltage of 750, and are capable of producing frequencies varying between 11,000 and 44,000 cycles. The control platform shows in the middle background. The reel-like objects in the background at either side of the room are the oscillation transformers and beneath them are groups of condensers



In Berkeley, Cal., the police, by means of radio sets installed in the department automobiles, have a rapid means of communication for emergencies

Danish Ferryboats Transmit Radiograms

DANISH ferryboats plying between ports of the Baltic carry radio now and have agreed to transmit radiograms for the patrons of the line. German ferryboats on the Gedser-Warnermude run have not as yet started transmitting.

This application of radio on inland water routes is surprising in Denmark, since a recent census lists only 3200 receiving fans, out of a population of about 3,225,000. Among the classes chiefly interested are recorded 602 students and pupils, 334 electricians, 341 craftsmen, 320 retired persons and 52 farmers.

Radio in the Polar Regions

AN interesting illustration of the value of wireless as a means of enabling a ship, in whatever part of the world she may be, to communicate with land, is provided by the fact that two Norwegian vessels, one in the Arctic and the other in the Antarctic, have been in telegraphic touch with their own country.

The Norwegian flag is now represented further north and further south than that of any other country, by the *Maud*, and the *Sir James Clark Ross*. The *Maud*, Captain Amundsen's vessel, which is attempting to drift across the North Polar basin, is now lying off the New Siberian Islands. She is equipped with a Marconi 1½ kw. tube transmitter, and is in communication with the Spitzbergen Radio Station, more than a thousand nautical miles away.

The *Sir James Clark Ross* is on a whaling expedition in the Ross Sea. Her wireless apparatus includes a Marconi 3 kw. tube transmitter, which enables her to communicate with the Awarua Radio Station, New Zealand,

some seventeen hundred nautical miles to the northward. At 3 p. m. on January 22nd, when the *Sir James Clark Ross* was in latitude 78 degrees 30 minutes south, the Norsk Marconikompani handed in a regular message at the telegraph office at Christiania to be forwarded to the vessel. The message was sent via England, Australia, and Awarua Radio. The reply, which was sent by the same route, was received in Christiania at 5 a. m. on January 24th.

Radio Boom in England

MORE than 12,260 miles of aerial wire have been erected in Great Britain in the past twelve months, so much has the radio craze seized the public. It is estimated by officials of the British Broadcasting Company that 2,000,000 persons are entertained daily at a cost of a farthing each.

Radio Shows

THE Pacific Coast radio show will be held in San Francisco's Exposition Auditorium from August 16 to 21, the Radio Trades Association announces. Extensive plans to make the exhibition the biggest ever held in the West are now being formulated.

The show will be advertised with a fund of \$10,000 which is now being raised for that purpose. A. S. Lindstrom heads the committee directing the radio exposition.

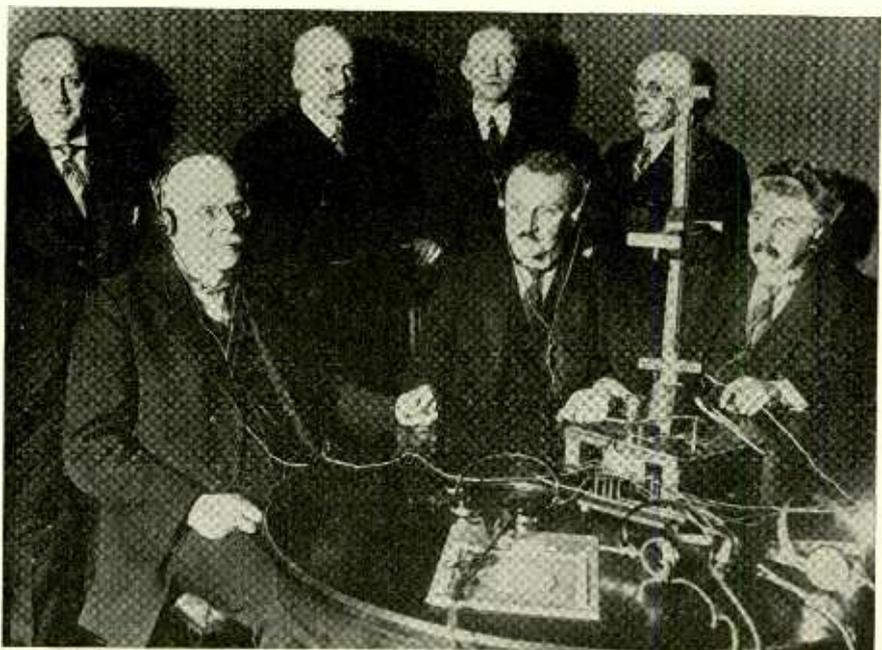
The American Radio Exposition Company announces the dates of the third annual radio show at the Grand Central Palace, New York City, as October 2-8, 1924. The ground and mezzanine floors will be used for exhibition purposes. The show will be profit-sharing in character as between the exhibitors and the management.

Radio will be featured at the electrical exhibition to be held at Melbourne, Australia, in September, 1924.

Railroads to Install Radio Train Control

AUTOMATIC train control by radio will be installed on at least one division of forty-nine first class roads of the country by 1925, it was announced at the opening session of the fourteenth annual convention of the Association of Railway Electrical Engineers.

Radio holds possibilities of inter-communication between moving trains and fixed points for personal wire or phone service and holds more promise of real value in the future than broadcast reception.



Germany appreciates the value of radio. Dr. Marx, the Premier, at the left, with Ministers Schole (center) and Fischer (right) are here shown listening in

Spanish Bull-Fights for Radio Fans

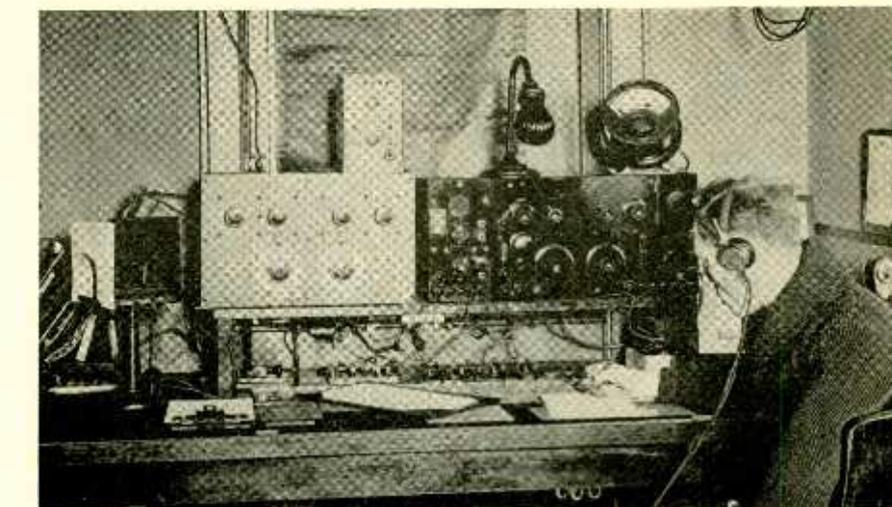
KING Alfonso has granted a British concession for broadcasting throughout Spain, and a central station and apparatus factory is shortly to be erected in Madrid.

D. H. Brayne, wireless expert at the Hotel Cecil, who has been offered an official position there, said that interest in wireless has reached such a pitch in Spain that within a few months transmitting stations will be erected throughout the country to enable even the humblest peasant to listen-in.

"This opens up an entirely new field to the listener-in," he said. "Spanish dance music will be heard in London and it is conceivable that some of the clamor and enthusiasm of the bull-ring will be heard by those who care to listen for it this summer."

Radio Men Lost in Vera Cruz Storm

ADVICES to the State Department from American Consul Wood at Vera Cruz revealed that Captain Herbert G. Sparrow and three radio men had lost their lives when the cruiser *Tacoma* broke up on the rocks in a heavy storm. The Consul had previously reported that the captain and two radio men had been killed. The dead are:



MEDICAL ASSISTANCE FOR SAILORS AT SEA
Station WNY where medical advice is radioed daily to ships at sea calling for such assistance on behalf of crews or passengers. The requests are relayed to a marine hospital where diagnosis is made and treatment prescribed which is then sent by radio from the shore station. This valuable service inaugurated by the Seamen's Church Institute is carried on by the Radio Corporation of America and the U. S. Public Health Service

Captain Herbert G. Sparrow, U. S. N.; and radio operators Edward T. Herrick, Homer H. Lussier and Solomon Sivin.

British Broadcasters Try to Reach America

IN the evening of March 13th the combined stations of the British

Broadcasting Company tried to reach America with a program sent out simultaneously from their eight high-powered stations. The results were unsatisfactory, although a few persons on our Atlantic seaboard with specially powerful receiving sets were able to get portions of this concert.

Broadcasting Makes a Giant Stretch

(Continued from page 29)

which is picked up at Hastings and in Manchester, England. Not only does the receiving station rebroadcast at the usual broadcasting frequency for direct reception within its range, but it can also retransmit at a second high frequency to a third more distant station when such a step may be desirable.

Much experiment was involved in the determination of the precise carrier wave frequency that would give the maximum constant strength of signal, particularly during usual broadcasting hours. This was shown to be about 3333 kilocycles. Subsequently 3200 kc. was determined upon. The receiving equipment had to be designed to meet high requirements as to sensitivity, ease of frequency control, avoidance of effect from powerful local transmitter and avoidance of body capacity effects. A circuit depending upon the standard regenerative principle was used. The circuit of the receiver used at Hastings is shown in the figure herewith. This tuner requires an inverted L antenna for sensitivity and a small loop against interference from the local station. L_1 , C_1 and R_1 comprise the balancing loop. The phase and the amplitude of the inductive component are adjusted by rotating the loop antenna.

All parts enclosed by the dotted line are built into one unit having filter systems in the ungrounded leads to mini-

mize the capacity effect of the operator's body. L_2 , L_3 , C_3 and C_4 comprise this filter. A wave trap L_4 and C_5 is also provided in series with the antenna to exclude as much of the undesired frequency as possible. A single step "back to back" amplifier further amplifies the signals and feeds the telephone line leading to the transmitter.

The speech received from the relay receiver, or over telephone lines from the studio in the business section of Hastings, is amplified by one five-watt, double or push-pull amplifier and one 50-watt double amplifier.

A rectifier supplying direct current at 10,000 volts, a filter composed of four 4-mfd. condenser units and one inductance unit with a value of 20 henries, a modulator panel and an oscillator panel complete the transmitter unit.

The vast possibilities of this method of extending the scope of broadcasting are evident when it is stated that a thousand high-frequency bands are available, a number much in excess of the broadcasting bands. This ground has barely been broken, it would seem, but already we have in this striking international test a vision of the magnificent structure of world-wide broadcasting that is destined soon to bless our civilization.

Prize Contest Just Send us a Photo

Illustrating the Beauty
of Radio in the Home

THE first four pages of this number present the 1924 offering of radio sets. That offering should suggest many attractive home settings that our readers can provide.

Send a snap-shot or photograph of YOUR radio set, or your FRIEND'S radio set, or BOTH, to THE WIRELESS AGE. Send as many as you wish. Tell your friends about this contest so that they, too, may enter. But do not fail to have the radio pictured as a part of the home furnishings.

For the best photograph THE WIRELESS AGE Receiver (described in this issue) will be awarded as the first prize.

Second prize, \$10.

Third prize, \$5.

And for the next 10 best photos, choice of a year's subscription to THE WIRELESS AGE or The Wireless Experimenter's Manual by Elmer E. Bucher, Member of Institute of Radio Engineers.

Send your snap-shot or photo to the Contest Editor before May 31st.

Contest closes May 31st

AFLOAT AND ASHORE WITH THE OPERATOR



By W. S. Fitzpatrick

NOT more than four or so years ago, Rudolph L. Duncan was a radio operator possessing the usual circle of friends and acquaintances. Today he is one of the best known men in the radio field.

Behind this rapid rise there is, as in every such case, a reason. Those who have met Mr. Duncan will say his polished manner, pleasing personality and keen business sense are the factors; intimate friends who enjoy his confidence will refer to his ardent ambition, which has even brought him to the point of taking up the study of law during his spare time, and the everlasting energy which keeps him plugging and forging ahead; the hundreds of young fellows to whom he has been counsellor, adviser and friend, will point to his real character as a man, this none being better able to judge than the students who place themselves in his care.

He sees good points in every fellow who comes to him and takes a sincere interest that never swerves. In all, he's a "square shooter"—and that means much—in fact, it helped to put him where he is and it is going to boost him a whole lot higher.

Mr. Duncan started his career as a railroad telegraph operator, later taking up radio. He was a radio man in the United States Navy during the World War and also saw active service during the previous Nicaraguan and Mexican troubles. He was a chief on the naval cruiser San Diego when that vessel was torpedoed by a German submarine during the war, losing, as did other members of the crew, his entire possessions when the ship sank.

Since assuming his present position as director of the oldest radio school in America, about two years ago, Mr. Duncan has been instrumental in having more than nine hundred men secure first class government licenses, this not counting the hundreds who obtained lesser grades or amateur licenses through his coaching.

Mr. Duncan is an active member of the Institute of Radio Engineers.

△ △

AMONG the government radio hydrographic reports, there recently appeared an item showing valuable work performed by the steamer *Eugene V. R. Thayer*, and of the mariners who read it there was perhaps



Rudolph L. Duncan, one of America's leading radio educators

none who knew that the radio operator on that vessel is a young girl.

Miss Lena Michaelsen has not missed a trip on that ship during the past couple of years. She has held a first-class license and has been engaged as operator on ships for more than six years. The *Eugene V. R. Thayer* is not her first assignment.

Repair men who go to her ship—their visits are not very frequently required—report that Miss Michaelsen always dons overalls and renders real assistance, whether repairs are needed to the set, the motor-generator is to be overhauled, or a new aerial built and raised. They say she keeps her apparatus in better condition and cleaner than many men operators.

△ △

A LITTLE story we carried on this page in the February issue, about an experience of William H. Wallace on having his own signals come back to him, has started something.

Elmer G. Kopp, a traveling radio salesman out of Chicago, says that he agrees with us about Wallace being a champion, but does not care to enter the controversy claiming it to be something a regular attendant at Sunday School should keep out of.

P. J. Rowland of New Castle, Pa., on the other hand, has entered with an attempt to wrest the championship away from Wallace. Here is Mr. Rowland's letter:

"Just a line to say that 'Windy' Wallace may not be as windy as you think. Here's one from my own experience;

"About three weeks ago I was listening to WGY while a man sang a baritone solo, 'The Trumpeter.' Then as usual there was a brief intermission. I turned my condenser just a trifle and got about the last two lines of the same song in the same voice. This startled me, but I did not give it much thought. I then crawled back to WGY and heard the same man singing 'Ship Mates of Mine.' Instantly after he stopped singing I turned to the place where I had received the other echo (?) and got the last two or three lines of the same song in the same voice.

"Take it or leave it, this is my story and I will not back down an inch."

Next!

△ △

AN incident of radio interest recently happened in the vicinity of Irvington, N. J., for the account of which we are indebted to G. A. Chute, radio operator on the steamer *Broad Arrow*. It appears that amateurs throughout that district had been endeavoring to hear stations in England, which operate on a lower wave length than those in America. They were greatly bothered by what apparently was a local station continually testing on a low wave and making unintelligible signals. Complaints to the local government radio supervisor brought an inspector who, through the use of a direction finder located the source of the interference. It proved to be a foundry, in the smoke-stack of which was installed apparatus for extracting precious metals from the fumes. The apparatus was working at 85,000 volts and 45 amperes, and emitted a wave length of 130 meters.

△ △

A NEW departure in American shipping is the around-the-world passenger cruises instituted by the Dollar Steamship Company. Heretofore such cruises were made only by British and German vessels. The Dollar line has just taken over a number of the "President" ships from the Shipping Board for this service.

Do you know what to
ask for when you buy vacuum tubes?

Tubes That Play 'Possum

The New Vacuum Tube More
Efficient and More Economical

By Jerome Snyder

UNTIL a short time ago the public had been using pure tungsten filament tubes. Gradually these tubes were sold less and less until today the only type of tungsten filament tube sold is the detector tube UV-200. In place were substituted the well known UV-199, the UV-201A, and the WD-11 and WD-12. Although this change was not marked by any violence, as it were, it really involved a small revolution in the design of tubes. It is the purpose of this brief article to point out the essential differences between the old tungsten tubes and the new one and to explain the great advantages of the latter.

THE OLDER TUBES EXPENSIVE TO OPER- ATE

The first great disadvantage which the old tungsten tubes had was the large filament current consumption. The filament of the detector and amplifier tubes consumed one ampere. This is a relatively large current for a small receiving tube and was necessary in order to raise the tungsten filament to the high temperatures required for the necessary electron emission. Thus it required three amperes to operate the filaments of a three-tube receiver, and if such a receiver was operated for three hours an evening the drain on the storage battery would be 9 ampere-hours. Thus a forty ampere-hour battery would have to be recharged every three or four days. This is quite expensive and any improvement which decreased the upkeep cost would be a very welcome one.

BURN-OUT FREQUENT

Then there was also the question of renewal of tubes. As mentioned above tungsten filaments have to be heated to very high temperatures (2300 to 2500 degrees Centigrade) to secure the necessary electron emission. A comparatively slight increase of temperature resulting from a little increase in current such as might be caused by varying the filament rheostat would burn out the filament, and burning out of filaments was consequently of provoking frequency.

Apart from these disadvantages there was always the great desirability of working vacuum tubes on dry batteries, thus doing away with the storage battery. Although in the long run a storage battery pays for itself, a large number of people do not want to be bothered with the care of a storage battery which is a messy proposition compared to dry cells, which, moreover, make portable receivers a possibility.

All of these considerations caused research on the development of new tubes. The result is the new tubes on the market to-day which have replaced the tungsten filament tube. Only the UV-200 gas content tube, which has a tungsten filament, still survives as a detector tube.

The filaments of the new tubes are called thoriated tungsten filaments and sometimes X-L filaments. The former name is really descriptive, because the filament is made of tungsten and a compound of thorium. These two are intimately mixed and then the wire is drawn. Now thorium emits electrons very copiously at a temperature of 1700 degrees Centigrade which is seen to be considerably lower than the required temperature of tungsten. So very low filament currents may be used. Thus a UV-199 tube requires only 0.06 ampere for its operation, with a terminal voltage of 3 volts. A dry cell is easily capable of furnishing such a current and three dry cells in series will easily take care of this job. In fact the drain is so small on the batteries that they last almost as long as they would if they were lying idle on the shelf. The writer has had three dry cells in use on a UV-199 tube for the past six months and they are only now beginning to go down.

A tube with low filament consumption is ideal for portable receivers. Thus it is perfectly feasible to use small flashlight batteries to light the filament, and flashlight cells take up small space and are very light. Small "B" batteries complete the battery installation for service during several weeks.

Where storage batteries are available the UV-201A tube may be used. This tube takes $\frac{1}{4}$ ampere for the filament,

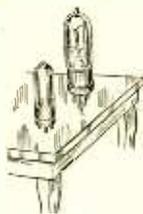
so for the same number of tubes the storage battery will last four times as long without charging. The second advantage of these low current thoriated tubes is that they practically never burn out, and tube life is thereby prolonged. The filaments are made with a core of tungsten, and hence the filament is capable of withstanding the usual high tungsten filament currents. However, due to the thorium compound, sufficient electron emission is secured at much lower currents.

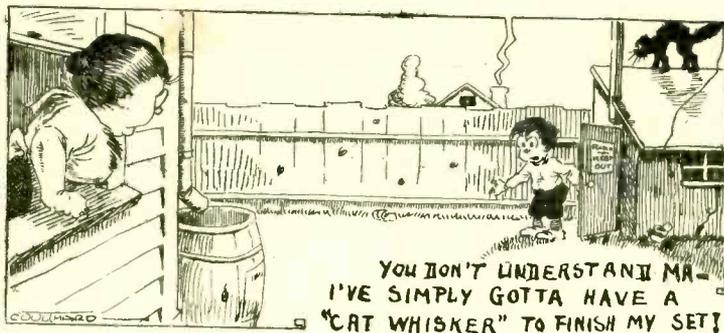
WHAT IS THE LIFE OF A TUBE?

These new tubes seldom, if ever, burn out, that is, for ordinary increases in current. Thus although the UV-201A tube takes $\frac{1}{4}$ ampere it will not burn out if this rises to $\frac{1}{2}$ ampere. The function of the filament is to emit electrons so that plate current is available. If the filament stops emitting electrons, or the number of electrons emitted per second decreases to a low figure, the tube becomes useless, obviously. Now in these thoriated tubes the electrons are supplied practically solely by the thorium. When the filament is heated by the passage of the current the thorium on the surface of the wire begins to emit electrons. As the thorium on the surface is used up more thorium from inside the wire comes to the surface and replenishes the supply of electrons. Thus for

a very long period of time the electron emission is normal. When the thorium finally is nearly used up the emission suddenly falls, which is evidenced by weak signals. Care should be taken that the battery is up in voltage as often the trouble is not lost emission, but simply run down batteries. Thus it will be seen that the life of these new tubes never is terminated by burned out filaments, but rather by being completely used up in service, which is very desirable. In a certain sense these thoriated filament tubes may be considered fool-proof for ordinary increases in current, since the tungsten core prevents actual filament burn-out.

(Continued on page 82)





YOU DON'T UNDERSTAND MA—
I'VE SIMPLY GOTTA HAVE A
"CAT WHISKER" TO FINISH MY SET!



COULHARD
FIRST BIRD - I'D LIKE TO TASTE ONE OF THOSE
RADIO BUGS! -
SECOND BIRD - DON'T BE HASTY - IT'S
LIABLE TO SHOCK YOU!!

Acquiring a Radio Set

ONE goes out and buys a hat, a player-piano or a lamp for the living room. The money is paid, and one has the hat, the player-piano or the lamp for the living-room. We never had a radio set, do not expect to have a radio set and would shoot any one we saw coming with a radio set, so our knowledge of radio is limited. But it had been our belief that one bought a radio set just as one bought a hat, a player-piano or a lamp for the living room. However, this was a mistaken belief, as was found on reading a few advertisements.

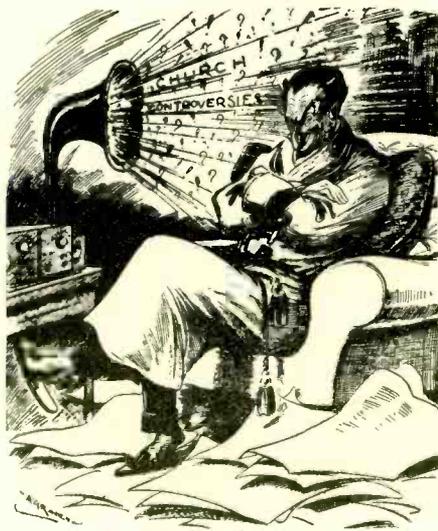
Desiring a radio set, one does not usually go out with the money and buy one, it seems. Instead, one acquires a radio set bit by bit, shopping around for some plugs, some wire, rheostats, variometers, cat's whiskers, tubes, condensers, grid leaks, coils, rectifiers, transformers and other articles with weird names. Then one puts these things together and if they are put together right gets Pittsburgh. Not content with getting Pittsburgh, one buys a potentiometer, a neutrodyne, a heterodyne and a couple of steps of amplification and gets Omaha. Dissatisfied with Omaha, one shops around some more and picks up some additional things with technical names, getting San Francisco, maybe, and even then is only a little way down the list.

It is surprising that nobody ever evolved

some method of buying a car, which process now requires only the necessary money and no mechanical ingenuity. After getting a sufficient number of parts and putting them together one might make Rahway. A half dozen more and one might get to Monmouth Junction, and so on. The idea seems to have all sorts of possibilities.

—Newark Evening News.

THOSE BROADCAST DISPUTES



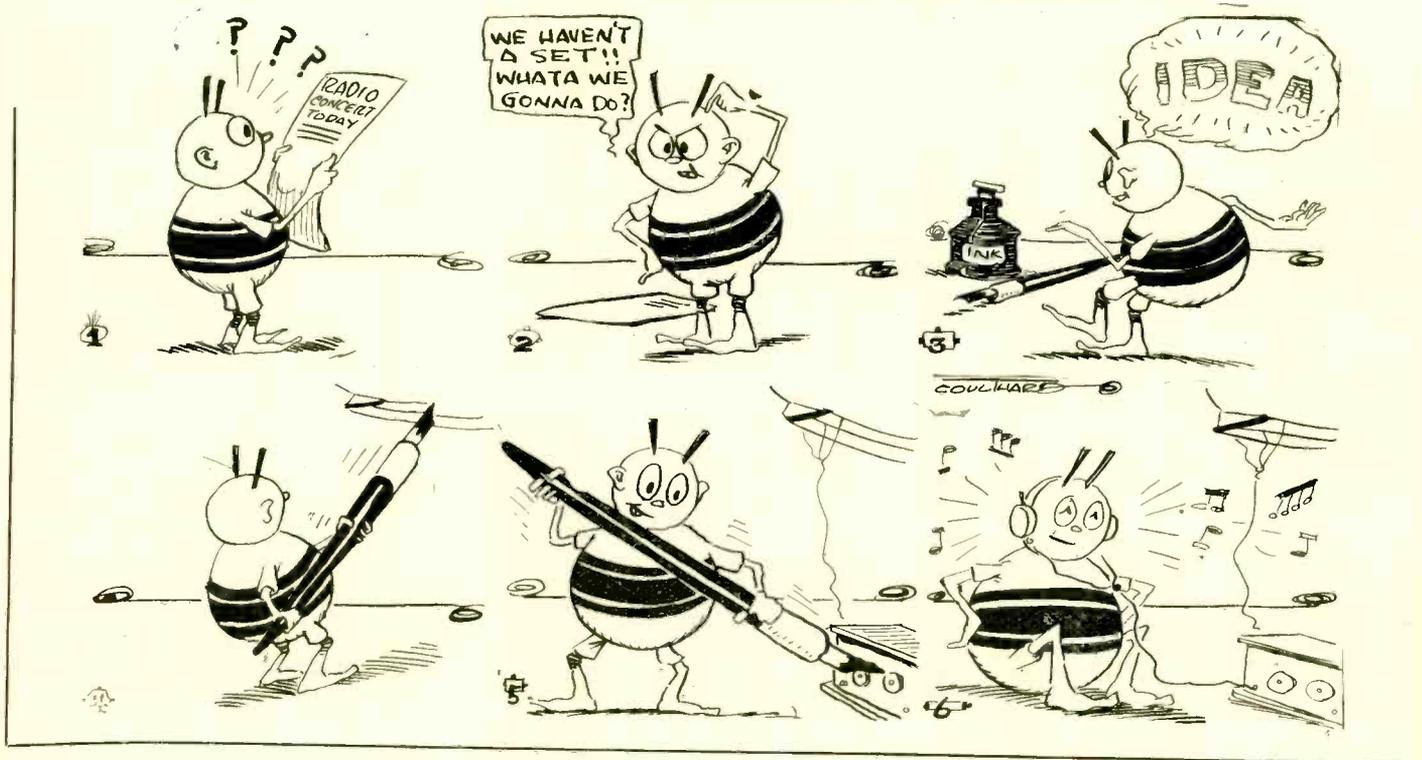
The delighted listener-in

The Making of a DX Liar

By WILLIAM HARVEY BRADFELD

I know a certain neighbor,
Who, until a month ago,
Had never told a falsehood—
Then he took up Radio.
Now with Singapore he chatters
Every night, to hear him say;
And stations in Calcutta
Call him almost every day.
He even heard a concert
Sung in Celtic from Thibet
When I told him I had listened
To Miami with my set.
"Why, man alive!" he chortled,
That's a piker dump for true;
Last night I talked to Dublin—
Old Kilkenny Castle, too.
"Vienna spoke me early,
London said they had a fog,
Paris boulevards were crowded,
Vamps were puttin' on the dog.
"Berlin said the riots
In Mulchenhausen Square
Were making markets nervous—
Even marks were in the air."
He mentioned other station—
Constantinople and Cairo—
He who never told a white fib
Till he took up Radio.

What a Radio Bug Does When He Isn't Biting People



THE WIRELESS AGE "On the Air" Again

Did You Attend Our Last Party?

THE WIRELESS AGE has inaugurated a new broadcast feature. Many are familiar with our activities in the past in broadcasting big sporting events transmitted from Station WJZ. THE WIRELESS AGE will now entertain the radio audience regularly with diversified programs most of which will probably be musical. Our initial program broadcast from WJZ was purely musical, but future schedules will depend largely upon the suggestions received from the radio audience and our readers. H. L. W. launched our first musical program on the air from WJZ with a radical departure from the customary mode of announcing. To begin

Alfred Armand, our vocalist, has had a brilliant career. He has studied under operatic professors of Europe and America. He is a well-known soloist, a member of the Verdi Opera Company, and at present is a member of the Manhattan Trio which has stormed "Little Ole New York." During the war he was with the "Over-There Theatre League," entertaining the soldiers of the allied countries, and he had his share of the dangers of that period which he relates with a touch of human interest appeal. He has an interesting collection of letters of appreciation for his work from the Nobility, from Generals and all down the line to the doughboys.

and characteristically concluded with a remark that if no one else enjoyed the program, he knew his red-headed son at home did. The great number of letters received expressing appreciation, indicates the certain success of our future parties.

"THE WIRELESS AGE Dance Orchestra" is composed of: Arthur Miller, saxophone; Ernest Harting, saxophone; Robert Richards, piano; Wilbur Kurz, cornet; William Schaffner, drums; Arthur Burke, violin.

with he introduced all the entertainers,



The Wireless Age Orchestra



Alfred Armand

The World Within a Prison Cell

(Continued from page 41)

their home will keep them there and that is where they belong!

Society itself is, after all, mostly to blame for crime. It can help solve the problem by establishing a Community House in each and every town and city in our country! Then put in a good radio set and a "loud speaker" and there will always be an audience! Corner poolrooms are a breeding place of crime, but it is there that the young fellow gets the first news of all sporting events and all of us, with a bit of red blood in our veins, are interested in games and sports of all kinds. That interest has made us the foremost nation of the world! The Community House is the only thing that society has to offer to take the place of the corner poolroom. Now all sporting events of any particular importance are being broadcast. Let the young people, as well as the old people, listen-in at a clean place:

namely, the Community House!

Then there are institutions of all kinds, but especially those for our defectives and delinquents, where radio would help. Society makes an awful mistake in its attitude toward those places and the unfortunate that are "behind the walls." Every man that I have talked to in prison has vowed that he is "going to get even some day!" Reform us, for we all need it, but you can't do it by depriving us of all the pleasures and even necessities of life! Give us amusements! You need a certain amount of relaxation after your day's work, but we need it far more than you do! Put a radio set in every prison then, for that is the cheapest and most convenient way of providing entertainment and amusement to the men "behind the walls." Put one in every jail, in every hospital for the insane, in every school for the feeble-minded, and in every hospital! When that is done you will find that

wonderful "cures" are being made! Gloomy, morose men will become cheerful! Yes, I believe even "crooks" will become real men again!

Broadcasting to Form Character

(Continued from page 37)

world by bad roads and lack of railroads. "We gather around our radio set—the neighbors too—and when your story came over I wish you could have seen the response of that group!"

A little girl of 14 writes to tell Mrs. Albion how in her community they have regular church parties and there she tells to the rest Peggy Albion's stories. "And I try to say them with my voice just like yours."

Many thousands of children and many of their seniors, too—are receiving a splendid course in "character," a sugar coated course, and Peggy Albion is blessed in many a home.

What Are the Opportunities in Radio Factories?

To the Young Man Interested in Radio, There is Nothing More Interesting Than a Radio Shop—But What Does it Offer as a Future?

By M. B. Sleeper

Radio Editor and Publisher

A LONG time ago, and not so long ago either, I wanted to spend my summer's vacation doing something to make money. I went to see Mr. Eastham, who was then at the Clapp-Eastham factory. He couldn't give me a job, for summer is the quiet time for radio companies, but I remember to this day how much I appreciated his kindness in showing me through the shop. It was a place to dream about. I saw men winding coils, turning out metal parts, assembling condensers, wiring instruments, and doing all kinds of marvelous things. I met Bowden Washington, who was there inspecting some of the old double-decked loose coupler sets for the Wireless Specialty Company, and I have to this day a diagram that he drew for me of the circuit.

There's no denying it—a radio factory has, for the experimenter, a gripping fascination that nothing else can equal. I thought Mr. Eastham must be the happiest man on earth, and I knew I would be if I could wear a long shop coat too and work on radio instruments all day long. However, there is a lot of difference between looking in from the outside and looking out from the inside.

Do you want to work in a radio factory? Yes? Well—just what do you mean when you say, "Yes"? Do you want to work at an assembly bench and, by years of steady work de-

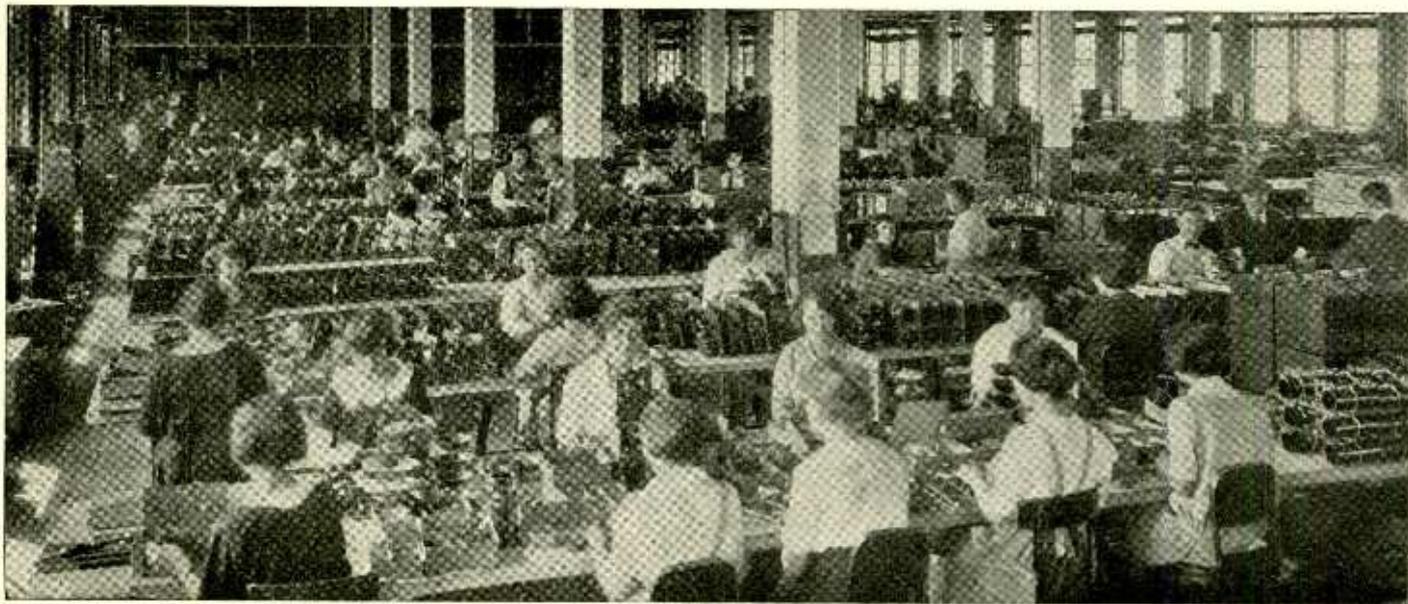
velop into an expert assembler, or become an inspector some day, or do you expect to own a factory of your own by and by? If the successful man is the one who stays at whatever he sets out to do until he can do it better than those around him, the bench worker may be as successful as the heads of the company though, to be sure, he will not make as much money.

Let me warn you, though, that Al Grebe, for example, if he started today in the little barn shop he had a few years back, would find it a lot slower climbing than it was at the time he started in. Not only is competition very keen, but there will not be again the big boom that helped so much. Where big success came in three years then, it may take five or ten years now, and pickings for the little shops may be pretty poor unless there is plenty of energy and ambition behind them as a driving force.

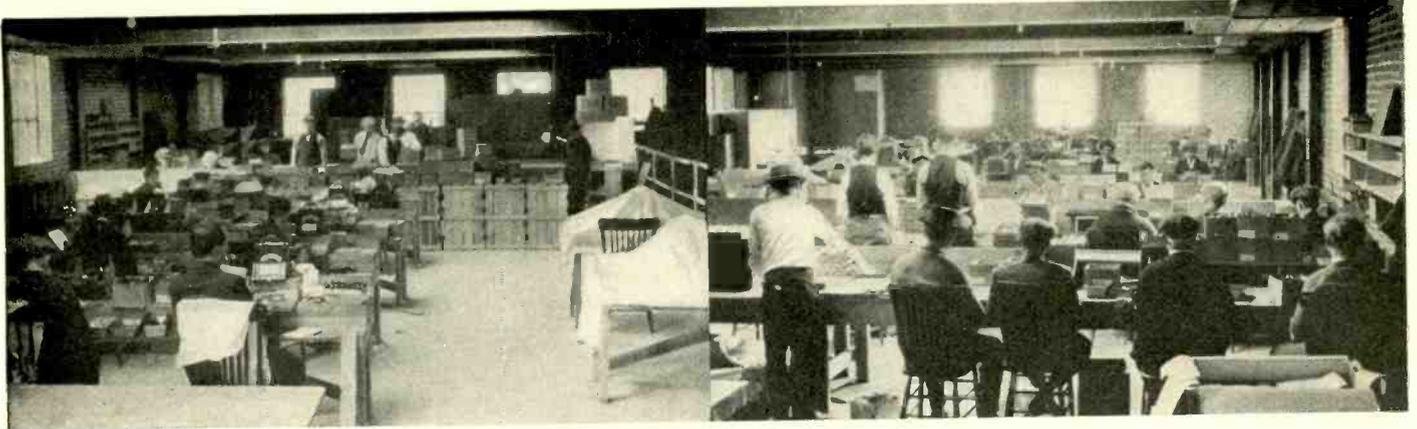
But let's suppose you want to go right up to the top, to own a factory doing a half or even one or two million dollars' worth of business a year. While you may stop somewhere along the line, at least you won't go high without aiming higher. I say that because ninety-nine men out of a hundred decide, on the way, that they are ready to stop climbing for the reason that they don't feel the work and the sacrifices worth while.

Are you fitted by natural instinct and training for factory work? You needn't have yourself psycho analyzed. Look at your radio set. Is it the work of a fellow who's all thumbs, or are the wires neatly soldered and the instruments arranged in a way that shows a neat, orderly mind of naturally mechanical bent? Would that workmanship pass in a set to be sold in a store? If the answer is "No," you'd better think a lot more about yourself before you go out for a job at an assembly bench. Do you know the use—the correct use, mind you—of the drill press, lathe, coil winder, and soldering iron? Can you read a micrometer? Can you look at a screw and tell the size of the thread, or guess quite nearly the size of a drill? Do you understand the sharpening of tools? Can you make a perfect right angle bend in a piece of bus bar? How accurately can you guess the gauge of a piece of wire? Are you able to draw clear and neat diagrams, and can you read circuits so as to follow them to the letter in wiring a set? Have you had at least a year or two of mechanical drawing in school, enough that you can read blue prints intelligently?

Test yourself on these points. If you can say "Yes," to each one, you ought to get along well in a shop, but if you burn up your iron, or don't know the difference between No. 20 and 24 wire.



Assembling Room in the Radio Department of the General Electric Company. This presents a fair picture of modern quantity production applied to radio, which as an industry, has a place for great numbers of workers



Filkostat testing room of DX Instrument Company, Harrisburg, Pa. Every bit of apparatus has to be carefully tested

The assembling room of this same plant. These operations afford good steady employment for many radio workers

or think a 3/16 in. drill is a No. 18, they'll know it in a week's time, and if you're not discharged as incompetent, at least you'll get only the dullest, most unpleasant work to do, such as sorting out chipped knobs, or cutting up bus bar.

Another thing—are you going to be able to keep the pace? Can you get at your bench before the bell rings, work full speed until lunch, carry on steadily until the end of the day, and stay at night if overtime is necessary? It's not easy. There is always someone who will throw broken pieces of molded parts around, or tip over a box of screws to waste time picking them up, and you'll get into bad habits very quickly. It's so easy, in fact, that the man who refuses to gossip about the stations he heard last night stands out like a headlight among those around him. If you get in in the morning and back from lunch at noon early enough

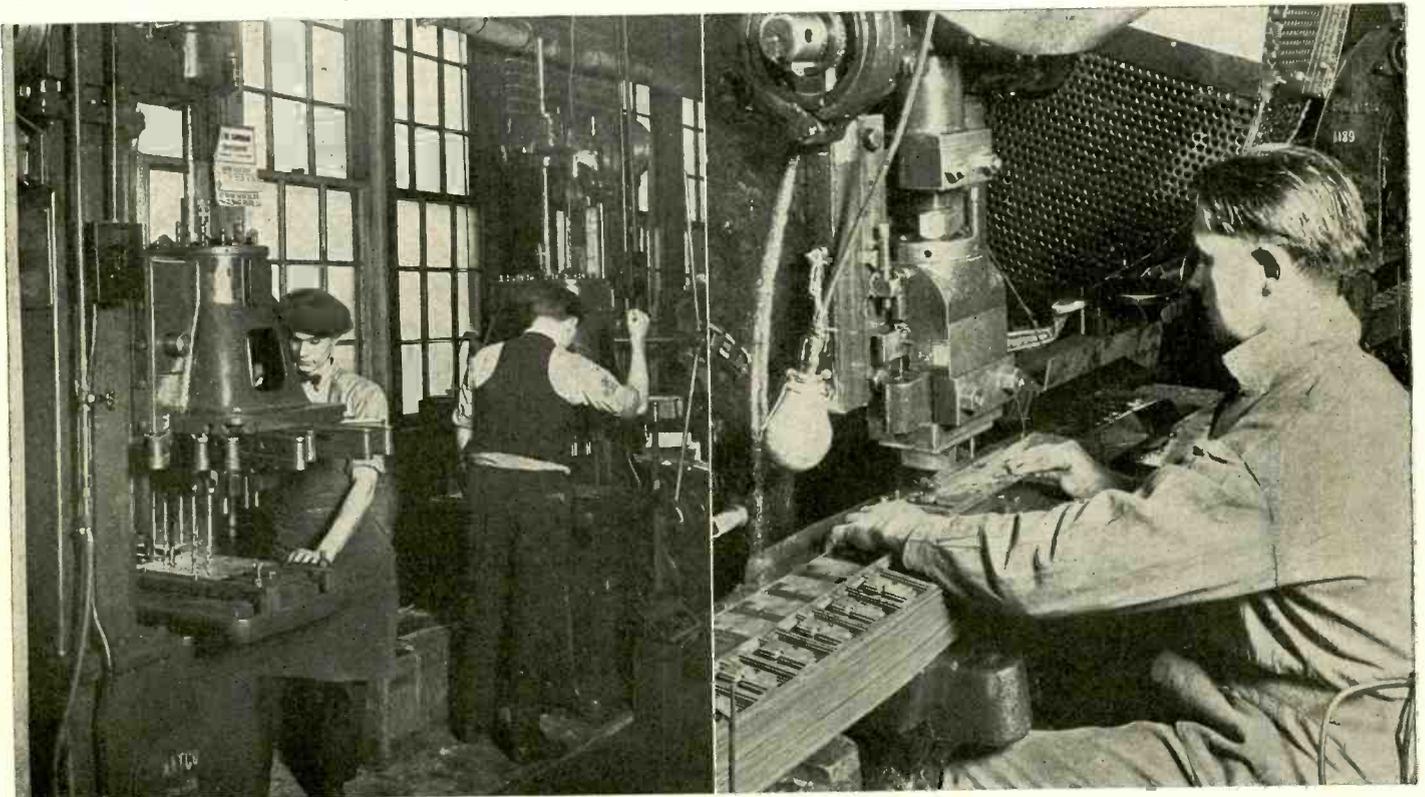
to have your soldering iron hot when the bell rings, the foreman will pick you for good jobs before you have been there a week.

That is as easy as it sounds until you have to do it day in and day out. Is it really worth while? You'll think so when spring comes, and the general manager asks the shop superintendent for a list of men he can let go. And later on when the factory personnel is stripped to a skeleton force during the summer. Will the super say about you, "We'd better keep him because he's too good to let go"? Indeed he will if you have made him feel that way because you've been to busy to do anything but your work. But remember. when you finish a job don't go buzzing up to the foreman with a don't-you-think-I'm-clever smile and ask for the next job. Just act as if it was the most natural thing in the world that you had finished. Don't be so anxious

that you make a nuisance of yourself. If you can't get more work immediately, keep acting busy. If you know more than the man next to you, don't help him any more than you have to, for the foreman wants every man with his nose at his own job. The foreman is there to assist his men. If he doesn't, he won't thank you for doing it, so don't interfere.

When Fall comes again, the man on the bench last season, who was good enough to keep through the summer, is made an inspector or tester. If the assistant foreman didn't do well, the inspector gets his job, or whatever shake-up takes place the all-year-round man generally goes ahead. Occasionally, however, it seems as if things don't break fairly, or the raise wasn't big enough. You must remember every single minute that the men working with you are the men who will be work-

(Continued on page 84)



Here are shown some of the manufacturing processes at the Federal plant at Buffalo, which employs over a thousand operatives. These views show two of the multiple drills which drill all the panel holes in a single operation, also a punching press which punches out the transformer core iron

Design of Loop Antennas

PART III

Directional Properties

By Ralph Batcher, E. E.

Author of "Prepared Radio Measurements,"
Wireless Press

LOOP antennas have become available for use in radio reception since the advent of vacuum tube amplifiers. In two previous chapters of this article the author has taken up the design of loop antennas with rules and tables for determining the inductance of any practical size loop. In this article (which will complete the series) directional properties of loops will be discussed.

The voltage induced in a loop is the combined effect or resultant of the voltages induced by the passing wave in each of its two vertical sides. Ordinarily these voltages are nearly equal, but are not in phase due to the time taken for the wave to move across the loop. If the voltages were exactly in phase there would be no potential dif-

fer-
loop as a whole is equal to

$$E_L = 2E_s \sin \frac{\theta}{2} \quad (2)$$

Since the sine of an angle is very nearly equal to the angle, for the small angles involved equation 2 becomes

$$E_L = E_s \theta \quad (3)$$

Combining equations 1 and 3 gives the following relation

$$E_L = Kh\theta = \frac{Khl \times 2\pi}{\lambda} \quad (4)$$

plotting the ratio $\left(\frac{\text{Area} \times \text{Turns}}{\text{Inductance}} \right)$

against the number of turns. This has been done for one style of loop in figure 2. The same characteristics will be found with loops with other spacings, etc. This figure shows that a few large turns give very much greater signal strength than a loop having a large number of small turns, although both loops may have the same total inductance and the same wavelength range. The absolute values for the units are of no value so that arbitrary values are given only in plotting this curve. The point of interest is that if a loop can be designed to give the desired inductance with 8 turns of wire or less, much louder signals may be expected.

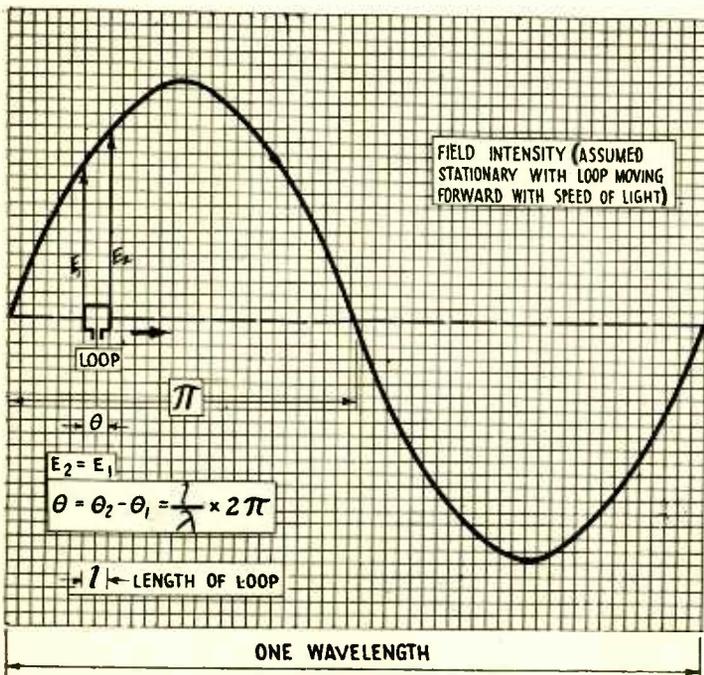


FIGURE 1

Curve of field intensity

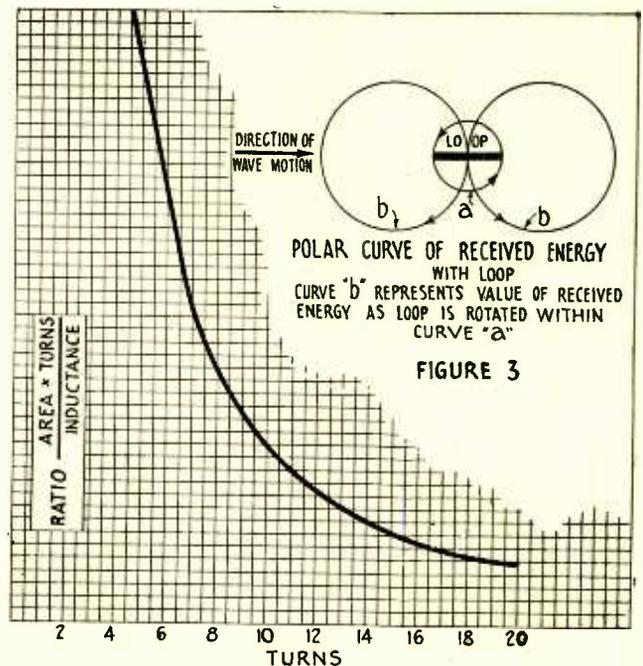


FIGURE 2

Polar curve of received energy

ference between the terminals and no signal would be produced.

From this viewpoint it will be seen that since the length of the loop is very small in comparison with the length of the wave received that the voltage cannot be large, when compared with the voltage induced in an ordinary antenna.

The angle by which the voltages in each side differs is equal to

$$\theta = \frac{2\pi l}{\lambda} \quad (1)$$

This is apparent from figure 1, which assumes that the ether wave is stationary and that the loop moves forward with the speed of light, through one cycle. The voltage then induced in the

since E_s is proportional to the height of each side. K is the proportionality factor. Thus it is seen that the effective voltage is proportional to the product of the length and height of a loop—or in other words, proportional to the area—and inversely as the wavelength. For a loop of N turns the voltage is N times as large.

It is then of vital importance to obtain the greatest area with the minimum amount of wire. This requirement calls for a circular loop, but the mechanical details prevent this type of construction so that the next best style is the square loop.

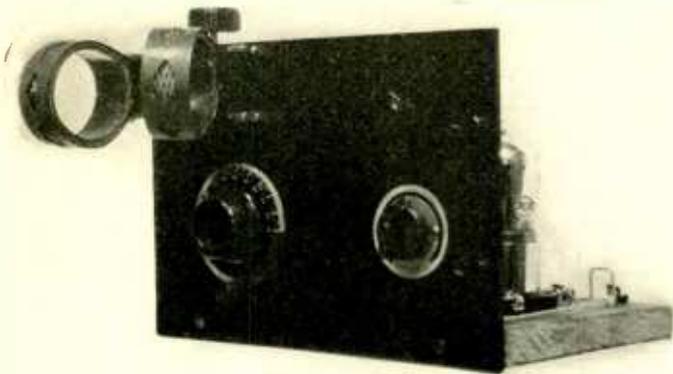
To determine the best shape ratio a comparison can be made graphically by

However if over 10 turns are required disregard this consideration entirely and base the design on securing a convenient sized loop. It will be seen that a loop with five large turns is very little better than one with twenty small turns, but one with three or four still larger turns will give very much louder signals, although all may have the same inductance.

Equation 1 and figure 1 assume that the plane of the loop is at right angles to the wave front, because in this position the greatest amount of time is consumed by the wave in passing from one side to the other, and the resulting voltage is the greatest. However, if the loop is turned through some angle

(Continued on page 55)

Flewelling on the Flewelling Circuit



Panel layout of a Flewelling receiver

This Circuit Is Tricky—But It Challenges Interest—It Has Produced the Results—and With One Tube

By E. T. Flewelling

Consistent audibility on 25-mile broadcaster with antenna loop or ground such that music is heard 35 to 40 feet from loud speaker.

If I now say that I would not guarantee what the receiver would do about a station 50 miles away, one can form one's own opinion about how very interesting such a circuit is.

As a super it is inclined to be extremely noisy and tricky, a scientific novelty; but, open up your coupling, adjust the grid leak properly and you find that you have not wasted a bit of time in building the circuit because it will then work as a plain regenerator, exceedingly sharp in its tuning, capable of real distance work as shown by hundreds of letters I have received; loud speaker operation within 20 miles of broadcaster on the one tube and, well, there is only one tube in the Flewelling circuit, let's take pity on it.

THERE is so much in radio that many of us do not know or understand that such actions, as this circuit exhibits at times, are responsible for the almost world wide interest it has aroused. We are all of us most interested in that which we do not understand, and I would be the last to make the claim that I understand the entire story of the Flewelling circuit. What I have observed, however, is presented with the feeling that it may be of help in cleaning up some bit of the haziness about the circuit.

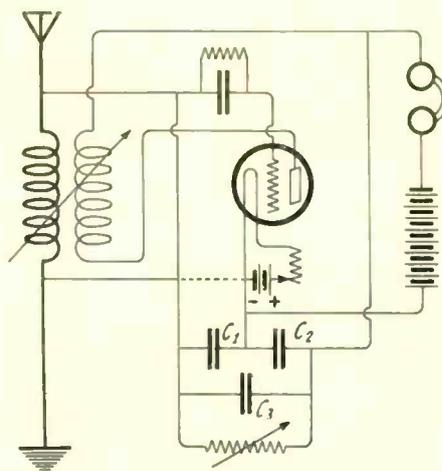
First, let me state that the Flewelling circuit may, by control of coupling of the feed-back coil and the grid leak, be used either as a plain regenerator of unique and substantial capabilities or as a super-regenerator.

With grid and plate coils at approximately close coupling and grid leak properly set, as found by trial, regeneration is increased beyond the familiar spill-over point. Ordinarily this means silence or a loud raucous howl. This howl may be introduced into any receiver of the type by grid leak adjustment, etc., but in the Flewelling circuit it is controlled and shaped to our ends by the capacity of the filament lead condensers and the grid leak. The greater the capacity of the condensers the louder the howl and incidentally the greater the power of it, up to .012 mfd. or perhaps even greater, but .006 mfd. is found to offer about the correct value for general use. The howl in the Flewelling circuit is caused in part by the blocking and freeing of the grid of the tube, and in a correctly built set it may be so lowered in pitch that it is nothing but a series of thumps occurring about once a second.

Now as the grid leak is varied we allow the accumulated charge on the grid to leak off faster and the thumps occur so fast that they merge into a continuous roar increasing in pitch as the leak is changed until the note is so

high as to be practically inaudible. Note that each time we allow the tube to block and free itself we are charging the .006 condenser and discharging it back into the grid circuit, thus utilizing these things to our end:—Excessive regeneration, plus the added discharge of the .006 condenser into the grid circuit, plus the grid leak to keep the circuit from running away by starting and stopping it at correctly timed intervals as we please by grid leak adjustment.

It is conceded that the circuit is tricky, so much so that a barrel of monkeys is tame in comparison. For instance, note such results as these and note also at the same time that reception without antenna loop or ground



Circuit diagram of Flewelling set

has been found reliable day in and day out only up to distances of about forty miles.

Boston to Los Angeles on a 16-inch loop reception for an hour or more steady without ground or other antenna

Audibility on 400-mile station with plain regenerator of excellent type on good antenna and ground, 150; but at same time on super circuit without antenna, loop or ground, 700.

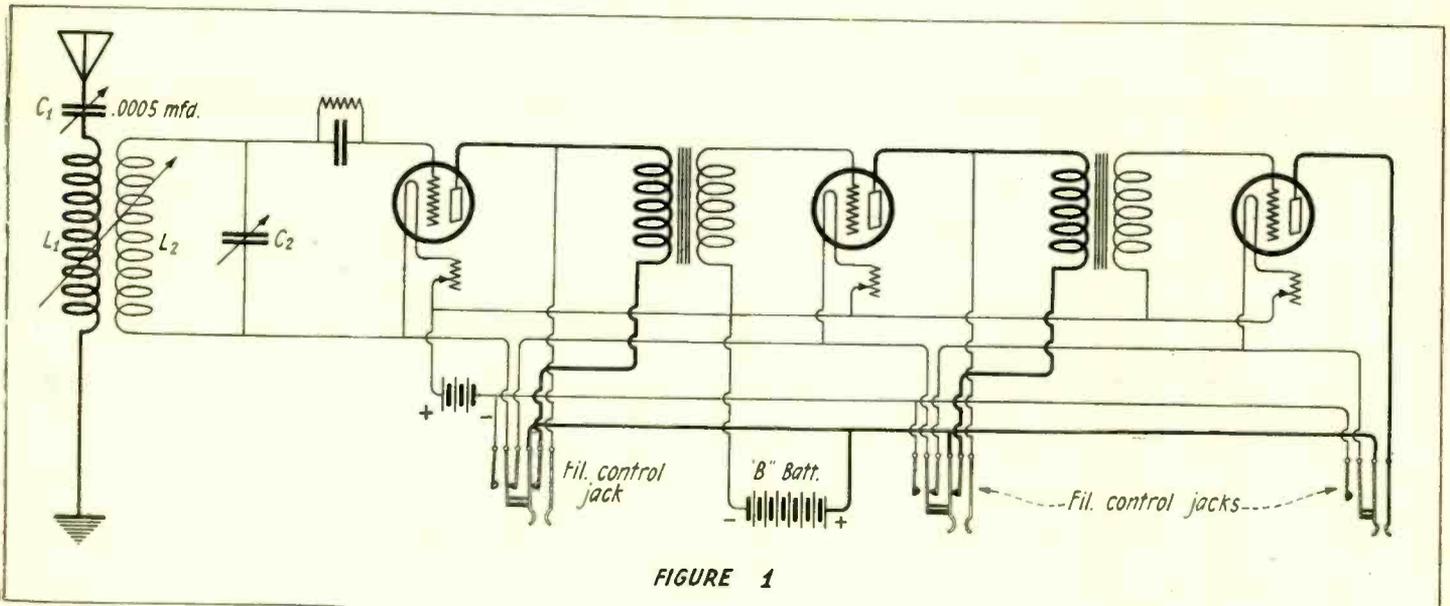
Design of Loop Antennas

(Continued from page 54)

ϕ the wave will traverse the distance in less time and the signal strength is smaller. In this case the voltage is proportional to the maximum voltage multiplied by the cosine of the angle ϕ , as indicated by figure 3. It is upon this principle that direction finders and radio compasses are based.

Since peace-time application of receiving loops do not require very sharp maximum or minimum values such as are required in direction finding work, or the unilateral directional feature where the signal is strong when the loop is turned in one direction only instead of the two directions indicated in figure 3, so that these features will not be taken up here. In passing it may be said that in some installations it is often found that this unilateral feature exists to a marked degree. This is generally a distinct advantage and is generally due to the fact that the filament batteries are grounded or act as a capacity ground. When this occurs the loop has an "antenna" effect in addition to the "loop" effect.

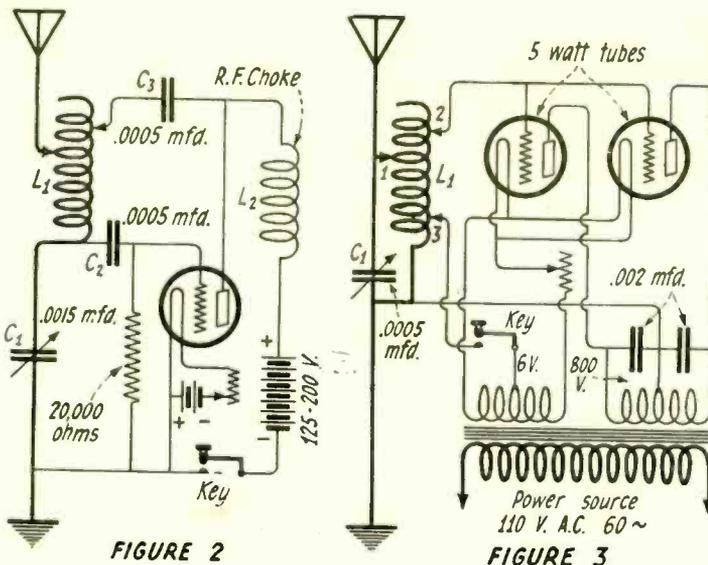
Popular Radio Hook-Ups



MANY of our readers have asked for a circuit showing the manner in which automatic filament control jacks are connected in the detector and amplifier units. Figure 1 illustrates the best method for using them. Great care is necessary in wiring these into the set. It is best to connect up the filament circuit complete and see that each tube lights correctly before making the B-battery and transformer connections.

FIGURE 2 illustrates a small low power continuous wave vacuum tube transmitter which may be easily constructed. The inductance L-1 consists of 30 turns of No. 14 wire on a tube 4 inches in diameter. The radio frequency choke L-2 is made by winding about 30 turns of No. 30 D.C.C. wire on a 2-inch mailing tube. The condenser C-3 must be such as to withstand the voltage of the B battery. The tube used may be a UV-201, UV-201-A or VT-2.

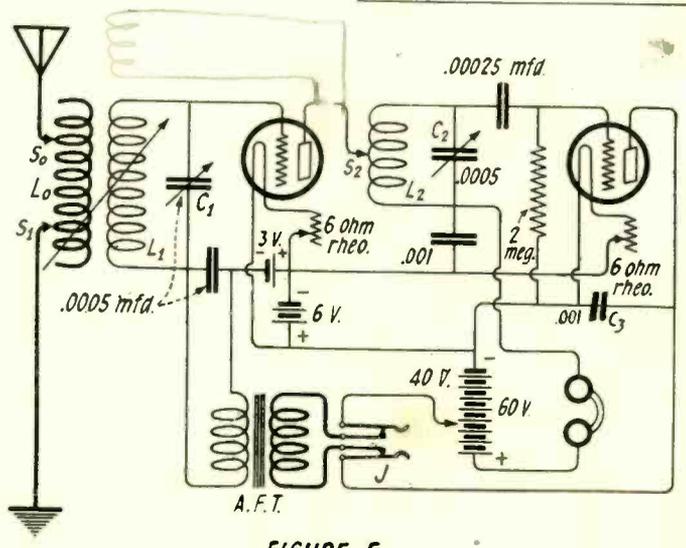
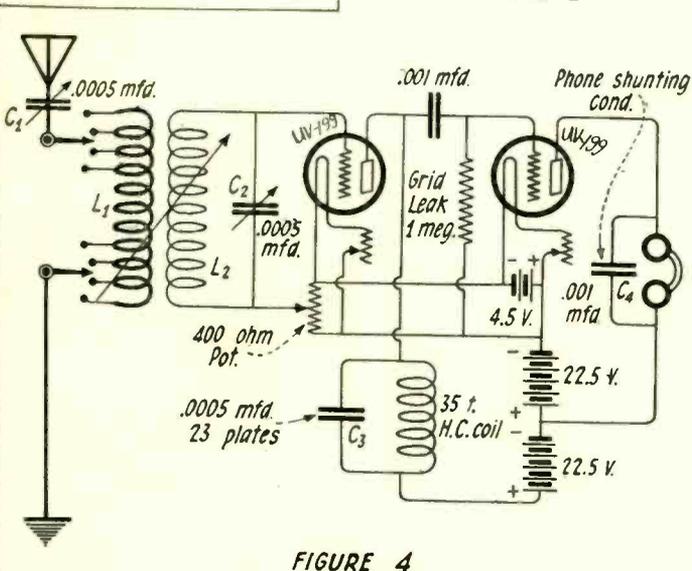
IN figure 3 we have a similar circuit using the 110 A. C. lighting current stepped up through a power transformer to a voltage of



800 as a source of plate supply. In addition the filaments of the tubes are lighted by a special winding on the transformer.

WE have had numerous requests for a sensitive receiver whose re-radiating powers are nil. The circuit for such a set is shown in figure 4. It represents one stage of tuned impedance radio frequency amplification inductively coupled to the antenna circuit. L-1 and L-2 are respectively the primary and secondary of an ordinary variocoupler. A 35 or 50-turn HC coil tuned with a 23-plate condenser furnishes the plate impedance. No difficulty should be experienced in connecting this receiver and two or three stages of audio frequency amplification added to the detector will bring in distant stations on the loud speaker.

FIGURE 5 represents a similar receiver with one stage of audio frequency reflex back into the radio frequency tube. This is a very satisfactory receiver and should prove very interesting to the experimenter.



BROADCASTING STATION DIRECTORY

(Revised to March 15th, 1924)

The Most Authentic, Up-to-the-Minute List

KDKA	Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.	326	KFIX	Reorganized Church of Jesus Christ of Latter Day Saints Independence, Mo.	240	KUO	Examiner Printing Co. San Francisco, Calif.	360
KDPM	Westinghouse Electric & Mfg. Co., Cleveland, Ohio	270	KFIZ	Daily Commonwealth and Oscar A. Huelsman Fon du Lac, Wis.	273	KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KDPT	Southern Electric Co. San Diego, Calif.	244	KFJB	Marshall Electric Co. Marshalltown, Iowa	248	KUY	Coast Radio Co. Elmonte, Calif.	256
KDYL	Telegram Publishing Co. Salt Lake City, Utah	360	KFJC	Seattle Post-Intelligencer Seattle, Wash.	270	KWG	Portable Wireless Telephone Co., 530 E. Market St., Stockton, Calif.	360
KDYM	Savoy Theatre San Diego, Calif.	280	KJFF	National Radio Manufacturing Co., Oklahoma City, Okla.	252	KWH	Los Angeles Examiner Los Angeles, Calif.	360
KDZB	Oregon Institute of Technology Portland, Ore.	360	KFJI	Liberty Theater Astoria, Ore.	252	KXD	Modesto Herald Publishing Co. Modesto, Calif.	252
KDYW	Smith Hughes & Co. Phoenix, Ariz.	360	KFJK	Delano Radio & Electric Co. Bristol, Okla.	233	KYQ	The Electric Shop Honolulu, Hawaii	360
KDXX	Star Bulletin Honolulu, Hawaii	360	KFJL	Hardsag Manufacturing Co. Ottumwa, Iowa	242	KYW	Westinghouse Electric & Mfg. Co., Chicago, Ill.	536
KDZB	Frank E. Siefert Bakersfield, Calif.	240	KFJM	University of North Dakota, Grand Forks, N. Dak.	280	KZM	Preston D. Allen, Thirteenth and Harrison Sts., Oakland, Calif.	360
KDZF	Automobile Club of Southern California, Los Angeles, Calif.	278	KFJQ	Electric Construction Co., Valley Radio Division Grand Forks, N. Dak.	280	KZN	The Deseret News Salt Lake City, Utah	360
KDZI	Electric Supply Co. Wenatchee, Wash.	360	KFJR	Ashley C. Dixon & Son, Stevensville, Mont. (near) Dexter, Iowa	226	KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing Denver, Colo.	360	KFJV	Thomas H. Warren Towanda, Kans.	226	WAAB	Valdemar Jensen, 137 S. St. Patrick St., New Orleans, La.	268
KDZR	Bellingham Publishing Co. Bellingham, Wash.	281	KFJW	Le Grand Radio Co. Cedar Falls, Iowa	246	WAAC	Tulane University New Orleans, La.	360
KFAD	McArthur Bros. Mercantile Co. Phoenix, Ariz.	360	KFJX	Iowa State Teachers College Fort Dodge, Iowa	246	WAAD	Ohio Mechanics Institute Cincinnati, Ohio	360
KFAE	State College of Washington Pullman, Wash.	330	KFJY	Tunwall Radio Co. Fort Dodge, Iowa	246	WAAF	Chicago Daily Drivers Journal Chicago, Ill.	268
KFAF	Western Radio Corp. Denver, Colo.	360	KFJZ	Texas National Guard, One Hundred and Twelfth Cavalry Fort Worth, Tex.	254	WAAM	I. R. Nelson Co. Bond St., Newark, N. J.	263
KFAJ	University of Colorado Boulder, Colo.	360	KFKA	Colorado State Teachers College, Greeley, Colo.	248	WAAN	University of Missouri Columbia, Mo.	254
KFAN	The Electric Shop Moscow, Idaho	360	KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286	WAAP	Omaha Grain Exchange Omaha, Neb.	360
KFAO	Rhodes Co. Seattle, Wash.	270	KFKC	Conway Radio Laboratories Conway, Ark.	224	WABA	Lake Forest College Lake Forest, Ill.	268
KFAR	Studio Lighting Service Co. Hollywood, Calif.	280	KFKD	F. E. Gray, 3200 Richardson St., Butte, Mont.	283	WABB	John B. Lawrence Harrisburg, Pa.	268
KFAU	Boise High School Boise, Idaho	270	KFKE	Westinghouse Electric & Mfg. Co., Hastings, Neb.	286	WABC	Parker High School Dayton, Ohio	263
KFAY	The Radio Den Santa Ana, Calif.	280	KFKF	Nassour Bros. Radio Co. Colorado Springs, Colo.	286	WABD	Y. M. C. A. Washington, D. C.	263
KFAZ	Virgin's Radio Service Medford, Ore.	283	KFLA	Abner R. Wilson, 1321 W. Platinium St., Butte, Mont.	283	WABE	Arnold Edwards Piano Co. Jacksonville, Fla.	275
KFBH	F. A. Buttry & Co. Havre, Mont.	360	KFLB	Signal Electric Manufacturing Co., Menominee, Mich.	248	WABF	Robert P. Weing, 522 Wooster Ave., Dover, Ohio.	266
KFBC	W. K. Azbill, 5038 Cliff Place, San Diego, Calif.	278	KFLC	Paul E. Greenlaw Franklinton, La.	234	WABG	Haverford College Radio Club Haverford, Pa.	261
KFBE	Reuben H. Horn San Luis Obispo, Calif.	360	KFLD	National Education Service Denver, Colo.	258	WABR	Scott High School Toledo, Ohio	270
KFBG	First Presbyterian Church Tacoma, Wash.	360	KFLH	Erickson Radio Co. Salt Lake City, Utah	286	WABS	Essex Mfg. Co., 117 Mulberry St., Newark, N. J.	244
KFBK	Kimball-Upson Co. Sacramento, Calif.	283	KFLI	Berette M. Foster Cedar Rapids, Iowa	240	WABT	Holiday-Hill Washington, Pa.	252
KFBL	Lesse Bros. Everett, Wash.	224	KFLJ	Bizzell Radio Shop Little Rock, Ark.	261	WABU	Victor Talking Machine Co. Camden, N. J.	228
KFBS	Trinidad Gas & Electric Supply Co. and The Chronicle News Trinidad, Colo.	360	KFLK	University of New Mexico Albuquerque, N. Mex.	254	WABV	John H. De Witt, 1812 Fifteenth Ave. S., Nashville, Tenn.	263
KFBU	The Cathedral Laramie, Wyo.	283	KFLM	Missoula Electric Supply Co., Missoula, Mont.	234	WABW	College of Wooster Wooster, Ohio	234
KFCB	Nielsen Radio Supply Co. Phoenix, Ariz.	278	KFLN	George R. Clough, 1214 Fortleth St., Galveston, Tex.	240	WABX	Henry B. Joy, Mount Clemens, Mich. (near) John Magaldi, Jr., 815 Kimball St., Philadelphia, Pa.	242
KFCF	Frank A. Moore, 701 Baker Bldg., Walla Walla, Wash.	360	KFLP	Fargo Radio Supply Co. Fargo, N. Dak.	231	WABY	Coliseum Place Baptist Church, New Orleans, La.	263
KFCG	Electric Radio Station (Inc.), Billings, Mont.	360	KFLQ	Atlantic Automobile Co. Atlantic, Iowa	273	WBA	Purdue University West Lafayette, Ind.	360
KFCM	Richmond Radio Shop Richmond, Calif.	360	KFLR	Christian Churches of Little Rock, Little Rock, Ark.	254	WBA	Sterling Electric Co., 31 S. Fifth St., Minneapolis, Minn.	360
KFCP	Ralph W. Flygare, 2421 Jefferson Ave., Ogden, Utah	360	KFLS	University of Arkansas Little Rock, Ark.	261	WBA	The Dayton Co. Seventh st. and Nicollet Ave., Minneapolis, Minn.	417
KFCY	Fred Mahaffey, Jr. Houston, Tex.	360	KFLT	Morningside College Sioux City, Iowa	283	WBAN	Wireless Phone Corporation, 193 Ellison St., Paterson, N. J.	244
KFCZ	Western Union College Le Mars, Iowa	252	KFLU	Freimuth Department Store Duluth, Minn.	275	WBAP	James Millikin University Decatur, Ill.	360
KFDZ	Omaha Central High School Omaha, Neb.	258	KFMU	Stevens Bros. San Marcos, Tex.	231	WBAP	Wortham-Carter Publishing Co. (Star Tele- gram) Fort Worth, Tex.	476
KFDJ	Adler's Music Store Baker, Ore.	360	KFMV	M. G. Sateren, 127 Blanche St., Houghton, Mich.	266	WBAV	Erner & Hopkins Co., 146 N. Third St., Columbus Ohio	390
KFDK	St. Michael's Cathedral Boise, Idaho	252	KFMW	Boy Scouts of America Long Beach, Calif.	229	WBAX	John H. Stenger, Jr., 66 Gildersleeve St., Wilkes-Barre, Pa.	360
KFDL	University of Arizona Tucson, Ariz.	360	KFMX	Roswell Broadcasting Club Roswell, N. Mex.	250	WBAY	Western Electric Co., 463 West St., New York, N. Y.	492
KFDJ	Oregon Agricultural College Corvallis, Ore.	360	KFNG	Wooten's Radio Shop Coldwater, Miss.	254	WBBA	Newark Radio Laboratories Newark, Ohio	240
KFDL	Knight-Campbell Music Co. Denver, Colo.	360	KFNH	State Teachers College Springfield, Mo.	236	WBBD	Barbey Battery Service, Fourth and Walnut Sts., Reading, Pa.	234
KFDO	H. Everett Cutting, 420 W. Koch St., Bozeman, Mont.	248	KFNJ	Warrensburg Electric Shop Warrensburg, Mo.	234	WBBE	Alfred R. Marcy, 113 W. Raynor Ave., Syracuse, N. Y.	246
KFDR	Bullock's Hardware & Sporting Goods, York, Neb.	360	KFOA	Rhodes Co. Seattle, Wash.	455	WBBF	Georgia School of Technology Atlanta, Ga.	270
KFDV	Gilbrech & Stinson Fayetteville, Ark.	360	KFSG	Ehno Park Evangelistic Assn. Los Angeles, Calif.	278	WBGG	Irving Vermilya, 24 Vermilya St., Mattapoisett, Mass.	240
KFDX	First Baptist Church Shreveport, La.	360	KGB	Tacoma Daily Ledger Tacoma, Wash.	278	WBH	J. Irving Bell, 1511 Gordon St., Port Huron, Mich.	234
KFDY	South Dakota State College Brookings, S. Dak.	360	KGG	Hallock & Watson Radio Service, 192 Park St., Portland, Ore.	360	WBBI	Indianapolis Radio Club, 1721 N. Somerset St., Indianapolis, Ind.	234
KFDZ	Harry C. Iverson, 2510 Thomas Ave. S., Minneapolis, Minn.	231	KGN	Northwestern Radio Mfg. Co., 1556 E. Taylor St., Portland, Ore.	360	WBBJ	Neel Electric Co., West Palm Beach, Fla.	258
KFEC	Meier & Frank Co. Portland, Ore.	360	KGO	General Electric Co. Oakland, Calif.	312	WBK	Kaufmann & Baer Co. Pittsburgh, Pa.	254
KFEJ	Guy Gresson, 1724 S. Jay St., Tacoma, Wash.	360	KGU	Marion A. Mulrony, Waikiki Beach, Honolulu, Hawaii	360	WBLC	Grace Covenant Church Richmond, Va.	283
KFEL	Winner Radio Corporation, 1435 Welton St., Denver, Colo.	360	KGW	Portland Morning Oregonian Portland, Ore.	492	WBMM	Frank Atlas Produce Co., 110 Park Place, Lincoln, Ill.	228
KFEQ	J. L. Scroggin Oak, Iowa	360	KGY	St. Martins College Lacey, Wash.	258	WBBO	Michigan Limestone & Chemical Co., Rogers, Mich.	250
KFER	Auto Electric Service Co. Fort Dodge, Iowa	231	KHJ	Times-Mirror Co. Los Angeles, Calif.	395	WBL	T. & H. Radio Co. Anthony, Kans.	261
KFEV	Felix Thompson Radio Shop Casper, Wyo.	263	KHQ	Louis Wasmer, 2020 Thirteenth Ave., Seattle, Wash.	360	WBS	D. W. May (Inc.), 325 Central Ave., Newark, N. J.	360
KFEK	Augsburg Seminary Minneapolis, Minn.	261	KJQ	C. O. Gould, 615 E. Main St., Stockton, Calif.	360	WBT	Southern Radio Corporation, 1116 Realty Bldg., Charlotte, N. C.	360
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co. Kellogg, Idaho	360	KJR	Northwest Radio Service Co., 4328 Sixth Ave., Seattle, Wash.	283	WBZ	Westinghouse Electric & Mfg. Co., Springfield, Mass.	337
KFEZ	American Society of Mechanical Engineers, St. Louis, Mo.	360	KJS	Bible Institute of Los Angeles, 536 S. Hope St., Los Angeles, Calif.	360	WCAD	St. Lawrence University Canton, N. Y.	280
KFFB	Jenkins Furniture Co. Boise, Idaho	240	KLS	Warner Bros. Radio Supplies Co., 2201 Telegraph Ave., Oakland, Calif.	360	WCAM	Clyde R. Randall, 2813 Calhoun St., New Orleans, La.	266
KFFE	Eastern Oregon Radio Co. Pendleton, Ore.	360	KLX	Tribune Publishing Co. (Oakland Tribune) Oakland, Calif.	509	WCAH	Entrekin Electric Co., 321 W. Tenth St., Columbus, Ohio	286
KFFO	E. H. Smith Hillsboro, Ore.	229	KLZ	Reynolds Radio Co., 1534 Glenarm Place, Denver, Colo.	509	WCAJ	Nebraska Wesleyan University, University Place, Neb.	360
KFFQ	Marksheffel Motor Co. Colorado Springs, Colo.	360	KMJ	Love Electric Co. 318 N. L. St., Tacoma, Wash.	273	WCAK	Alfred P. Daniel, 2504 Bagby St., Houston, Tex.	263
KFFR	Nevada State Journal Sparks, Nev.	226	KMN	Grays Harbor Radio Co. Aberdeen, Wash.	263	WCAL	St. Olaf College Northfield, Minn.	360
KFFV	Graceland College Lamoni, Iowa	360	KNV	Radio Supply Co., 815 S. Main St., Los Angeles, Calif.	256	WCAM	Villanova College Villanova, Pa.	360
KFFX	McGraw Co. Omaha, Neb.	278	KNX	Electric Lighting Supply Co., 216 W. Third St., Los Angeles, Calif.	360	WCAP	Sanders & Stayman Co. Baltimore, Md.	360
KFFY	Pincus & Murphy Alexandria, La.	275	KOB	New Mexico College of Agriculture and Me- chanical Arts State College, N. Mex.	386	WBBN	A. B. Blake, 125 N. Front St., Wilmington, N. C.	275
KFFZ	Al. G. Barnes Amusement Co., Dallas, Tex. (portable)	226	KOP	Detroit Police Department Detroit, Mich.	260	WBPP	Potosky High School Potosky, Mich.	248
KFGC	Louisiana State University Baton Rouge, La.	254	KPO	Hale Bros. San Francisco, Calif.	423	WBQQ	Frank Crook 150 Exchange St., Pawtucket, R. I.	242
KFGD	Chickasha Radio & Elec. Co. Chickasha, Okla.	248	KQP	Apple City Radio Club, Hood River, Ore.	360	WBRR	Peoples Pulpit Association Rossville, N. Y.	244
KFGH	Leland Stanford University, Stanford University, Calif.	360	KQV	Doubleday-Hill Electric Co., 719 Liberty Ave., Pittsburgh, Pa.	360	WCAP	Chesapeake & Potomac Telephone Co., Washington, D. C.	469
KFGI	Missouri National Guard, One Hundred and Thirty-eighth Infantry St. Louis, Mo.	266	KQW	Charles D. Herrold, 467 First St., San Jose, Calif.	360			
KFGL	Arlington Garage Arlington, Ore.	234	KRE	Berkeley Daily Gazette Berkeley, Calif.	276			
KFGQ	Crary Hardware Co. Boone, Iowa	226	KSD	Post-Dispatch St. Louis, Mo.	245			
KFGB	Heidbreder Radio Supply Co. Utica, Neb.	224	KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif.	360			
KFGC	First Presbyterian Church Orange, Tex.	250	KTW	First Presbyterian Church Seattle, Wash.	360			
KFGZ	Emmanuel Missionary College, Berrien Springs, Mich.	268						
KFHA	Western State College of Colorado, Gunnison, Colo.	252						
KFHB	Rialto Theatre Hood River, Ore.	280						
KFDH	Utz Radio & Electric Co. St. Joseph, Mo.	226						
KFHH	Central Christian Church Shreveport, La.	360						
KFHI	Amrose A. McCue Neal Bay, Wash.	266						
KFHJ	Fallon & Co. Santa Barbara, Calif.	360						
KFHS	Sist Electric & Radio Co. Seattle, Wash.	283						
KFHT	Clifford J. Dow Lihue, Hawaii	275						
KFHX	Robert W. Nelson, 407 E. First St., Hutchinson, Kans.	229						
KFI	Earle C. Anthony (Inc.), Tenth and Hope Sts., Los Angeles, Calif.	469						
KFID	Ross Arbuckle's Garage Iola, Kans.	246						
KFIF	Benson Polytechnic Institute Portland, Ore.	360						
KFIL	Windisch Electric Farm Equipment Co., Louisburg, Kans.	234						
KFIO	North Central High School Spokane, Wash.	252						
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242						
KFIU	Alaska Electric Light & Power Juneau, Alaska	226						

WCAR Alamo Radio Electric Co., 608 W. Evergreen St., San Antonio, Tex. 360
 WCAS William Hood Dunwoody Industrial Institute, Minneapolis, Minn. 246
 WCAT South Dakota State School of Mines, Rapid City, S. Dak. 240
 WCAU Durham & Co., 1936 Market St., Philadelphia, Pa. 286
 WCAV J. C. Dice Electric Co., 113 W. Capitol Ave., Little Rock, Ark. 360
 WCAX University of Vermont, Burlington, Vt. 360
 WCAY Kesselman O'Driscoll Co., 517 Grand Ave., Milwaukee, Wis. 261
 WCAZ Carthage College, Carthage, Ill. 246
 WCBA Charles W. Helmback, 1015 Allen St., Allentown, Pa. 280
 WCBC University of Michigan, Ann Arbor, Mich. 280
 WCBD Wilbur G. Voltra, Zion, Ill. 345
 WCK Stix-Baer & Fuller Dry Goods Co., St. Louis, Mo. 360
 WCM University of Texas, Austin, Tex. 360
 WCX Detroit Free Press, Detroit, Mich. 517
 WDAE Tampa Daily Times, Tampa, Fla. 360
 WDAF Kansas City Star, Kansas City, Mo. 411
 WDAJ J. Laurance Martin, Amarillo, Tex. 263
 WDAH Trinity Methodist Church (South), El Paso, Tex. 268
 WDAK The Courant, Hartford, Conn. 261
 WDAO Automotive Electric Co., Erway and Corsicana Sts., Dallas, Tex. 360
 WDAF Board of Trade, Philadelphia, Pa. 360
 WDAE Lit Brothers, Philadelphia, Pa. 395
 WDAS Samuel A. Waite, 692a Main St., Worcester, Mass. 360
 WDAU Slocum & Kilburn, 23 N. Water St., New Bedford, Mass. 360
 WDAY Radio Equipment Corporation, 117 Broadway, Fargo, N. Dak. 244
 WDBC Kirk, Johnson & Co., Lancaster, Pa. 258
 WDM Church of the Covenant, Washington, D. C. 234
 WDW James L. Bush, Tuscola, Ill. 278
 WEAA Frank D. Fallain, Police Bldg., Flint, Mich. 280
 WEAF American Telephone & Telegraph Co., 24 Walker St., New York, N. Y. 492
 WEAH Wichita Board of Trade, Wichita, Kans. 280
 WEAL Cornell University, Ithaca, N. Y. 286
 WEAJ University of South Dakota, Vermillion, S. Dak. 263
 WEAM Borough of North Plainfield, North Plainfield, N. J. 252
 WEAN Shepard Co., Providence, R. I. 273
 WEAO Ohio State University, Columbus, Ohio 360
 WEAP Mobile Radio Co., O'Gwinn Bldg., Mobile, Ala. 360
 WEAR Baltimore American and News Publishing Co., Baltimore, Md. 360
 WEAS Hecht Co., Washington, D. C. 360
 WEAU Davidson Bros. Co., Sioux City, Iowa 360
 WEAY Irls Theatre, Houston, Tex. 360
 WEB Kenwood Co., 1110 Olive St., St. Louis, Mo. 360
 WEV Huriburt-Still Electrical Co., McKinley Ave. and San Jacinto St., Houston, Tex. 360
 WEW St. Louis University, St. Louis, Mo. 261
 WFAA Dallas News and Dallas Journal, Dallas, Tex. 476
 WFAE Carl F. Woese, 802 McBride St., Syracuse, N. Y. 234
 WFAF H. C. Spratley Radio Co., 357 Main St., Poughkeepsie, N. Y. 360
 WFAH Electric Supply Co., 637 Procter St., Port Arthur, Tex. 236
 WFAJ Hi-Grade Wireless Instrument Co., 25 Hanover St., Asheville, N. C. 360
 WFAM Times Publishing Co., St. Cloud, Minn. 360
 WFAN Hutchinson Electric Service Co., Hutchinson, Minn. 360
 WFAQ Missouri Wesleyan College, Cameron, Mo. 360
 WFAT New Columbus College, Sioux Falls, S. Dak. 258
 WFAV University of Nebraska, Lincoln, Neb. 275
 WFI Strawbridge & Clothier, Philadelphia, Pa. 395
 WGAL Lancaster Electric Supply and Construction Co., 23 E. Orange St., Lancaster, Pa. 248
 WGAN Cecil E. Lloyd, 216 W. Romana St., Pensacola, Fla. 360
 WGAJ Glenwood Radio Corporation, 900 Texas Ave., Shreveport, La. 360
 WGAW Ernest C. Albright, 1918 W. Chestnut St., Altoona, Pa. 261
 WGAZ South Bend Tribune, South Bend, Ind. 360
 WGI American Radio and Research Corporation, Medford Hillside, Mass. 360
 WGL Thomas F. J. Howlett, 2303 N. Broad St., Philadelphia, Pa. 360
 WGR Federal Telephone & Telegraph Co., Buffalo, N. Y. 319
 WGV Interstate Electric Co., 356 Barrone St., New Orleans, La. 242
 WGY General Electric Co., Schenectady, N. Y. 380
 WHA University of Wisconsin, Madison, Wis. 360
 WHAA State University of Iowa, Iowa City, Iowa 283
 WHAB Clark W. Thompson, Galveston, Tex. 360
 WHAD Marquette University, Milwaukee, Wis. 280
 WHAG University of Cincinnati, Cincinnati, Ohio 222
 WHAH Hafer Supply Co., 112 W. Sixth St., Joplin, Mo. 283
 WHAK Roberts Hardware Co., Clarksburg, W. Va. 258
 WHAM University of Rochester (Eastman School of Music), Rochester, N. Y. 283
 WHAP Otto and Kuhns, 160 S. Water St., Decatur, Ill. 360
 WHAR Paramount Radio & Electric Co., 17 1/2 S. Virginia Ave., Atlantic City, N. J. 231
 WHAS Courier-Journal and Louisville Times, Louisville, Ky. 400
 WHAV Wilmington Electrical Specialty Co., 403 Delaware Ave., Wilmington, Del. 360
 WHAZ Rensselaer Polytechnic Institute, Troy, N. Y. 380
 WHB Sweeney School Co., Sweeney Bldg., Kansas City, Mo. 411
 WHK Radiovor Co., 5005 Euclid Ave., Cleveland, Ohio. 283
 WHN George Schubel, 1540 Broadway, New York, N. Y. 360
 WIAB Joelyn Automobile Co., 320 Church St., Rockford, Ill. 252
 WIAC Galveston Tribune, Galveston, Tex. 360
 WIAD Howard R. Miller, 6318 N. Park Ave., Ocean City, N. J. 254
 WIAF Gustav A. DeCortin, 139 N. Alexander St., New Orleans, La. 234
 WIAI Heer Stores Co., Springfield, Mo. 252
 WIAJ Fox River Valley Radio Supply Co., 425 Sherry St., Vennah, Wis. 224
 WIAK Journal-Stockman Co., Omaha, Neb. 278
 WIAO School of Engineering of Milwaukee, 415 Marshall St., Milwaukee, Wis. 360
 WIAQ Chronicle Publishing Co., 413 S. Washington St., Marion, Ind. 226
 WIAR Paducah Evening Sun, Paducah, Ky. 360

WIAS Home Electric Co., 315 N. Third St., Burlington, Iowa. 360
 WIAU American Trust & Savings Bank, Le Mars, Iowa. 360
 WIK K. and L. Electric Co., 427 Olive St., McKeesport, Pa. 234
 WIL Continental Electrical Supply Co., 808 Ninth St., Washington, D. C. 360
 WIP Gimbel Bros., Philadelphia, Pa. 509
 WJAD Jackson's Radio Engineering Laboratories, 801 Austin St., Waco, Tex. 360
 WJAF Muncie Press and Smith Electric Co., Muncie, Ind. 360
 WJAK Clifford L. White, Greentown, Ind. 254
 WJAM D. M. Perham, 332 Third Ave., West, Cedar Rapids, Iowa 268
 WJAN Peoria Star, Peoria, Ill. 280
 WJAP Capper Publications, Topeka, Kans. 360
 WJAR The Outlook Co., Providence, R. I. 360
 WJAG Norfolk Daily News, Norfolk, Nebr. 283
 WJAS Pittsburg Radio Supply House, 963 Liberty Ave., Pittsburg, Pa. 254
 WJAT Kelley-Vawter Jewelry Co., Marshall, Mo. 360
 WJAX Union Trust Co., Cleveland, Ohio 390
 WJAZ Chicago Radio Laboratory, 332 S. Michigan Ave., Chicago, Ill. 448
 WJD Denison University, Granville, Ohio 229
 WJH William P. Boyer Co., 812 Thirteenth St. N. W., Washington, D. C. 273
 WJX DeForest Radio Telephone and Telegraph Co., 1391 Sedgwick Ave., New York, N. Y. 360
 WJY Radio Corporation of America, New York, N. Y. 405
 WJZ Radio Corporation of America, New York, N. Y. 455
 WKAA H. F. Paar, Cedar Rapids, Iowa 286
 WKAD Charles Loeff (Crescent Park), East Providence, R. I. 240
 WKAF W. S. Radio Supply Co., Wichita Falls, Tex. 360
 WKAN United Battery Service Co., Montgomery, Ala. 226
 WKAP Dutee W. Flint, Cranston, R. I. 360
 WKAQ Radio Corporation of Porto Rico, San Juan, P. R. 360
 WKAR Michigan Agriculture College, East Lansing, Mich. 280
 WKAW Laconia Radio Club, Laconia, N. H. 254
 WKAY Brenau College, Gainesville, Ga. 280
 WKY W K Y Radio Shop, Oklahoma, Okla. 360
 WLAG Cutting & Washington Radio Corporation, 18 W. Franklin St., Minneapolis, Minn. 417
 WLAH Samuel Woodworth, 125 Brownell St., Syracuse, N. Y. 234
 WLAI Waco Electrical Supply Co., 616 Austin Ave., Waco, Tex. 360
 WLAK Vermont Farm Machine Corp., Bellows Falls, Vt. 360
 WLAL Naylor Electrical Co., 24 W. Second St., Tulsa, Okla. 360
 WLAP W. V. Jordan, Louisville, Ky. 360
 WLAQ Arthur E. Schilling, 108 Elm St., Kalamazoo, Mich. 283
 WLAV Electric Shop, 30 S. Palafox St., Pensacola, Fla. 254
 WLAW Police Department, City of New York, New York, N. Y. 360
 WLAX Putnam Electric Co. (Greencastle community broadcasting station), Greencastle, Ind. 231
 WLB University of Minnesota, Minneapolis, Minn. 360
 WLW Crosley Radio Corporation, Cincinnati, Ohio 309
 WMAB Radio Supply Co., 707 N. Broadway, Oklahoma, Okla. 360
 WMAC Clive B. Meredith, Fernwood St., Cazenovia, N. Y. 261
 WMAF Round Hills Radio Corp., Dartmouth, Mass. 360
 WMAH General Supply Co., 144 N. Thirteenth St., Lincoln, Neb. 254
 WMAJ Drivers Telegram Co., Kansas City, Mo. 224
 WMAK Norton Laboratories, Lockport, N. Y. 360
 WMAL Trenton Hardware Co., 35 E. State St., Trenton, N. J. 256
 WMAN First Baptist Church, Columbus, Ohio 286
 WMAP Utility Battery Service, 665 Northampton St., Easton, Pa. 246
 WMAQ Chicago Daily News, Chicago, Ill. 448
 WMAV Alabama Polytechnic Institute, Auburn, Ala. 250
 WMAW Wahpeton Electric Co., Wahpeton, N. Dak. 254
 WMAZ Kingshighway Presbyterian Church, St. Louis, Mo. 280
 WMAZ Mercer University, Macon, Ga. 268
 WMC Commercial Appeal, Memphis, Tenn. 500
 WMD Doubleday-Hill Electric Co., Washburn, D. C. 261
 WME Shepherd Stores, Boston, Mass. 278
 WMDA University of Oklahoma, Norman, Okla. 360
 WMDL R. J. Rockwell, 5019 Capitol Ave., Omaha, Neb. 266
 WMDM Syracuse Radio Telephone Co., 207 E. Jefferson St., Syracuse, N. Y. 286
 WMDN Wittenberg College, Springfield, Ohio 231
 WMDP Charleston Radio Electric Co., Charleston, S. C. 360
 WMDR C. C. Rhodes, Butler, Mo. 231
 WMDS Texas Radio Corporation and Austin Statesman, Austin, Tex. 360
 WMDT Lennig Brothers Co., 927 Spring Garden, Philadelphia, Pa. 360
 WMDV Peoples Telephone & Telegraph Co., Knoxville, Tenn. 236
 WMDW Denakota Radio Club, Port Monroe, Pa. 360
 WMDX Dakota Radio Apparatus Co., Yankton, S. Dak. 244
 WMDY Shotton Radio Mfg. Co., Albany, N. Y. 360
 WMDZ Maus Radio Co., 404 N. Main St. Lima, Ohio 266
 WMDA Friday Battery & Electric Corp., Sigourney, Iowa 360
 WMDC Midland College, Fremont, Neb. 360
 WMDD Tyler Commercial College, Tyler, Tex. 360
 WMDE Apollo Theatre, Belvidere, Ill. 273
 WMDF Palmetto Radio Corporation, 267 King St., Charleston, S. C. 360
 WMDG Southern Equipment Co., San Antonio, Tex. 385
 WMDH William E. Woods, Webster Groves, Mo. 229
 WMDI James D. Vaughn Electric Co., Lawrenceburg, Tenn. 360
 WMDJ Lyradion Mfg. Co., Mishawaka, Ind. 360
 WMDK Kalamazoo College, Kalamazoo, Mich. 283
 WMDL Henry P. Lundskow, 1066 Sheridan Road, Kenosha, Wis. 229
 WMDM Boyd M. Hamp, 215 Market St., Wilmington, Del. 360
 WMDN Pennsylvania National Guard, One Hundred and Twelfth Infantry, Erie, Pa. 242
 WMDO Woodmen of the World, Omaha, Neb. 526
 WMDP Franklyn J. Wolf, 600 Ingham Ave., Trenton, N. J. 240
 WMDQ Palmer School of Chiropractic, Davenport, Iowa 360
 WMDR Iowa State College, Ames, Iowa 360
 WMDS Fine Bluff Co., Fine Bluff, Ark. 360
 WMDT John Wamaker Electric, Philadelphia, Pa. 508
 WMDU Western Radio Co., Kansas City, Mo. 360
 WMDV L. Bamberger & Co., Newark, N. J. 405
 WMDW Missouri State Marketing Bureau, Jefferson City, Mo. 441

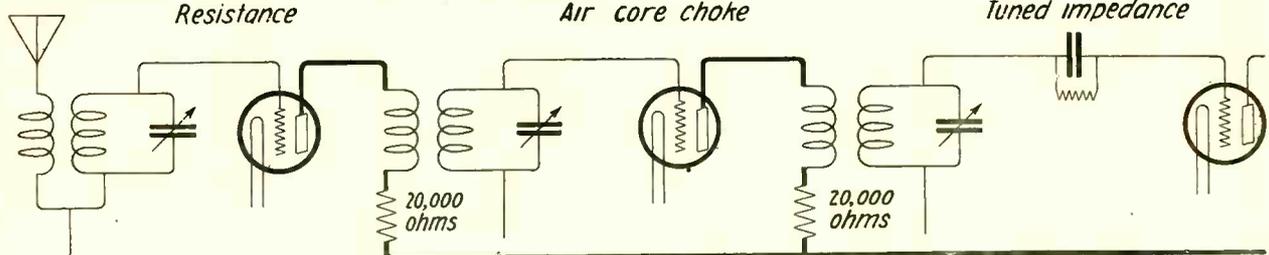
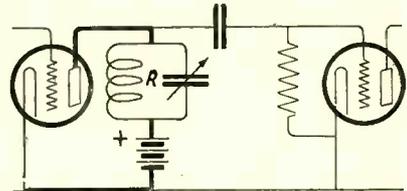
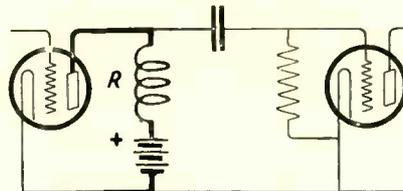
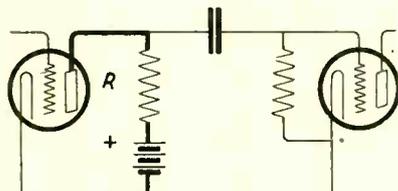
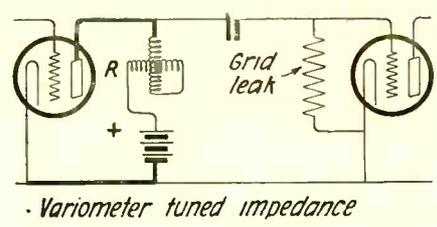
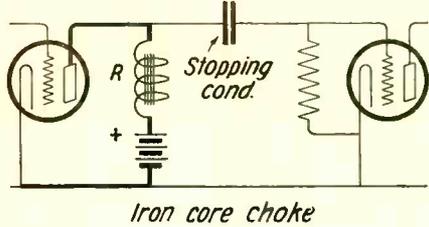
WPAB Pennsylvania State College, State College, Pa. 283
 WPAC Donaldson Radio Co., 210 Tiger Bldg., Okmulgee, Okla. 360
 WPAH Wisconsin Department of Markets, Waupaca, Wis. 360
 WPAJ Doolittle Radio Corporation, 39 Center St., New Haven, Conn. 268
 WPAK North Dakota Agricultural College, Agricultural College, N. Dak. 360
 WPAL Avery & Loeb Electric Co., 114 N. Third St., Columbus, O. 286
 WPAM Auerbach & Guettel, 709 Kansas Ave., Topeka, Kans. 368
 WPAP Theodore D. Phillips, 222 Lexington Ave., Winchester, Ky. 360
 WPAQ General Sales & Engineering Co., Frostburg, Md. 360
 WPAT St. Patrick's Cathedral, El Paso, Tex. 360
 WPAU Concordia College, Moorhead, Minn. 360
 WPAZ John R. Koch, Charleston, W. Va. 273
 WPG Nushawg Poultry Farm, New Lebanon, Ohio 234
 WQAA Horace A. Beale, Jr., Parkersburg, Pa. 360
 WQAC E. B. Gish, 108 E. Eighth St., Amarillo, Tex. 360
 WQAD Whitall Electric Co., 59 W. Maine St., Waterbury, Conn. 242
 WQAE Moore Radio News Station, Springfield, Vt. 275
 WQAF Sandusky Register, Sandusky, Ohio 240
 WQAH Brock-Anderson Electrical Engineering Co., Lexington, Ky. 254
 WQAL Coles County Telephone & Telegraph Co., Mattoon, Ill. 258
 WQAM Electrical Equipment Co., Miami, Fla. 283
 WQAN Scranton Times, Scranton, Pa. 280
 WQAO Calvary Baptist Church, New York, N. Y. 360
 WQAQ West Texas Radio Co. (Abilene Daily Reporter), Abilene, Tex. 360
 WQAS Prince-Walter Co., 108 Merrimack St., Lowell, Mass. 266
 WQAV Huntington & Guerry (Inc.), Greenville, S. C. 258
 WQAW Catholic University, Washington, D. C. 236
 WQAX Radio Equipment Co., Peoria, Ill. 360
 WQAA Rice Institute, Houston, Tex. 360
 WRAD Taylor Radio Shop, Marton, Kans. 248
 WRAF The Radio Club, Laporte, Ind. 224
 WRAH Stanley N. Read, 131 Alabama Ave., Providence, R. I. 231
 WRAL Northern States Power Co., St. Croix Falls, Wis. 248
 WRAM Lombard College, Galesburg, Ill. 246
 WRAN Black Hawk Electrical Co., Waterloo, Iowa 236
 WRAO St. Louis Radio Service Co., 5735 Barmter Ave., St. Louis, Mo. 360
 WRAW Antioch College, Yellow Springs, Ohio 242
 WRAW Avenue Radio Shop, Reading, Pa. 238
 WRAX Flexon's Garage, Gloucester City, N. J. 268
 WRAY Radio Sales Corporation, 110 Spruce St., Scranton, Pa. 280
 WRZ Radio Shop of Newark, 89 Lehigh Ave., Newark, N. J. 233
 WRC Radio Corporation of America, Washington, D. C. 459
 WRK Doron Bros. Electrical Co., Hamilton, Ohio 360
 WRL Union College, Schenectady, N. Y. 360
 WRM University of Illinois, Urbana, Ill. 360
 WRR City of Dallas, Police and Fire Signal Department, Dallas, Tex. 360
 WRW Tarrytown Radio Research Laboratory, Tarrytown, N. Y. 273
 WSAB Southeast Missouri State Teachers College, Cape Girardeau, Mo. 360
 WSAC Clemson Agricultural College, Clemson College, S. C. 360
 WSAD J. A. Foster Co., 69 Dorrance St., Providence, R. I. 261
 WSAG Loren V. Davis and George Prestman, Jr., St. Petersburg, Fla. 244
 WSAH A. G. Leonard, Jr., 4801 Woodlawn Ave., Chicago, Ill. 248
 WSAI United States Playing Card Co., Cincinnati, Ohio 309
 WSAJ Grove City College, Grove City, Pa. 360
 WSAK Franklin Electric Co., Rockville, Ind. 246
 WSAN Allentown Radio Club, Allentown, Pa. 229
 WSAR Doughty & Welch Electrical Co., Fall River, Mass. 254
 WSAT Donohoo-Ware Hardware Co., Plainville, Tex. 268
 WSAW John J. Long, Jr., Canandaigua, N. Y. 275
 WSAX Chicago Radio Laboratory, Chicago, Ill. 268
 WSB Port Chester Chamber of Commerce, Port Chester, N. Y. 233
 WSBZ Chase Electric Shop, Pomeroy, Ohio 258
 WSB Atlanta Journal, Atlanta, Ga. 429
 WSL J. & M. Electric Co., 26 Bank Place, Utica, N. Y. 273
 WSY Alabama Power Co., Birmingham, Ala. 360
 WTAB Fall River Daily Herald Publishing Co., Fall River, Mass. 248
 WTAC Penn Traffic Co., Washington St., Johnstown, Pa. 360
 WTAF Louis J. Gallo, 2222 Lapeyrouse St., New Orleans, La. 268
 WTAG Kern Music Co., 84 Weybosset St., Providence, R. I. 258
 WTAH Carmen Ferro, Belvidere, Ill. 236
 WTAJ The Radio Shop, Portland, Me. 236
 WTAL Toledo Radio & Electric Co., Toledo, Ohio 252
 WTAM Willard Storage Battery Co., Cleveland, Ohio 390
 WTAN Orndorff Radio Shop, Mattoon, Ill. 240
 WTAP Cambridge Radio & Electric Co., Cambridge, Ill. 242
 WTAQ S. H. Van Gorden & Son, Osseo, Wis. 226
 WTAR Reliance Electric Co., Norfolk, Va. 280
 WTAS Charles E. Erbstein, (near), R. F. D. No. 6, Box 75, Elgin, Ill. 286
 WTAT Edison Electric Illuminating Co., (portable), 39 Boylston St., Boston, Mass. 244
 WTAU Ruegg Battery & Electric Co., Tecumseh, Neb. 360
 WTAW Agricultural and Mechanical College of Texas, College Station, Tex. 280
 WTAX Williams Hardware Co., Streator, Ill. 231
 WTAY Iodair-Oak Leavens Broadcasting Station, Oak Park, Ill. 226
 WTAZ Thomas J. McGuire, Lambertville, N. J. 283
 WTG Kansas State Agricultural College, Manhattan, Kans. 360
 WWAB Hoenig, Swern & Co., Trenton, N. J. 226
 WWAC Sanger Bros., Waco, Tex. 360
 WWAD Wright & Wright (Inc.), 2215 N. Broad St., Philadelphia, Pa. 360
 WWAE Alamo Dance Hall, Joliet, Ill. 227
 WWAF Galvin Radio Supply Co., 521 Market St., Camden, N. J. 236
 WWOA Michigan College of Mines, Houghton, Mich. 244
 WWI Ford Motor Co., Dearborn, Mich. 273
 WWJ Detroit News, Detroit, Mich. 517
 WWL Loyola University, New Orleans, La. 280

RADIO ENGINEERING

An Experimental and Home-Laboratory Course of Simple and Advanced Radio Design

By John R. Meagher
Consulting Engineer

INTER-TUBE COUPLING



THE problem of coupling vacuum tubes for amplification of all frequencies employed in radio reception is one of importance; and it is a problem to the understanding of which the ambitious student may well direct this mental energy.

Let us first consider inter-tube coupling as a whole rather than the more usual way of dividing amplifiers into those types suited for high, intermediate or low frequencies.

We have one object: to make the plate current variations produce as large voltage variation on the grid of the next tube as possible; or better stated, to make the plate current variations produce maximum voltage variation between the plate and filament so that this voltage variation may be applied to the grid of the next tube. In doing this we are somewhat restricted by the necessity of applying the proper plate and grid voltages to the tubes so that they may operate properly.

To obtain the largest possible voltage variation between the plate and filament we may include in the plate circuit an impedance of a value at least equal to the plate-filament impedance. For small receiving tubes the plate-filament impedance for all except rather high frequencies is practically the same as the plate-filament direct current resistance which is found by the ratio of "B" battery voltage and plate current when the grid voltage is zero.

The external plate circuit impedance may be of any form which will permit a flow of direct current and also have a suitable high impedance for the frequency being amplified.

The external plate circuit impedance may be directly or indirectly coupled to the grid and filament of the next tube. If the impedance is an inductive one, it may be magnetically coupled to another coil connected to the grid and filament of the next tube—in which case we have "transformer" coupling. But whether it is an inductive impedance or not, it may be directly coupled to the grid and filament of the next tube: If common "A" and "B" batteries are used in this type of amplifier it is necessary to keep the plate voltage off the grids; this is usually done with a "stopping" condenser which insulates the grid from direct current, but has a value such as to readily pass alternating or pulsating current of the frequency to be amplified. (For one should remember that there is no alternating current in the plate circuit.) With such a "blocking" condenser, the grid would be "free" and might attain an excessively high negative charge—due to the negative space charge—which would reduce the plate current and "paralyze" the tube." So a leak must be provided from the grid to the filament. Depending upon what point in the filament circuit the "grid leak" is connected to, the grid may be maintained at

any desired value with respect to the negative terminal of the filament. This leak resistance must have a value high enough to prevent short-circuiting the grid; and a value low enough to permit the accumulated grid voltage to leak off during one wave train and thus prevent the tube from "paralyzing."

To summarize—1. The external plate impedance should at least equal and if possible exceed the internal plate-filament impedance at or over the band of frequencies being amplified. And the impedance should be capable of passing direct current.

2. The "stopping" condenser, if one is used, should be of such a value as to readily pass the frequency or band of frequencies being amplified, but should not pass direct current.

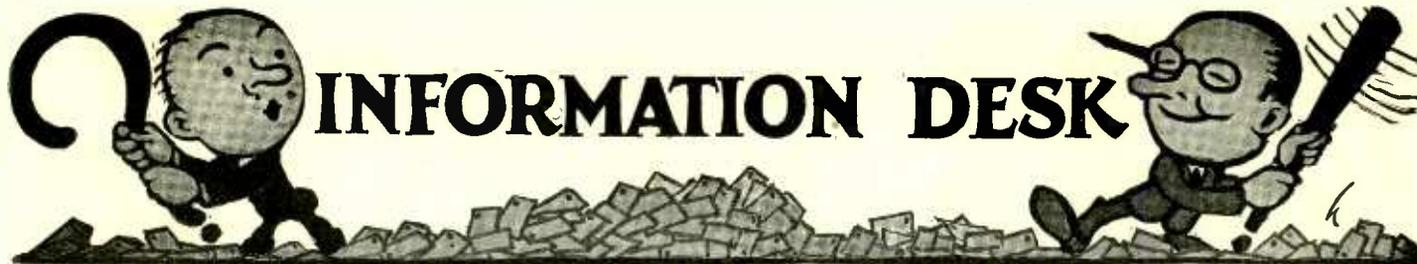
3. The grid leak should have a value sufficiently high to prevent short-circuiting the grid for the frequency being amplified, and a value low enough to permit proper and regular leaking off of the negative charge accumulated during each "wave train." The leak connection should be such as to enable maintenance of a proper grid voltage in order that the tube may be worked at a favorable point on the plate-grid characteristic curve.

The five figures represent several variations of "impedance" coupling; each has special qualifications and limitations, but essentially they are alike. Every transformer coupling is the same thing done differently.

We shall, in time, take up efficiency-requirements of these amplifiers, but at present we would like to point out how the above information might be applied to receivers that, while they operate well, could nevertheless be improved in design. These receivers have a few stages of transformer-coupled radio frequency amplification; the primaries of the transformers are composed of only a few turns; the secondaries are of such an inductance value as to permit a small variable condenser to tune them over the desired range. Now the impedance of the primaries is excessively low so that the plate voltage variations are not nearly as great as they might be. The purpose of such a few turns is to eliminate self-oscillation.

An easy method of "jacking up" the impedance would be to insert a (non-inductive, low inter-electrode capacity) resistance of say 20,000 ohms in series with the primaries as shown in the diagram. This would reduce the plate voltage, but with the value suggested (20,000 ohms) there would be no necessity of increasing the "B" battery voltage of the radio frequency amplifiers. The rather high distributed capacity from the primaries to the filament would be in shunt to these resistances and would lower their effective impedance.

(To be continued.)

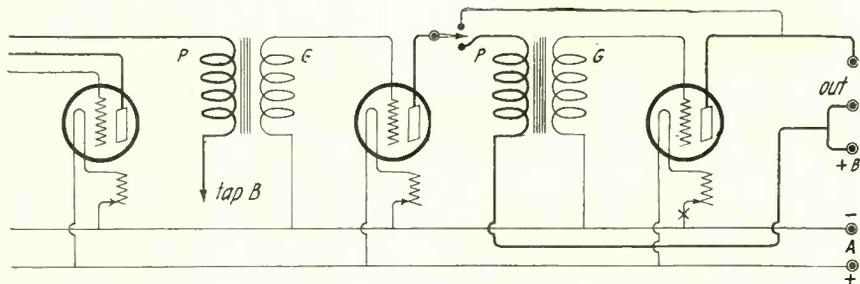


CONDUCTED BY R. A. BRADLEY
A self-addressed stamped envelope will insure a prompt reply to any queries on radio

Why Jacks?

"I am planning to build a receiver with two stages of audio frequency amplification; not being adept at soldering and realizing that connections to jacks require rather delicate workmanship, I am wondering if I could eliminate the jacks — using some simple method to change from step to step." Thus writes Mr. R. V. Marsten of San Diego, California.

The diagram in these columns shows an exceedingly simple, reliable and "fool-proof" switching arrangement to enable transfer of the headset from the first to second stage.



No provision for using the detector alone is shown as when an amplifier is available we very seldom wish to use less than one stage—even with a headset.

An extra "battery switch" may be placed at X in the diagram to break the filament circuit of the last tube when that is not in use. This is better than turning the rheostat to the "off" position.

Personally we do not like jacks and it is evident that many of the best manufacturers are of the same opinion, as numerous high grade receivers are now equipped with switches rather than jacks.

Avoid Hand Capacity Effects

Mr. Alfred Whitman of Iowa City, Iowa, asks how he can prevent the hand capacity effects especially troublesome in his receiver.

Very often, the average experimenter in connecting up a variable condenser to tune the secondary of a variocoupler or honeycomb coil unit, does not take into consideration this troublesome and annoying effect. In connecting a variable condenser in a circuit, always see that the rotary plates are connected either to the ground side of the circuit or the filament side, and the stationary plates to the grid side of the circuit. The reason for this is evident. Your hand as well as the rest of your body is at or near ground potential. That is, at zero voltage with respect to ground. Now if the rotary plates and the shaft of the condenser are connected to the filament or ground side of the circuit, there will be no difference of

potential between your hand and the dial on the panel and consequently no condenser effect. A condenser which has the rotary plates grounded to the framework is a particularly advantageous instrument, as the greater part of the metal work in it is at ground potential, and, if connected up in accordance with these directions, it will be found that hand capacity effects are practically nil.

Adjustment of the Neutrodyne

Mr. Joseph Studer, Fort Wayne, Ind., says that in his neutrodyne receiver, if he takes

either the second radio frequency tube or the detector tube out of the socket the music comes in just as loud as with them in.

This shows that one of the radio frequency tubes is rectifying, which in turn shows that the neutralizing condensers are improperly adjusted.

They may be adjusted as follows: Remove the first radio frequency tube from its socket and place a wad of paper around the two filament prongs, then replace the tube in the socket. The filament prongs are now not making contact with the springs in the socket and consequently the filament will not light. Tune in a signal as loud as possible, then adjust the first neutralizing condenser until you have decreased the signal strength as much as possible or eliminated it entirely. Now remove the wads of paper on the filament prongs and repeat the process with the second radio frequency tube. Your neutrodyne is now adjusted to its most sensitive condition. Note that this process will have to be repeated each time that new or different tubes are used.

C Battery Voltage

Mr. Julius Hengerer of Elkhart, Ind., wants to know the proper value of "C" battery to use with his audio frequency amplifier when applying 90 volts to the plates of the UV-199 tubes.

The correct value of the "C" battery in this instance is $4\frac{1}{2}$ volts. It would not be advisable to exceed this "B" battery voltage of 90.

A Successful Crystal Set

Mr. Haseltine informs us that he has been getting remarkable results with his crystal set made up in accordance with the diagrams and sketches in the January issue of THE WIRELESS AGE. His greatest DX has been Hastings, Nebr., approximately 1,180 miles from his home.

Parts for the Uni-Control

Mr. Van Valkenburgh asks for the address of the Kardon Products Company, which is 101 Varick Street, New York City.

This company manufactures audio frequency transformers and the mounting shelf with the tube sockets already attached. He also states that he has been unable to obtain the Veldar variable condenser for use in the Uni-Control Receiver. Any variable condenser of good reliable manufacture with a means of vernier adjustment and with a capacity of .0005 mfd. will function satisfactorily in this set.

Shamrock Variometers for "The Wireless Age" March Set

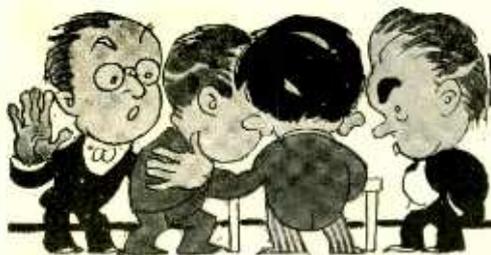
Mr. Miller of Glens Falls, N. Y., inquires whether or not Shamrock variometers can be used in the Special Three Tube set described in the March issue.

They can be used very satisfactorily. The Shamrock variometer comes provided with four Fahnestock clips fastened to the framework of the variometer. Two of these clips are the terminals of the stator and the two others are the terminals of the rotor. Before attempting to connect up these instruments in the set, be sure to run a strap between one rotor terminal and one stator terminal so that the two windings will be in series. Use the two remaining clips as the terminals of the completed variometer in connecting up the receiver.

Get Rid of Your Whistle

Mr. A. G. Hilson of Pasadena, Calif., wants to know how to cut out the high frequency whistle which he gets in the second stage of his two step a. f. amplifier.

There are a number of ways in which this can be done. The whistle can be eliminated by shunting the secondaries of each transformer with a 100,000-ohm grid leak of the sealed glass tube variety. Grounding the negative side of the "A" battery will accomplish it with about the same degree of effectiveness, and, of course, is easier to do. If neither of these have any effect, ground the cores and framework of the transformers. If the whistle is still in evidence, the transformers are mounted too close together and should be placed farther apart and at right angles to prevent interaction between their magnetic fields.



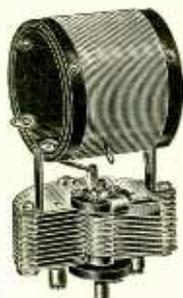
NEW APPLIANCES AND DEVICES



Condenser Tuned Radio Frequency Transformer

THE New York Coil Co. has brought out a condenser tuned radio-frequency transformer so designed that electrical losses, such as distributed capacity, have been reduced to the minimum.

The ratio between primary and secondary,



NEW YORK COIL CO.

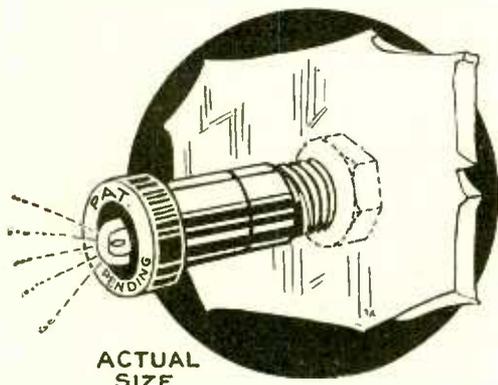
and the correct separation of same all represent the highest development, which together with the grade of material used—results in superior performance.

The transformer is rigidly secured to the New York Variable Condenser of 17 plates, which will tune sharply all wave lengths from 250 to 575 meters.

Kant-Blo Signal Protective Unit

THE Kanter Manufacturing Corporation, New York City, have perfected and are now marketing the Kant-Blo Signal, which is a protective unit for preventing the blowing out of radio tubes in receiving circuits.

This Kant-Blo Protective Unit is being made in two styles—one in the style of a B-



ACTUAL SIZE

battery binding post and one in the style of a push-pull A-battery switch.

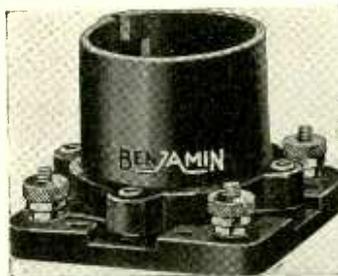
This protective unit takes the place of either a binding post or an A-battery switch that is now on any set, and one signal of either style will protect any number or type of receiving tubes from blowing out due to any short circuit that can develop.

The Kant-Blo eliminates the necessity and expense of using fuses for protection of the filaments; at the same time it provides a visible signal should a "short" develop.

New Vacuum Tube Socket

THE Benjamin Electric Mfg. Company, Chicago, is now producing a socket for radio vacuum tubes called the Cle-Ra-Tone.

The tube holding element of the socket floats on light springs which act as shock absorbers and neutralizes interfering vibrations which ordinarily would cause "tube noises." The general effect is clearer reproduction.



It is made in two sizes, one for standard base tubes and the other for UV-199 types.

A New Broadcast Set

THE Bristol Co. of Waterbury, Conn., has brought out a new B.C.L. set using the Grimes Inverse Duplex Circuit. As shown by the cut, the equipment is mounted on a horizontal panel in a mahogany case with hinged lid, all connections to the set except phones being made through a panel board mounted at the back of the case. Ten plugs with four-foot cords are part of the equipment. The first two tubes are radio

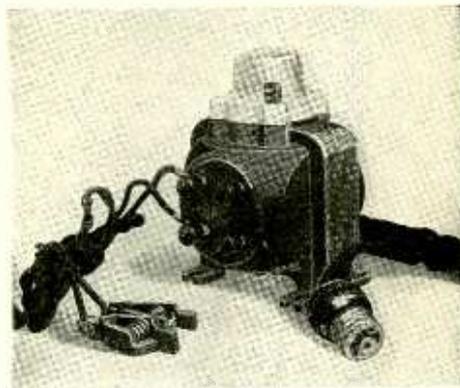


frequency amplifiers, the third a detector, and then the first two tubes are used again in reverse order as reflexed audio amplifiers, the final tube being a power amplifier in the well known and really excellent Bristol circuit. The combination makes an unusual set.

The set has but one control, a vernier-equipped tuning knob. A voltmeter, showing the voltage at which the amplifier tubes are operating, is a valuable and rarely-seen part of the set.

"A" and "B" Battery Charger

THE Acme battery charger for radio "A" and "B" and also automobile batteries has recently been brought out on the market.



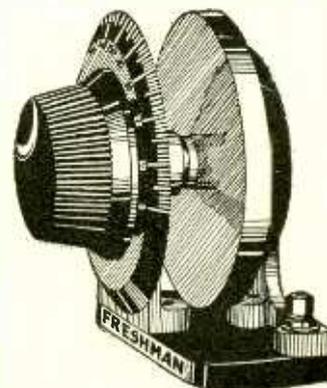
The capacities that these battery chargers are built in are 2 ampere and 5 ampere sizes to charge up to and including 36 "B" type cells.

The construction and design is very unique, and the operating characteristics are such that radio "A" batteries can be charged while the receiving set is in operation.

These battery chargers are being manufactured by The Acme Electric and Manufacturing Company, Cleveland, Ohio.

A Variable Condenser for Transmission or Reception

A VARIABLE condenser of entirely new construction has been developed by the Chas. Freshman Co., Inc., New York City. It has long been conceded by radio engineers that a variable condenser with mer-

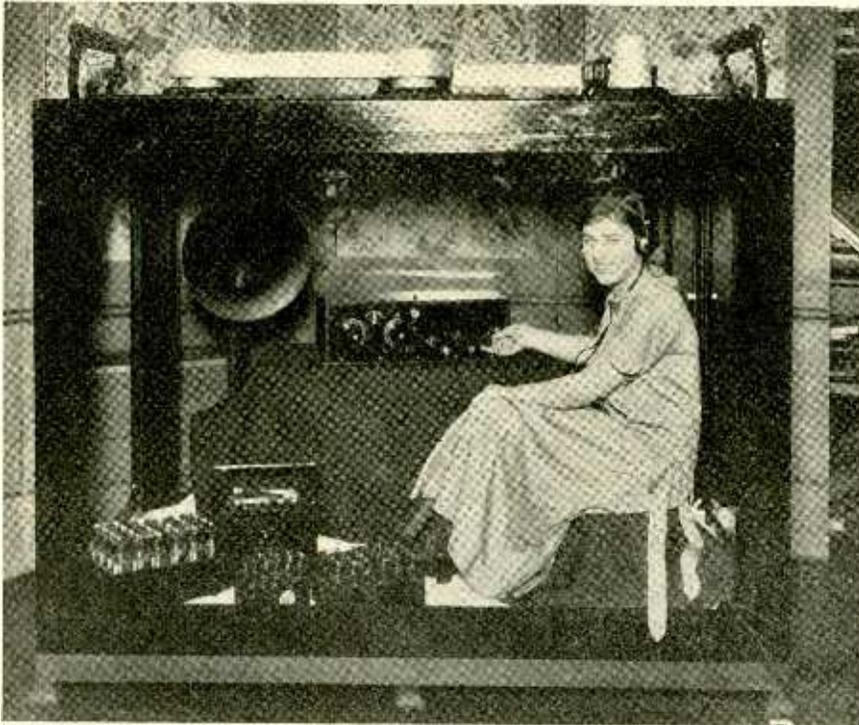


cury plates and a mica dielectric would be the most efficient and compact condenser made. This can be readily understood, as the mercury plates make very intimate contact with the mica dielectric. The inventor has achieved this and has also evolved a construction wherein the plates vary in area.

The dielectric is a heavy piece of India ruby mica and the housing is made of Bakelite. The variation in capacity is accomplished by rotating the entire structure

(Continued on page 62)

INDUSTRIAL INKLINGS



A business-getter innovation of the Willard Storage Battery Co.

THE Radio Industries Corporation, New York, have been granted a patent on adjustable phones and loud speakers which covers any resilient member interposed between the diaphragm and the receiver case.

ROLLER-SMITH COMPANY, New York, offer in a pamphlet several direct current switchboard instruments which comprise ammeters, milli-ammeters, voltmeters, milli-volmeters, volt-ammeters. Their booklet contains charts which give the values per scale division. Such information is valuable when selecting instruments of this kind.

THE Federal Telephone and Telegraph Company, Buffalo, New York, have solved the constructional problems for the buyers of parts, by issuing an accurately marked template, showing how to correctly space the screw holes for mounting the instrument whether it be a variable condenser, variometer, variocoupler, rheostat, potentiometer or anti-capacity switch. A glance at the illustration will indicate the convenience of a template when marking and drilling holes in the panel. The builder has only to paste it on the spot where the holes are wanted and gently, but firmly, punch a sharp instrument through the paper into the panel, thus transferring the correct spacing from the paper template to the panel. The drill size for each hole is also furnished, so that when all holes are drilled, all you have to do is put the parts in position and tighten up the screws.

THE Rieger Research Corporation, manufacturers of Curkoids and Curkoid couplers have changed their location to 100 Charles Street, New York City, where they are occupying two floors. This change in location affords the corporation a considerable increase in manufacturing ability over that which they had in their old location.

ADAMS-MORGAN COMPANY have placed with every dealer appointed by Paragon distributors, an attractive counter display card to show Paragon connection. Every month they select their best piece of consumer advertising, have it reprinted to proper size to fit the card and send it to each dealer, so that he can keep his card up to date. In this way they tie together their consumer advertising with the dealer.

BRUNSWICK Electric and Radio Company, St. Louis, Mo., are distributing to their customers a small card which any radio dealer can have printed at a small cost. This card is made up in the form of an appreciation card which the radio listener may fill out and send to the broadcast station as his applause. These cards serve to promote the good-will of the dealer who issues them to his customers.

THE WINKLER-REICHMANN COMPANY, Chicago, Ill., have canvassed radio dealers with a snappy folder illustrating their Thorophone, attached to a questionnaire, well calculated to elicit some response.

PRESIDENT FREDERICK DIETRICH of C. Brandes, Inc., manufacturer of "Matched Tone" radio headsets and the Brandes "Table-Talker" has announced that the capitalization of the company has been increased from \$500,000 to \$1,000,000. The original capitalization was \$5,000, and on March 3, 1923, less than a year ago, it was increased to the half-million mark.

Mr. Dietrich and Mr. C. E. Brigham, chief research engineer, sailed for Europe on March 8th, to visit the new plant of the Brandes, Ltd., in England.

Mr. Harry J. Walsh, who for the past year was assistant to Director Lane of the Electrical Industry's Joint Committee for Business Development, has been appointed publicity manager of C. Brandes, Inc.

LUDWIG-HOMMEL, Pittsburgh, Pa., have issued an encyclopedia of radio apparatus. This book contains their latest price list, particularly the receiving equipment section which will unquestionably be of paramount interest to all radio fans reading *THE WIRELESS AGE*. This encyclopedia-price list may be recommended unreservedly to any radio fan who is interested in the purchase of parts and equipment.

THE Progress Press of Union, S. C., have brought out a book, "Where I Go by Radio," for the B.C.L. which enables him to keep a complete record of his reception.

Spaces are provided for noting of dial setting, time, weather conditions, etc., and thus a really comprehensive record can be kept.

A Variable Condenser for Transmission or Reception

(Continued from page 61)

on two shafts which act as the terminals. The reservoir which contains the mercury is at the extreme lower portion when the condenser is set for zero capacity. As the condenser is rotated the mercury rides out of this reservoir into a thin circular chamber about one-sixteenth of an inch thick, forming a thin wall of mercury which increases in size, until the reservoir is at the top part of the casing. At this point maximum capacity is attained, due to the fact that you have a complete circular plate of mercury which is opposite to the circular plate of mercury on the other side of the mica dielectric.

The condensers give practically twice the capacity ever attained before in the same space where condensers of semi-circular plates are used.

In the official tests the condenser was found to withstand a voltage of 8,000 volts and to have a phase angle loss of less than one minute—the actual loss being too small to be measured accurately.

“THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS”



Why Big Cells Count in Radio “B” Batteries

THIS handsome metal case Eveready “B” Battery No. 766 costs only two-thirds more than the smallest Eveready “B” Battery, but it contains seven times the electricity! This makes the No. 766 over four times as economical as its baby brother. That is why most people buy it.

Its fifteen large cells give 22½ volts of strong, steady energy day after day. Cells that pour out power the moment you turn on your tubes. Cells that rest well when idle, renewing their vigor for your next demands.

No cells have a bluer-blooded ancestry than these. They are the product of thirty years of dry battery research and development of the

world’s foremost electro-chemical laboratories. We think that No. 766 is the handsomest battery ever made. But that is a matter of opinion. It is a matter of engineering record, however, that this great standard “B” Battery has proved itself as perfect in performance as we are convinced it is superfine in appearance.

The 45-volt Eveready No. 767 contains the same large powerful cells as the No. 766. For maximum “B” Battery economy, therefore, buy the 22½-volt Eveready No. 766 or the 45-volt Eveready No. 767, as you prefer. Here is the “B” Battery at its best.



Eveready “B” Battery No. 766
22½ volts. Six Fahnestock Spring Clip Terminals, giving variable voltage from 16½ to 22½ volts, in 1½-volt steps. Length, 6¾ in.; width, 4¼ in.; height, 3 3/16 in. Weight, 5 lbs.

NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Company, Limited
Factory and Offices: Toronto, Ontario

If you have any radio battery problem, write to G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 198 Orton Street, Long Island City, N. Y. Informative and money-saving booklets on “A,” “B” and “C” Batteries sent free on request.



Eveready 6-volt Storage Battery

No. 764 The Space Saver Vertical 22½-volt “B” Battery

Eveready Radio “A,” Dry Cell Specially manufactured for use with dry cell tubes

No. 767 “B” Battery, 45 volts Variable taps Fahnestock Clips

No. 771 “C” Battery Clarifies tone and increases “B” Battery life

EVEREADY

Radio Batteries

—they last longer

When writing to advertisers please mention THE WIRELESS AGE

Results of Amateur Trans-Atlantic Tests

IN the recent trans-Atlantic Amateur Tests made under the auspices of the American Radio Relay League the American operators report hearing thirty-seven European transmitters.

The American prize winners have been announced as follows:—

1ANA, R. B. Bourne, Chatham, Mass., Grand Prize.

Greatest Mileage For Any Single Reception

5AC, Norman S. Hurley, Mobile, Ala., 4,750 miles.

9DES, William Moore, Caney, Kan., 4,710 miles.

4BL, L. W. and T. E. Bryant, Lakeland, Fla., 4,540 miles.

9COL, Quentin Swigart, Galesburg, Ill., 4,310 miles.

9CD, Fred Marco, Chicago, Ill., 4,200 miles.

Greatest French Mileage For Any Single Night

IBDT, Sheldon S. Heap, Atlantic, Mass.

c1DD, W. Coates Borrett, Dartmouth, N. S.

3YO, Lafayette College Radio Club, Easton, Pa.

3II, Ed. Scattergood, Cynwyd, Pa.

2BIS, M. H. Hammerly, Bronxville, N. Y.

Greatest British Mileage For Any Single Night

c1AF, J. L. Fenderson, Jacquet River, N. B., Can.

Bronx Radio Club, Bronx, N. Y.

1GG, Robert H. Sproul, South Hamilton, Mass.

1BVL, Richard S. Briggs, Dorchester, Mass.

2AJF, J. VanRiper, Passaic, N. J.

Greatest Total French Mileage

1BCF, Levi G. Cushing, South Duxbury, Mass.

c1BQ, A. W. Greig, Halifax, N. S.

R. W. Woodward, Hartford, Conn.

3APV, Bernard J. Kroger, Washington, D. C.

1CKP, George H. Pinney, South Manchester, Conn.

Greatest Total British Mileage

A. A. Learned, Providence, R. I.

A. R. Tabbut, Bar Harbor, Me.

1BDU, Boardman H. Chace, Winthrop, Mass.

1AUC, Chester W. Sprague, Bar Harbor, Me.

1AUR, Harold G. Riley, Livermore Falls, Me.

Stations Worked and Heard

8DHQ—Chesaning, Mich.

(6aru), 6cdg, 6che, 6vf, 6brf, 6buy, 6cie, 6rn, 6awt, (6bpz), (6aoi), 6zp, 6azk, 6bzn, (6bcl), 6la, 6cmt, 6buj, (6ahp), 6gh, 6cei, 6bbw, 6cbw, 6zis, 6lv, 6fm, 6cmu, 6blh, 6buh, 6aoh, (6xad), 6cbb, 6aqq, 6nb, 6if, 6aao, 6eb, 6cgw.

7co, 7ahi, 7to, 7ih, 7lv, 7lb, 7abb, 7sy, (7bj), 7ajv, 7zl, 7af, 7ahu, 7vm, 7acx, 7ads, 7fn, 7ahv, 7fq.

8DCF—VINCENT FRENCH, 31 Kingsville Ave., Ashtabula, Ohio.

All cw—1aez, 1alj, 1all, 1aw, 1ayt, 1bwj, 1caz, 1cjr, 1ckp, 1fs, 2afp, 2axr, 2azy, 2bnc, 2ckl, 2cja, 2cor, 2cpd, 2ctu, 2cvj, 2ku, 3adb, 3aic, 3bhv, 3boi, 3bwt, 3bz, 3ccx, 3cel, 3hh, 3jx, 3qv, 3zm, 4mi, 4my, 4sh, 5alv, 5be, 5ek, 5jl, 5mo, 5vc, 5uk, 6akz, 6aur, 6brf, 6fp, 6li, 6rn, 6zh, 7co, 9aci, 9aic, 9apf, 9aza, 9baz, 9boz, 9caa, 9cvs, 9dlw, 9dtt, 9dun, 9dur, 9dyy, 9dyz, 9edb, 9eht, 9mc, 9vk, 9zy.

100 meters: 1dq, 3adb, 3bji, 4eh, 8aaf, 8aol, 8xbh, 9vm.

Spark: 4fg. Can. 2cg.

If any of above want check on thr sigs just drop me a crd. Wud appreciate qsl's on mi sigs.

96-LJ—S. K. LEWER, 32 Gascony Avenue, West Hampstead, London N.W.6, England.

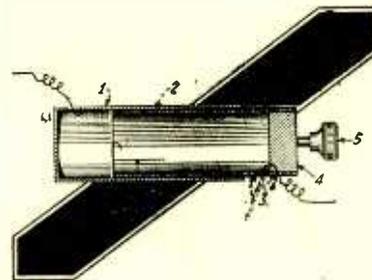
1ajp, 1ajt, 1al, 1all, 1alu, 1an, 1aol, 1ar, 1arc, 1ark, 1ary, 1as, 1atb, 1aur, 1bdi, 1bdt, 1bl, 1bq, 1bt, 1bwj, 1cmk, 1cmp, 1csw, 1dw, 1fe, 1fk, 1ii, 1jlf, 1kc, 1ma, 1mo, 1mv, 1my, 1ow, 1pa, 1rd, 1rj, 1sn, 1tx, 1vv, 1xam, 1xm, 1yb, 1yk, 1zp, 1pc, 1bx, 1cj, 1bd, 1wl, 1ly, 1rk, 1tp, 1yd, 1bn, 1atm, 1bcf, 1bdu, 1bse, 1ccx, 1cmx, 1dq, 1gu, 1tw, 1cru, 1fm, 1xah, 1xj, 1ahf, 1arq, 1mm, 1xw, 1bbo, 1xak, 2adw, 2aed, 2ajd, 2ajp, 2al, 2ana, 2aur, 2ax, 2bar, 2bqh, 2ft, 2fone, 2fx, 2gk, 2ht, 2io, 2iu, 2qe, 2tf, 2tu, 2ud, 2wa, 2wr, 2xap, 2ym, 2bsc, 2cla, 2br, 2fo, 2gx, 2it, 2cee, 2awl, 2el, 2bnu, 2cnk, 2azy, 2bn, 2awf, 2agb, 2csl, 3adb, 3aou, 3bd, 3bg, 3bgj, 3bkt, 3bq, 3bt, 3cbz, 3ck, 3cv, 3hg, 3wb, 3wf, 3ac, 3auw, 3co, 3te, 3xjp, 3bfq, 3pk, 3oe, 3ot, 3tu, 3qv, 3ud, 3cc, 3bl, 3yo, 4fs, 4ft, 4ht, 4rh, 4ri, 4tu, 4yx, 4zbq, 4gw, 4cl, 4ow, 4ar, 4ea, 4by, 4bz, 4hs, 4io, 5ab, 5aiu, 5cc, 5fg, 5ml, 6am, 6aos, 6awt, 6br, 6cmp, 6lj, 6xad, 6zz, 6bcr, 6bn, 7ac, 7af, 7bf, 7bj, 8adg, 8anm, 8ao, 8ary, 8asv, 8atd, 8awp, 8bd, 8bdi, 8bfm, 8blv, 8boa, 8btm, 8bw, 8ca, 8cb, 8cei, 8co, 8coj, 8com, 8cxy, 8cy, 8da, 8dg, 8dku, 8es, 8bk, 8ff, 8tc, 8tt, 8uf, 8vy, 8wz, 8xan, 8bbd, 8bcp, 8bqi, 8byq, 8dkd, 8ab, 8bh, 8ctp, 8ddc, 8hc, 8gz, 8rn, 8vz, 8vw, 8ekm, 8bdv, 8zu, 8aol, 6bbj, 9an, 9aon, 9aps, 9aur, 9bak, 9bed, 9bm, 9bof, 9bp, 9cmr, 9col, 9cra, 9cx, 9cy, 9dib, 9dix, 9dl, 9dop, 9drw, 9dwx, 9edm, 9efe, 9ta, 9tv, 9vc, 9zt, 9acq, 9biz, 9caf, 9eak, 9rm, 9aa, 9bl, 9ccm, 9cga, 9my, 9lm, 9ms, 9azx, 9fu, 9jy, 2bxw, 2by, 2ccx, 2cjx, 2cua, 2dac, 2dk, 2nj, 2br.

(All heard on detector and one-step.)

Simple Variable Condenser

A FRENCH amateur has told in the publication "L'Antenne" (The Antenna) how he built a small capacity variable condenser out of simple parts, for use in a resistance-coupled radio frequency amplifier.

The condenser uses the zinc can from a pocket flashlight battery for one plate. After the can has been cleaned and the interior scoured with emery paper a wire is soldered to it and it is ready. Next a small pill bottle is found of such a size that it will be a sliding fit within the can. Inside the bottle and cemented to its wall is coiled



some brass, tin or copper foil, likewise provided with a wire. A cork in the bottle, and a suitable insulating handle attached to the cork, and the job is done. This condenser, being of extremely small capacity, also has been found of value as a vernier in tuning.

Static

(Continued from page 23)

regions, and, probably elsewhere, and extending skyward, several hundred miles up.

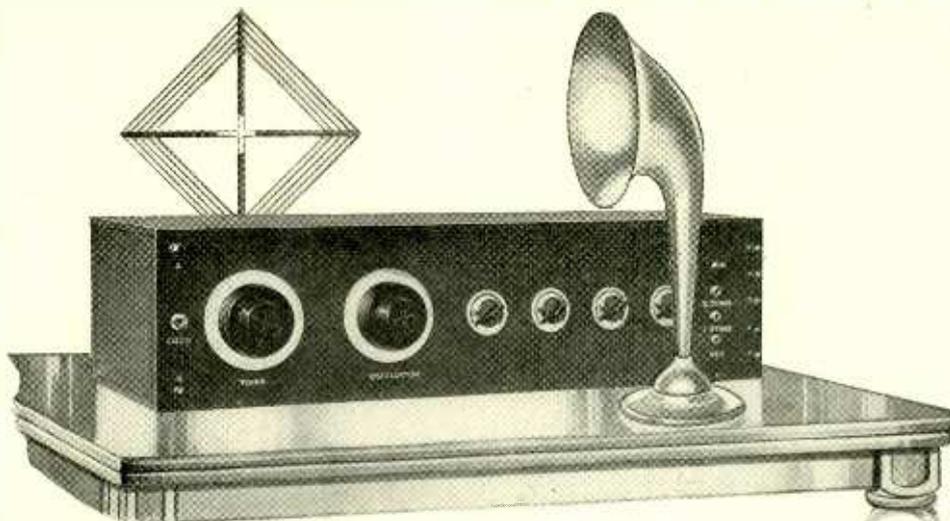
The phenomenon of the aurora borealis as seen in the Northern Hemisphere and the aurora australis, as seen in the Southern Hemisphere are mysteries as profound as the magnetic poles, and may not be explained until we can explain the magnetic poles and terrestrial magnetism.

In fact, the magnetic poles seem to be responsible for the northern and southern auroral displays. These displays usually occur in the regions of the magnetic poles and it appears that they occur simultaneously at both the north and the south magnetic poles.

The smaller magnetic poles and other unreported magnetic spots may be responsible for lesser auroral displays, the meaning of which are still beyond the understanding of mankind.

Brilliant auroral displays occur coincidentally with violent sun spot eruptions. Simultaneously, heavy static discharges disrupt line communication and seriously interfere with radio transmission and reception. But such phenomena is recorded in lesser degree when the sun spots are less active.

Since radio appears to be the most sensitive medium through which static



The famous Ultradyne engineers recommend

ACCURATUNE

MICROMETER CONTROLS

On Ultradyne and Super-Heterodyne receivers, in which close tuning apparatus is employed, engineers recommend micrometer controls in preference to ordinary dials. R. E. Lacault, A. M. I. R. E., designer of the famous Ultradyne, recommends only the Accuratune Micrometer Tuning Control for use with this set.

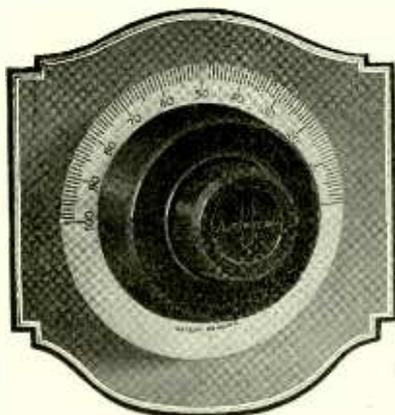
The Accuratune is not a mere dial, but an actual micrometer tuning control, very responsive to the slightest touch of the micrometer knob, and ten times more efficient than any other tuning device. Stations that have never been heard before, are brought in clearly when tuned with the Accuratune.

Designed for either coarse or precise tuning and to fit all standard condenser shafts. Guaranteed. Price \$3.50. At your dealers, otherwise send purchase price and you will be supplied postpaid.

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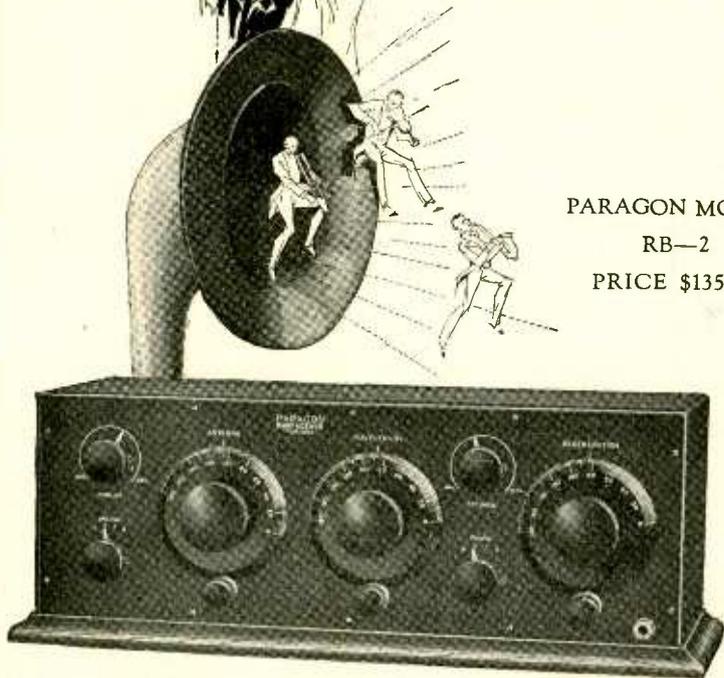
Every tone, every note clear and sweet. You can almost see the musicians swaying in time to the music. It's just as if the orchestra was right in the room with you. Why pay money to go dance when the best in the land can be had right at home over the radio?

The Paragon 3-Circuit Receiver here illustrated is the last word in sensitivity, selectivity and simplicity. You need only to switch on the tubes and set the dials for the station you want. The cabinet is of highest finish mahogany or walnut and includes compartment for dry batteries. The Paragon is the ideal Radio Receiver for the home.

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PARAGON MODEL
RB-2
PRICE \$135.00



discharges may be observed, and consequently recorded, sun spot and auroral phenomena can be studied with a greater amount of accuracy through that agency.

HOW RADIO FANS CAN HELP

Radio experimenters throughout the world can assist in establishing the following:

(1) Are auroral displays simultaneous occurrences at both the north magnetic poles and the south magnetic poles?

(2) Are auroral displays always attended by magnetic and electric disturbances; if so, to what extent, by actual registration of instruments; and to what extent geographically?

(3) Are auroral displays accompanied by "cracking" or "rustling" noises?

Radio broadcasting has made it possible to detect cosmic noises, unrelated to the world's machinery, which we may find to be related to the phenomena of auroral displays.

How? No one knows. It is another riddle—very important to the extension of radio activities that may easily be solved by the world's radio workers by little more than listening to these cosmic noises, reporting when possible their nature, duration and direction and the behavior of the compass to the Aerial League of America, who will sort these reports and transmit them to a body of the highest government and civilian authorities, who will arrange to have the information plotted and tabulated and—from the preponderance of evidence in favor of given deductions—may establish facts of great importance to the radio world.

By adding to their radio set the simplest equipment used for determining magnetic variations, the world's radio experimenters may in the course of a year supply data in their reports that will make it possible to establish the connection of the so-called "static" and "atmospheric" disturbances to the polar lights, the connection between polar lights and magnetic storms, the direction and geography of magnetic disturbances and other basic data.

Why man's total knowledge cannot yet explain these natural mysteries is a natural question.

The answer is that there are more branches of science involved and a larger territory than any individual or group of individuals has been able to master heretofore. I say heretofore, because I believe that the radio fans of the world can, combined, within two years, explain these phenomena.

As a result of earlier observations and tests, I suggested to the Aerial League of America a world-wide check-up, to last twelve months, the

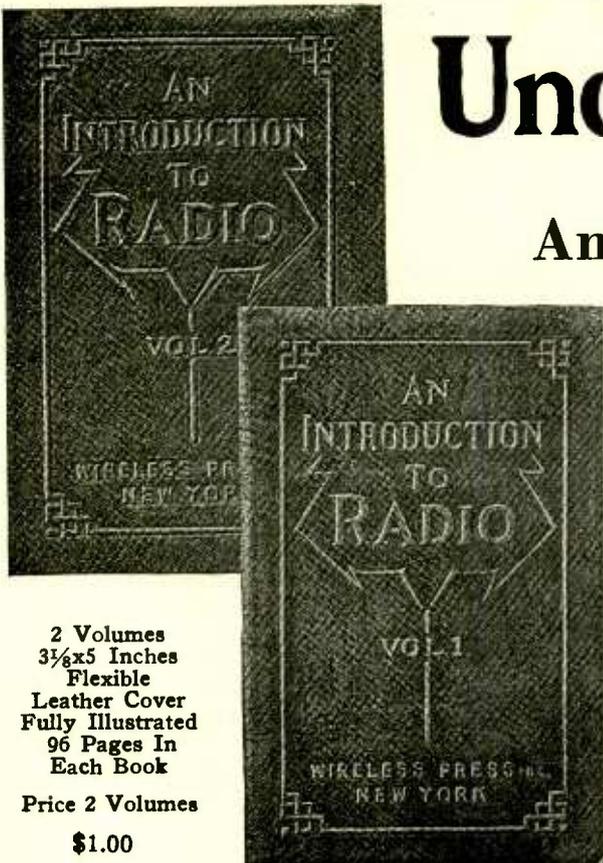
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ANSWERS YOUR QUESTIONS—Every novice in radio always asks the same questions: What is a radio wave? How is it made? How long does it take to get to me from the broadcasting station? Is there any difference between the dot and dash waves and the music waves? What is a condenser for? What is a variometer? What is the difference between a variocoupler and a loose coupler? How are the ear phones made? What does the crystal detector do? How does a vacuum tube work? What is the grid leak for? Is there any danger that my antenna will be struck by lightning? How can I tune my set to get the loudest signals? What is the difference between radio frequency and audio frequency? What is a potentiometer for and how does it differ from a rheostat? And scores of other questions. All are answered in this book.

Make no mistake. This is a non-technical book. All who can read English can understand it. Funny how hard it is for an expert to talk shop so everyone can understand—there are a number of good technical books, but this is the best book we have ever seen of the hardest kind to do well.

An introduction to Radio. That is just what it is. Mr. (Miss or Mrs.) Reader, we take great pleasure in introducing Radio. After a few hours you can meet the other members of the family and talk radio with them as you can't now.

If you were sailing for France you would study an elementary text book on the French language—here is your book for your trip to radio land, the most fascinating country ever discovered by modern science. Explore it knowingly, as thousands are now doing, with a receiving set and "An Introduction to Radio."

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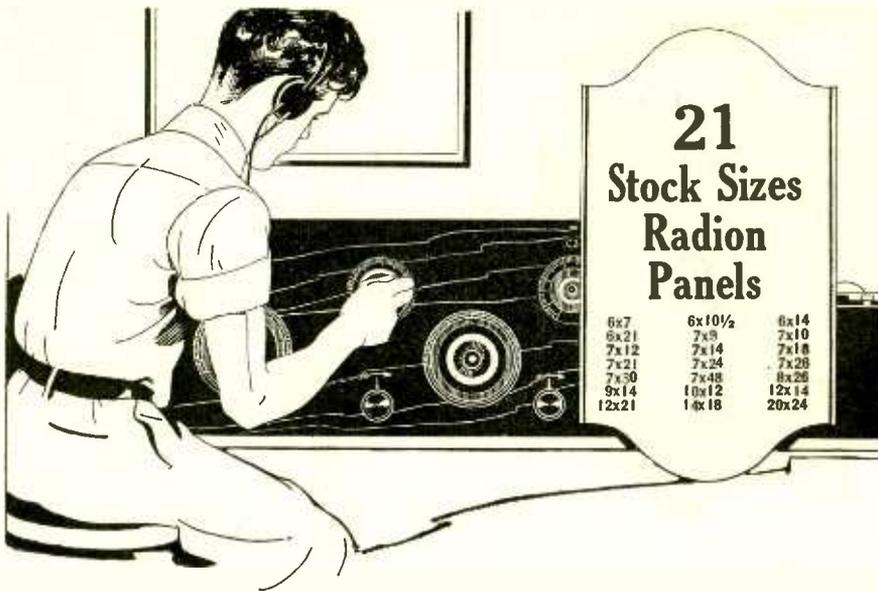
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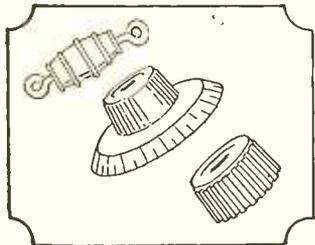
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length of time required to obtain data during the four seasons; and the world's radio fans—whoever has a receiving set—can participate by collecting data which may prove of great value to the art and science of radio and electric transmission. The League offers monthly prizes for the best monthly reports submitted.

The fact is that one of the most basic and frequent interferences in radio—as with wire service—is the aurora or polar lights. No remedy has been found because very little is known of the phenomena back of the aurora. The radio experimenter seems destined to solve that difficult problem. Whoever works out the solution will win world fame.

Further information regarding this contest should be addressed to The Aerial League of America, in care of THE WIRELESS AGE, 326 Broadway, New York City.

The Broadcast Riddle

(Continued from page 28)

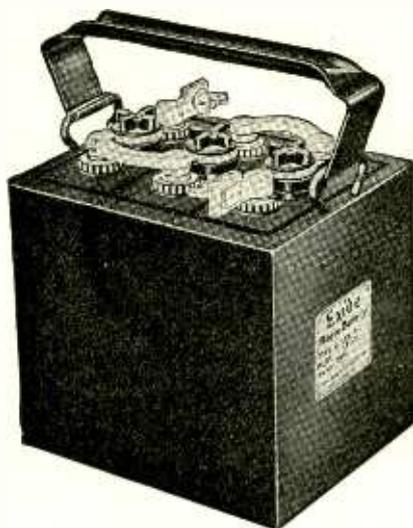
tainment to the station proper at Schenectady which in turn retransmits or broadcasts to the radio audience on a higher wave-length and greater power output.

When the cost of soliciting talent has been added to the budget for station operation, the unsound economics of broadcasting, as practiced today, is apparent. And obviously, getting what the public wants in choice program material becomes, daily, a more difficult problem as the excessive operating costs steadily rise.

The phenomenal growth of the new science that was destined to become the greatest instrument of publicity the world had ever known, or for that matter, had even conceived of in moments of wildest fancy, startled men of affairs in every phase of the modern industrial system. Publicity innovations, designed for engaging the public's attention increased by the hundredfold and the possibility of exhausting the field seemed to be ever more remote. Commercial enterprises rushed into the business of broadcasting. Manufacturers of radio equipment fairly sprang into being. Radio experts oozed from the appalling jam in ever increasing numbers. Editorials discussed radio. Newspaper and magazine stories toyed with radio. Radio became a universal topic. But none dared to analyze the situation.

THE KERNEL OF THE THING

From the Olympian heights of wisdom a little group of men concerned with management alone, set



"A" Battery for
six-volt tubes

When is a battery cheap?

A BATTERY that allows your soloist to be accompanied by a noise like a thunder storm is never a cheap battery; because it's certain that you will be dissatisfied and soon supplant it with a good battery.

Obviously, a battery that does not last long is not a cheap battery.

The battery that is really cheap is the one that gives perfect service and gives it a long time; one that does not have to be recharged too frequently—a silent, long-lasting battery, steady and dependable.

Because they give such good service and such long service, you will find Exide Radio Batteries cheap in the true sense of the word. They may cost you more than some to start with, but long life and freedom from repairs make the last cost low. And the added enjoyment you get from your set, through clarity and lack of needless bother, will be priceless.

In replacing a worn-out battery or when buying a new set, be good to yourself and get an Exide.

Complete line of Exides for Radio

There is a complete line of Exide Radio Batteries—batteries that give uniform filament current over a long period of discharge.

Apart from the 12-cell "B" battery there are three "A" batteries for whatever type tube you use. The Exide for 6-volt tubes gives full-powered, ungrudging service. It has extra-heavy

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The Exides for low-voltage tubes are midgets in size but giants in power. The 2-volt battery weighs only five pounds, has a single cell, and will heat the filament of WD-11 or other quarter-ampere tube for approximately 96 hours. The 4-volt "A" battery has 2 cells and will light the filament of UV-199 tube for 200 hours.

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On sea and on land the Exide plays an important role in the industrial life of the nation. In marine radio, Exide Batteries provide an indispensable store of emergency current. A majority of all government and commercial radio plants are equipped with Exides.

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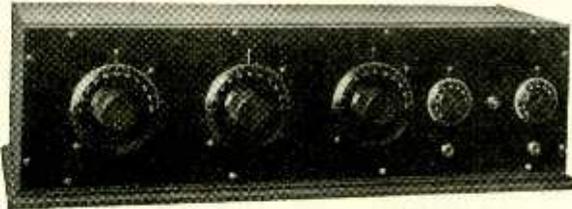
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The Pathé "Minute Man" is housed in a genuine mahogany cabinet equipped with beautiful mahogany panel and gold engraved dials, making a handsome as well as efficient instrument.

FREE

A most complete and detailed instruction book showing how to construct a "Minute Man" Receiving Set will be sent you absolutely free of charge. Address Dept. 224.

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about to systematically determine just what broadcasting was. Having arrived at various conclusions, they compared notes. Having decided upon given conditions and approximate results, they forthwith turned their individual attentions to the solution of the broadcast situation according to the future problem of each.

They found that three factors constitute the primary motive for broadcasting. First, publicity. Secondly, as exemplified by the telephone company, the sale of broadcasting as another form of communication, and a definite industry. Thirdly, the manufacturer of radio equipment must encourage the demand for his product.

Individuals frequently find themselves handicapped in the progress of their particular endeavors because they need publicity that would be too costly through the customary channels, such as advertising and renting halls or financing public appearances on a tour. Broadcasting offers them a possible audience of well over 500,000 people, and moreover, an audience deliberately seeking entertainment. A lecturer can entertain with stories of travel, adventure, or discussion of topics concerning inventions and developments, instruction in finance, education, politics or industrial and social achievements and even deliver running accounts of news subjects. The musician can distribute samples of his accomplishment. The teacher can open new fields of culture and education. And the politician or public servant can obtain a hearing on projects of moment. All of which serves the public as well as the individuals seeking publicity. And such contact serves the dual purpose of developing latent talent and broadening the horizon for a public that eagerly seeks the world's knowledge just beyond the threshold.

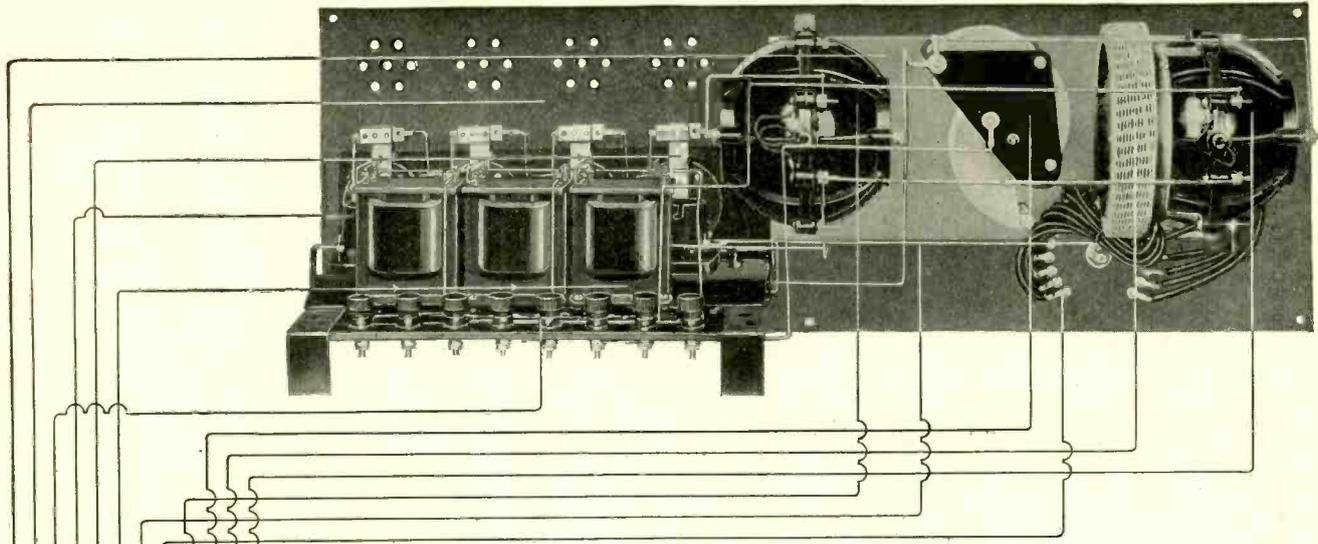
Organizations of the department store character employ broadcasting for publicity purposes. Unlike all their other forms of advertising, however, they do not expect, nor can they ascertain any direct return.

Newspapers have little else than the good will of subscribers that they may reasonably anticipate as a result of their adoption of broadcasting.

Manufacturers of products other than radio blandly charge broadcast expenditure to publicity costs and let the matter rest there.

Now let us consider the second factor. Communication as a marketable product is thoroughly established, as manifest in the telephone, cable and telegraph systems. And so, if broadcasting be considered as one form of communication, it may be reasonably assumed that everyone who wants to broadcast should expect to purchase this service. But the message to be

A NEW CIRCUIT DIAGRAM—READ IT!



It's Not the Face of the Watch, It's the Works that Tell the Story.

1. **Variable Condenser.** Contains forty-three plates of heavy aluminum with five plate vernier for fine tuning. Mounting plates of heavy Bakelite. Ends of rotor plates bolted, preventing bending or "shorting." Large bearings make smooth, easy operating.
2. **Inductance Coil.** Increases the wave range of the variocoupler to 3000 meters. Diamond wound for minimum distributed capacity. Tapped for selective tuning.
3. **Variocoupler.** Coupler shell and rotor built of solid Kellogg Bakelite, treated to avoid "distributed capacity." Many radio experts consider this the best coupler obtainable today.
4. **Variometer.** Rotor shaft accurately and permanently held in bearings. No sliding contacts. This variometer gives great added selectivity, more value.
5. **Transformers.** Designed to overcome defects of existing types and to furnish distortionless amplification of all audio frequencies. Sheet metal case heavily enameled. Primary and secondary binding posts most accessibly placed on the transformer, plainly marked.
6. **Rheostats.** Have strong, wide springs, grasping the rotor resistance on two sides with strong, positive contact. The control varies on the half turn of the coil wire on the rotor, giving vernier effect and enabling the operator to secure great selectivity, and freedom from noise and trouble.
7. **Tube Sockets.** All Bakelite. Bayonet slot reinforced with brass plate. Terminals plainly marked. Heavy springs inset into base, so they cannot touch mounting surface. With Kellogg tube sockets, there is no worrying about proper connection with your lamp terminals.
8. **Binding Post Assembly.** Symphony Binding Posts connect through separate openings in the rear of the set. Each of these openings have an insulating bushing. This does away with unsightly and unnecessary wiring connections on the front panel.
9. **Bakelite Panel.** This slender, strong, highly polished panel has the equipment located upon its face in the most advantageous positions. These mountings fit most accurately drilled openings and this face equipment is a model of proper radio assembly.
10. **Aluminum Shielding.** One who has not operated a radio set cannot appreciate the importance of careful shielding and grounding. Symphony shielding is pure aluminum and ample size, correctly drilled.
11. **Circuit.** The circuit of the Symphony is controlled by the apparatus above described, and mechanically wired as indicated, produces receiving of the highest order.
12. **Contact Points.** Heavy, silver plated for minimum resistance, an instance of the fine and all important attention to details that makes for successful radio receiving.

Mr. Dealer:

Write for our bulletins and discount sheet. The Symphony will increase your profits.

In addition to the important, accurate and successful units pictured above, there are also the other Kellogg radio parts to complete this most efficient circuit.

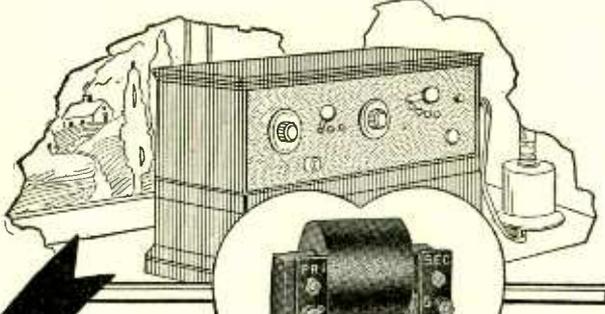
JONES RADIO COMPANY

1066 W. ADAMS STREET, CHICAGO, ILL.

The Symphony is manufactured under the U. S. Patent No. 1113149, Armstrong Regenerative Circuit
All parts used in the Symphony are built and guaranteed by the Kellogg Switchboard & Supply Company manufacturers for twenty-five years of complete telephone equipment

Mr. Radio Fan:

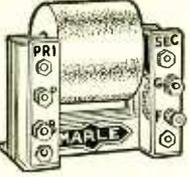
If your dealer does not carry Symphony receivers, send us his address. We will send you our illustrated Symphony catalog by return mail.



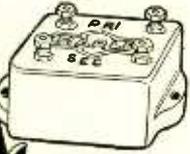
Type A9
Ratio 5 to 1
Shelltype \$6.00



Audio F
Type A7
Ratio of 3 3/4 to 1
\$4.50



Audio F Shelltype
Type A6
Ratio 5 to 1 \$4.25



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MARLE ENGINEERING CO.
Orange New Jersey

delivered is intended for the general edification of an audience seeking entertainment and must consequently be dressed with the proper embellishments to render it acceptable. Having accomplished that end by rigid censorship the next step is merely a matter of fixing the charge in accordance with the fair balance between operating costs and service rendered.

Coming to the third factor, radio manufacturers try to encourage the sale of their products by operating broadcast stations. The broadcast stations now owned by radio manufacturers strive to serve the public according to the best interests of both and the rather particular enjoyment of the latter. They have no desire to market communication; they utilize to a great extent the desire of artists and others for publicity; their aim is to stimulate desire for their product.

AN EXPERIMENT

A dominant figure in broadcasting has advanced a theory and substantiates its practicability so convincingly that several of his fellow-executives expect to see the full realization of his plan in the near future. It seems to him that very likely there exists a group of people who desire grand opera avidly enough to welcome a subscription that would procure it. Collectively, the small individual fees could represent the purchasing power necessary to broadcast the best in opera. And likewise, symphony concerts, successful plays and famous artists could be procured for the asking.

And then, he claims, consolidation of broadcast centrals on a national scale would further enhance the real service of broadcasting. Subscription fees would automatically become smaller and a greater area gradually become cosmopolitan through intimate contact with the world at its best in culture and education.

But another well-posted radio executive maintains that broadcasting can surely be made commercially practicable without any means being found for collecting from the consumer. He insists that just as soon as the freedom and universality of radio is destroyed, and confined to only those who pay for the service, the fundamental of the whole situation is destroyed. This official believes that broadcasting as constituted today, is commercially sound, and will remain so in the future. He admits, however, that some selective and narrowcast methods may be found which will do no harm.

In a consideration of broadcasting and its development it is well to have a clear analysis as a starting point.

Broadcasting, as described, became a public service almost of its own ac-



CARTER Inductance Switch

DISTINCTIVE FEATURES

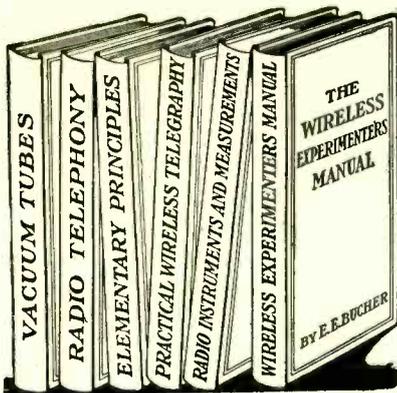
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DX INSTRUMENT CO.
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cord. Program directors then had to determine just what the public wanted. Next, they determined what programs were made of. And then came the problem of just how to get the public what it wanted. That problem became an acute responsibility when the executives discovered that broadcasting involved tremendous costs that were mounting rapidly.

The same executives who have made the foregoing analysis are not agreed upon the issue of whether broadcasting rests at present on a sound economic basis. So the question, "Who will pay the broadcasting bill?" would still seem to be an open one.

* * *

There is now manifest a strong tendency to force this problem upon the public for solution. Already movements are well under way to organize the public into associations for such purpose. This is probably premature. Association — organization — at the present time would serve merely to substantiate the opinions of those who inspire the organization.

That problem must first be fairly presented, and then well understood. Radio fans must comprehend its proportional values. Then they must THINK . . . and DISCUSS . . . There is plenty of time.

But time—even time—advances.

[EDITOR'S NOTE: The writer of this article has alluded to the important part that letters from listeners have played in developing broadcasting. Letters can FURTHER contribute to its progress and stabilization.

THE WIRELESS AGE presents this problem and this opportunity to its readers.

You—Reader—are invited to contribute your opinion. YOUR opinion will be published in a later number as a symposium of what the public thinks about footing the broadcast bill.]

The Artist

(Continued from page 25)

tion of the total music of the world; they do not represent a monopoly or constitute a so-called "music trust" as those opposing us would have you believe; but I do claim that they create the essential music which the radio public desires to hear broadcasted.

Let us briefly summarize the arguments advanced by the broadcasters who decline to pay for the use of our works. (a) That they receive no compensation from the radio audience and therefore cannot afford to pay the copyright owner. (b) That recognition to the composer and author of music will necessitate payment to the musician, singer and lecturer who

Face of Panel Mounting



Jones Multi-Plug and Cable

The Standard Radio Set Connector

Either panel or binding post mounting. Does away with unsightly wires. Leaves set free from live wires when not in use. Several binding post ends can be connected to different sets—using one plug and cable connected to batteries, etc. Ideal for dealers—and experimenters. Prices, Multi-Plug and Cable Panel Mounting Type, \$4.00. Binding Post type, complete, \$5.00. Write for illustrated folder of Howard B. Jones Radio Products

Howard B. Jones, 612 S. Canal St., Chicago, Ill.

now volunteer their service without compensation, an expense which it is claimed they cannot afford. (c) That broadcasting advertises music and is of material benefit to the writer who should look to other sources for his income.

The first point is not based upon the facts for though no payment is directly received from the beneficiaries of the service, payment is indirectly made in profits from the sale of radio apparatus, advertising, etc. The second contention is too absurd for any extended discussion. Upon what basis does the broadcaster expect anyone to give their service without compensation? Radio ought to pay everyone who renders it a service, most generously. It should secure the best talent available and pay it adequately. The radio audience should not be subjected to an inferior program of amateur artists and others seeking publicity. The third point, which is the one chiefly stressed, is without any merit whatsoever. In the first place we deny that broadcasting our music increases the sale of our product, and we reach this conclusion not by theory, but upon facts. Radio broadcasting seriously competes with the sale of sheet music, phonograph records and music rolls; it has diminished the royalties received by our members during the past six months upwards of fifty per cent., and to all appearances, promises to continue a further decrease.

In conclusion let it be said that in every civilized country of the world similar societies exist for the protection of composers and authors of music, and due recognition is given by payment for the privilege of performing copyrighted music. In this country, the organized effort and insistent desire for an equitable distribution of the rewards of industry, for a wider justice, for a more consistent righteousness in human affairs, is one of the most stimulating and hopeful signs of the present era. There ought to be a militant public demand for progress in this direction, but in the accomplishment of these ends there needs to be a better understanding in the name of the composers and authors for whom I speak.

The Broadcasters

(Continued from page 24)

tra simply to entertain its patrons, but frequently, because of the popularity already obtained by the orchestra through broadcasting and in other ways, it has a drawing power. There is a prominent Broadway café which occasionally employs the services of a well-known orchestra; when the or-

from New York to "Frisco"! By air-line, about 2600 miles apart! Yet, only a few "degrees" apart when you travel—

via

The GAROD Neutrodyne*

* Licensed under Hazeltine Patent No. 1,450,080 and others

Whether you "tune-in" from the home of WEAJ or that of KHJ—you can always pick your own program with a Garod

A MUSICAL broadcast from New York, an organ recital from Philadelphia, a bed-time story from Pittsburgh, stock quotations from Chicago, the revels of the famous "Night-Hawks" of Kansas City, wholesome entertainment features from Omaha, from Dallas, from Detroit, and the throbbing dance music that has made Art Hickman famous up and down the West Coast—are all at your beck and call. With the Garod you pick the program you want—for after once getting a station you can always turn to it again—instantly—if it's on the air. Just write down the numbers on each of the three dials as you get a new station, and watch your list grow.

It is not unusual for an inexperienced operator to bring in stations a thousand miles away, or more, with the Garod. Our dealers are always glad to demonstrate. Listen in today and become a Garod fan.

Garod Type RAF

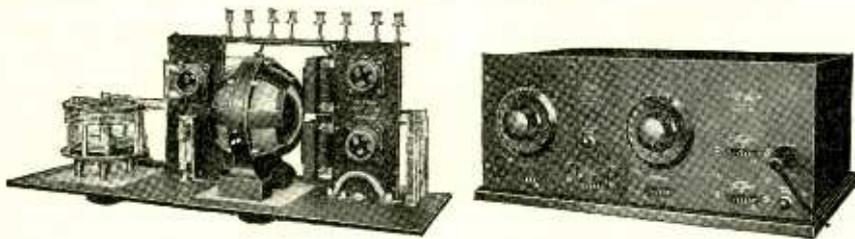
\$135

The **GAROD** Corp.

120 Pacific Street, Newark, N. J.

BAKELITE

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



Grebe and Bakelite

The character of broadcast reception enjoyed by users of Grebe Radio Sets is due, in no small measure, to the extensive use of Bakelite.

Grebe standards of craftsmanship demand the best, and in selecting a dependable insulating material which would present a refined physical appearance, they chose Bakelite as the one material which would meet their requirements.

The excellence of Bakelite and the dependability of its qualities is indicated by the fact that a large majority of Radio Manufacturers choose Bakelite as insulation, and

for improving and simplifying the design of their sets and parts.

Bakelite combines in ONE material the essential properties of many. It is highly dielectric and mechanically strong; it is unaffected by moisture, temperature or climatic changes; its color will not fade, even in strong sunlight; it will not warp, bloom or crack—but the most important property of "The Material of a Thousand Uses" in its relation to Radio is that of providing *permanently* effective insulation regardless of temperature or atmospheric conditions.

Write for a copy of our Radio Booklet A.

**BAKELITE
Condensite**

REDMANOL

are the registered
Trade Marks for the
Phenol Resin Products
manufactured under
patents owned by
**BAKELITE
CORPORATION**

Send for our Radio Map

Enclose 10c. to cover mailing cost and we will send you a large Radio Map which lists the call letters, wave length and location of every broadcasting station in the world. Address Map Department.

BAKELITE CORPORATION

247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22d Street

THE MATERIAL OF A THOUSAND USES

Radio Offers Unlimited Opportunities



Last year was a \$175,000,000 radio year, and Radio has just commenced to grow! Get in on the ground floor. Train for a position as Radio Operator or Radio Installation and Service man. New Radio Sales and Service course just started.

SEND TODAY FOR ILLUSTRATED BOOKLET

Y. M. C. A. Radio School

149 East 86th Street

New York

chestra plays there, more persons patronize the café, and naturally the more persons who go there, the more food and drink the café sells, with the increased attendant profit. This is a common sense viewpoint, and one that by the very nature of it, cannot be applied to broadcasting stations. Thus the analogy is not a fair one.

That broadcasting does popularize music, not only partially, but to a greater extent than by other methods, is evinced by the number of songs hardly heard of before broadcasting, but which now are sold by the millions of copies, and sung and played from one end of the country to the other.

Many songs have unquestionably been made by radio broadcasting. The American Society of Authors, Composers and Publishers offered \$75,000 for a number that was popularized through broadcasting, indicating another attempt to corner everything worth while.

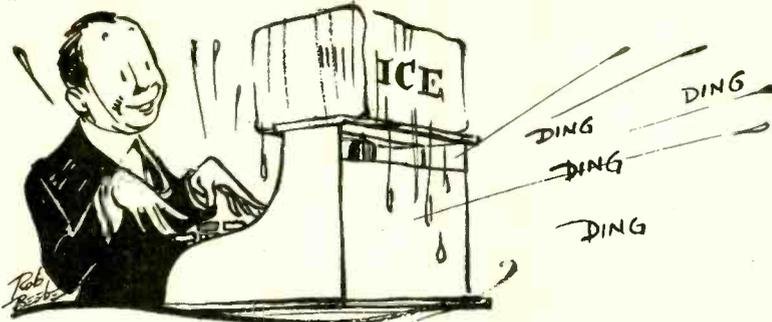
The only way any song can become popular and thus increase its commercial value, is by having a great number of persons hear it. Obviously they will not buy a copy of the sheet music, a phonograph record, or a music roll unless they like the composition, and in order to like it, they must hear it. A vocalist may reach, either through appearances on the stage, concert platform or auditorium, perchance in a lifetime, a few hundred thousand persons. Through the medium of broadcasting, millions hear a song in three minutes!

Performers are paid well for their time and talents, through broadcasting. Millions of persons who would probably never have heard of them had it not been for radio, attend the theaters where their names are advertised simply because their performances had been broadcast and found to be good. Thus the performers distribute samples of their talents to millions of potential buyers. Since the managements of theaters profit directly by this, salaries to performers are increased as the result. In fact, many actors who once had difficulty in securing engagements have found themselves in demand after broadcasting.

Broadcasting pays the actor well, and he knows it. Stars spend hundreds of thousands of dollars in other publicity stunts. And no advertising compares even remotely with broadcasting.

Authors, composers and performers profit through broadcasting; now how about the broadcasting stations? Do they operate at a loss, or do they derive a profit either directly, or indirectly from radio broadcasting? It is of course untenable to suppose that any good station costing thousands of dollars to install and from \$25,000.00

HOMMEL SERVICE MAKES MORE PROFITS



THIS company has been wholesale distributors of high grade electrical equipment for over 16 years and have built up an enviable reputation for dependability and service. The same principles responsible for their success in the electrical field have been applied to their activities in the radio field.

They wholesale exclusively,—they never compete with their dealers by retailing;—their discounts are fair and liberal;—they represent only the leading manufacturers of radio equipment;—they carry complete stocks of radio supplies insuring prompt deliveries and a dependable source of supply for the dealers.

Dealers who align themselves with HOMMEL service enjoy a steady repeat business—with satisfied customers—and that means more and better profits.

Let us send you complete facts—
Encyclopedia No. 246E sent on request

- DISTRIBUTORS FOR
Radio Corporation of America
- RCA**
- Westinghouse General Electric
 - Acme Atwater-Kent
 - Baldwin Brandes Burgess
 - Chelsea Cunningham
 - Cutler-Hammer
 - Dubilier Fada Frost
 - Freshman General Radio
 - Grebe Homecharger
 - Murdock
 - Remler Rhamstine
 - U.S. Tool Western Electric
- And other leading manufacturers

LUDWIG HOMMEL & CO
530-534 FERNANDO ST. PITTSBURGH, PENNA

The New Genuine Guaranteed "SHEPCO" "ALL WAVE" JR. TRADE MARK—PATENTS GRANTED AND PENDING NON-RADIATING DX COUPLER

Combination Flat and Bank Wound



"ALL WAVE" Sr.
\$7.00
150 to 3000 meters
Guaranteed
Wavelength

Set of six efficient hook-ups packed with every "All Wave" coupler or mailed on receipt of 10 cents in stamps to cover cost of mailing.

ALL the SELECTIVITY OF TUNED RADIO FREQUENCY at a SMALL FRACTION OF ITS COST. Like its companion, the 3000 meter Capitol "All Wave" Coupler, Sr., it may be used in a single circuit with the added feature that it may be used in a double or triple circuit.

Used in the "All Wave" triple circuit, the "All Wave" Jr. is guaranteed not to radiate and to bring in distant stations clear and loud on one tube. Log your stations and get them at the same setting every time. Only one dial to tune.

THE "SHEPCO" "ALL WAVE" JR.
Eliminates use of all variometers, vario couplers and loading coils. Permits building most efficient, sharp tuning, loud, long distance receiver at lowest cost.



"ALL WAVE" Jr.
\$6.00

150 to 1000 meters
Guaranteed
Wavelength

On sale at all dealers in standard radio parts or sent direct on receipt of price. ABSOLUTE MONEY BACK GUARANTEE.

Read These Results

F. S. Thompson, DeKalb, Mo.
"Picked up London, England so it could be heard through two rooms."
J. W. Sutcliffe, Providence, R. I.
"Got KFI, Los Angeles, Cuba, Porto Rico and Nebraska. Convinced of quality of your product."

J. M. Blauvelt, Dallas, Texas
"For selectivity it is the goods. I can tune out and in any station at will."
Augustus H. Gill, Ph.D., Cambridge, Mass.
"Far superior to any combination of loose coupler, variometers or vario coupler."

SHEPARD-POTTER CO., Inc.
PLATTSBURGH, N. Y.

BRISTOL SINGLE CONTROL RADIO RECEIVER



Most Simple to Operate

The set for those who want results with little effort. Anyone in the family can quickly learn to operate it because technicalities and guesswork are eliminated—One Control Dial does it all.

Does Not Interfere with Your Neighbor

Other close by reception is not disturbed when you tune in with this non-reradiating Receiving Set. It gives you a comfortable sensation of freedom to be able to change from one station to another knowing that you will not interfere with your neighbor's receiving.

Choice of Aerial or Loop

Where conditions make it difficult to install an outside aerial, as in congested sections of cities, good results can usually be had by using inside Loop. In fact, the directional feature of the Loop often brings in stations not possible with a stationary aerial.

Mounted in solid mahogany case with walnut finish, the Bristol Single Control Radio Receiver is handsome in appearance. The price is \$190.00. Bulletin 1303-V describing this set will be mailed on request.

BRISTOL

TRADE MARK
AUDIOPHONE
REG. U. S. PAT. OFFICE



Loud Speaker

This is known everywhere as the Loud Speaker with the quality tone. Not only is the tone natural and without mechanical distortion, but is sufficiently big in volume to be easily heard in a large room or all through the house. Comes to you ready to use—no auxiliary batteries are required.

Made in three models:

Audiophone Senior Price \$32.50

Audiophone Junior Price 22.50

Baby Audiophone Price 12.50

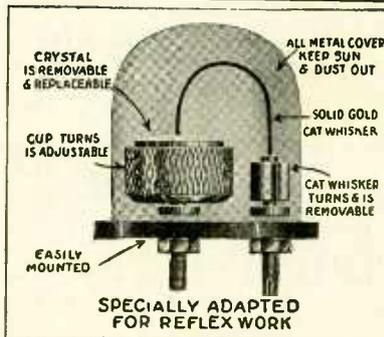
THE BRISTOL COMPANY, Waterbury, Conn.

The "LINCOLN" Enclosed Fixed Adjustable Detector

New. Wonderful. Fans wildly enthusiastic. Kills your reflex troubles. Brings in distant stations loud and clear. Price only \$2.00. Absolutely guaranteed for one year. Ask your dealer or write—today. Jobbers and dealers: wire or write. Mention this ad. Address Dept. I.

Lincoln Mfg. Co.

Los Angeles, Calif.



to \$200,000.00 a year to operate, should be a philanthropic institution. Nevertheless it is a fact that in dollars and cents, the overhead of running a station is a pure expense. Whatever returns the station may secure are mostly in good will and from an enlargement of their sphere of influence, two assets which are difficult to capitalize.

With broadcasting stations struggling under this load of expense, and with "listeners" having invested millions of dollars in radio apparatus, why should the radio public, the most vitally interested factor in this newest and greatest of sciences, permit any interference with its rights?

THE FORCE OF PUBLIC OPINION

Public opinion governs the world, and radio entertainment will be governed by public opinion. If broadcasters allow a get-rich-quick group to first corner the music market, and then dictate terms, it will be, as is usually the case, the public which will pay the bill.

Your Radio Storage Battery

(Continued from page 43)

KEEP THE BATTERY CLEAN

The battery should be kept clean and free from moisture. If moisture does gather on the top, this moisture, containing as it will a small amount of the electrolyte from the cell, forms a conducting path across the top of the battery from one terminal to the other and the result will be that there is a constant drain upon the battery.

Do not discharge the battery at greater than its normal discharge rate as this will overheat the battery and cause its plates to be ruined. This is something that will not happen unless a short circuit develops inside of the radio receiver as the present day tube with its low current consumption does not place a very great strain upon the battery. And though it is impossible to injure the battery by discharging it at a low current rate, remember that the storage battery, like many other pieces of apparatus, needs to be worked a certain amount to keep it in perfect condition.

HOW LONG YOU SHOULD CHARGE IT

Do not charge it at too high a current rate for this will also overheat it and damage its plates. The small sized tube rectifier will charge a six-volt battery at approximately two and one half amperes which means that it would take twenty hours to put into it a charge of fifty ampere-hours. So the battery may be left on charge all night if it is partially discharged. It

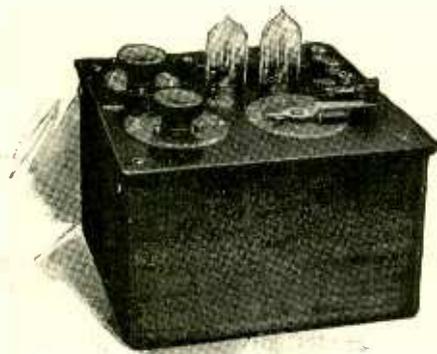


THE SYMBOL OF SERVICE

CONTINENTAL

"New York's Leading Radio House"

Radiola III and III-A



Radiola III

Radio Corporation receivers need no introductions.

The radio public always buy most generously and confidently where nationally advertised radio receivers are sold.

We have but one message for the radio dealer: We can supply you with the standard sets your customers want to buy.

Make it, "A Radiola for Every Sale."



Radiola III-A

2671-Q

CONTINENTAL RADIO & ELECTRIC CORPN.

15 Warren Street

New York, U. S. A.



Price

\$ 7⁰⁰

(2200 OHMS)



Federal
Standard RADIO Products

PERFORMANCE

THE performance of a radio receiving set, like any other mechanical piece is only as good as its weakest part.

The Federal Telephone and Telegraph Company manufacture 130 different radio parts, which carry the Federal guarantee of perfection, due to more than 25 years' research by experts in the radio field.

To insure 100% performance specify Federal when purchasing a complete radio or parts.

All reliable dealers carry Federal Standard Radio Products

Federal Telephone & Telegraph Company

Factory: BUFFALO, N. Y.

BOSTON

PHILADELPHIA

SAN FRANCISCO

NEW YORK

CHICAGO

PITTSBURGH

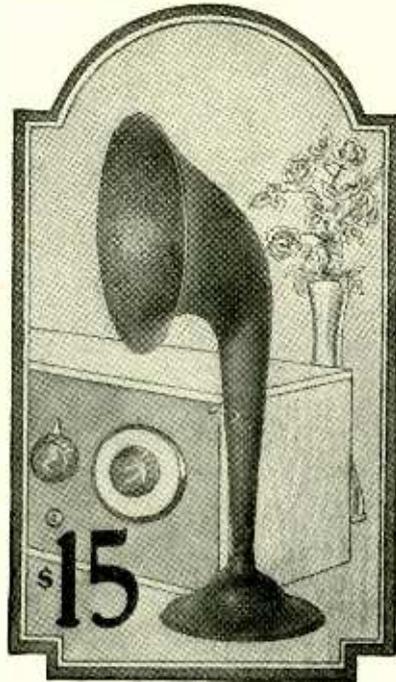
LONDON, ENGLAND

BRIDGEBURG, CANADA

Perfectone

TRADE MARK

FAMOUS
for performance
ATTRACTIVE
in appearance
POPULAR
in price



Phonograph Attachment

\$8.75

It is refreshing to hear a Perfectone as its tone convinces you of its superiority.

Before you purchase a loud speaker or phonograph attachment at any price, see and hear the Perfectone.

At your dealers, otherwise send purchase price and we will supply you postpaid.

PERFECTONE RADIO CORPORATION
490-F Broome Street New York

BROADCASTING IS THE UNIVERSAL STAGE — YOUR ARM CHAIR A BOX SEAT

is perfectly safe to do this as the author has made actual tests with the thermometer to see how hot the inside of the case will get after a run of about twelve hours and it was found that, with the case entirely closed up, at the end of a half-hour the temperature had risen to one hundred degrees Fahrenheit and it remained there during the entire charging process.

BEWARE OF EXPLOSION

Do not use matches to look inside of the cells to see if the solution is above the top of the plates for during the charging process hydrogen gas is generated and this when combined with air will result in an explosion which will spray the electrolyte over the surroundings and if one were looking into the battery he would most likely have his eyes burned seriously and might even be permanently blinded. This precaution is not included here to deter anyone from using the storage battery, but merely to emphasize the fact that as an explosive it ranks with gasoline only differing in that it is only present during charging and of course, being only present in small amounts, will not cause fires, but will spray the acid around. But it is something which should be guarded against.

The final precaution to be observed is to always keep the level of the solution inside of the battery from one-half to one inch above the tops of the plates of the cell. This will be done by the addition of pure water only, and this does not necessarily mean drinking water for the storage battery demands a water which is free from mineral matter such as is present in most drinking water. In some cities in the United States such as New York City for example, the use of the ordinary city supply is approved for use by some storage battery manufacturers for use in their storage cell, but unless information has been procured from the maker of your particular battery that you may use the water of your particular location in his battery you should use nothing but distilled water which has been obtained from a battery repairman.

If these precautions and any others which are supplied with your battery are faithfully carried out it will be found that the battery will last longer and will give much greater satisfaction in operation than would otherwise be possible. Last but not least, if any trouble should occur which you do not understand, write to the maker of your battery or take it to a reliable repairman who is acting as a service station for that make of battery and be governed by his suggestions.

BURGESS RADIO BATTERIES



"A Laboratory Product"

Madison, Wisconsin

2 Transformers for the price of 1 NEUTRODYNE

No Distortion
Greater Volume
Half-Price

For \$6 we will send postpaid TWO of the famous Globe Audio Transformers made especially for Neutrodyne sets.

MONEY BACK GUARANTEE

If you are not fully satisfied with the transformers, return them within 5 days and your money will be refunded.

COYNE RADIO SERVICE
Suite 603
507 Fifth Avenue, New York City

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Complete Radio Supplies

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Visit Our Model Store

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NEW JERSEY

NATIONAL LIGHT AND
ELECTRIC COMPANY

Co-operative Merchandisers

289-291 MARKET STREET
NEWARK, N. J.

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LANDAY BROS.

A Complete Stock of R. C. A. Merchandise Always on Hand

311 Sixth Avenue, New York

Retailed at the 7 Landay Stores

TUSCOLA RADIO SUPPLY
STATION

Dependable Radio Apparatus

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Guaranteed Radio for Every Purpose

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OHIO

THE MILNOR ELECTRIC
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Large Stocks—Quick Service

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Complete  Service

21 TEMPLE ST., PORTLAND, ME.

TRI-CITY ELECTRIC CO.

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General Radio
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10th & Cherry Sts.
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Special Service to
Dealers on Radio Cor-
poration of America
Products, in Pennsyl-
vania, New Jersey,
Delaware, Maryland,
District of Columbia,
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JOS. M. ZAMOISKI CO.

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BALTIMORE, MARYLAND

NEW YORK

CONTINENTAL RADIO
AND ELECTRIC CORP'N

New York's Leading Radio House

15 WARREN STREET
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LUDWIG HOMMEL & CO
30-524 FERNANDO ST. PITTSBURGH, PENN.

WHOLESALE EXCLUSIVELY

Hommel's Illustrated Encyclopedia of Radio
Apparatus 235-E will be sent free to dealers.
We sell to no others.

MASSACHUSETTS

ATLANTIC RADIO CO., Inc.

Complete  Service

727 Boylston St. Boston, Mass.

TIMES APPLIANCE CO., Inc.

Approved Radio Merchandise
Wholesale Only

145 WEST 45th ST. NEW YORK

PENN ELECTRICAL
ENGINEERING CO.

Westinghouse Agent Jobbers
SCRANTON, PA.

MINNESOTA

STERLING ELECTRIC
COMPANY

MINNEAPOLIS, MINN.

DEALERS

Here

you will find the

R. C. A. DISTRIBUTOR

who can serve you

best

Tie up to him

THE PHILADELPHIA ELECTRIC
COMPANY SUPPLY DEPT.

130-32 So. Eleventh St.
Philadelphia

MISSOURI

WESTERN RADIO CO.

Dependable Merchandise
from

America's Greatest Manufacturers

BALTIMORE AT FOURTEENTH
KANSAS CITY, MO.

WEST VIRGINIA

CHARLESTON
ELECTRICAL SUPPLY CO.

Electrical Jobbers

CHARLESTON, WEST VIRGINIA



Eagle Neutrodyne

Balanced! RADIO RECEIVER

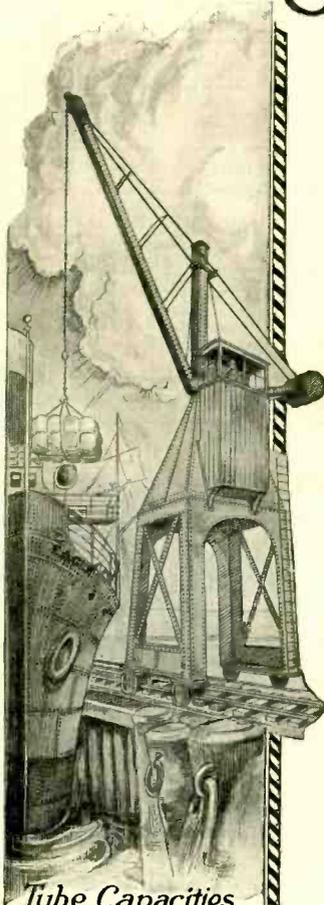
THE sincerest praise of all—that of the user—is time and time again accorded to the EAGLE—greatest of neutrodyne receivers. All the uttermost resources of radio are yours to command with the remarkable Eagle Neutrodyne Receiver. Far-distant stations are brought in clear and loud, as easily as a phonograph is operated. Tube capacities are balanced just as the power crane is balanced by its counterweight. Each Eagle Receiver is individually balanced and tested by a prominent radio expert. Backed by an excellent reputation. Guaranteed without reservation.

Licensed by Independent Radio Manufacturers, Inc., under Hazeltine Patent No. 1,450,080, dated March 27th, 1923, and other patents pending.

Write for Illustrated Leaflet



24 Boyden Place



Tube Capacities
BALANCED

Just as the Electric
Crane Arm is
Balanced

Tubes That Play 'Possum

(Continued from page 49)

HOW TO REVIVE AN APPARENTLY USED-UP TUBE

A very peculiar action often occurs with these tubes. It sometimes happens that the electron emission drops to low values after being used for only a short period. This is frequently due to the fact that a high voltage was accidentally applied to the filament, as a result of which the surface thorium emits all of its electrons. If a very high voltage is applied to the tube for a very long time it is possible that the tube will lose all of its electron emission, since the filament may be heated so much that all of the thorium emits all of its electrons. But if this high voltage has been applied for a short time only it is possible to bring back the emission as follows: Simply apply normal filament voltage to the filament, without applying plate battery. This will have the effect of reactivating the thorium which is on the inside of the filament wire, bringing it out on the surface where it is of use.

THE NEW TUBES BETTER AMPLIFIERS

These thoriated tubes have other advantages over the old tungstens, chief of which are higher efficiency, greater amplification, and more output. The filament efficiency is measured by the number of electrons emitted for unit power consumed in the filament. The emission of thorium is far greater than that of tungsten, and since the current consumption in the thoriated tubes is also smaller, it follows that the emission efficiency of a thoriated tube is much greater than that of a tungsten tube. Due to the difference in the two types of filaments it is possible to design the other parts of the tube so that higher amplification constants are obtainable. Thus the UV-201A has an amplification constant of about 8 as against that of about 6 for the old tungsten UV-201 tube. Even the peanut tubes operating on dry cells have amplification constants equal to that of the large UV-201.

THE SILVERING MAINTAINS THE VACUUM

Questions are sometimes asked about the silvery appearance of these new thoriated tubes. This silver coat has nothing to do really with the performance of the tube. It is obtained during the process of evacuating the tube. During the period of exhausting the tube of gas, and especially toward the end of the evacuating process a chemical is flashed inside of the tube which takes up the small residual gas and is deposited on the wall of the tube as a silvery deposit. This chemical is called a "getter"—in view of the fact that it "gets" the gas. It is active through-

RADIO PIN-MAP

of United States, Canada and West Indies with indexed booklet broadcasting guide.

SPOT STATIONS YOU HAVE HEARD WITH
COLORED MAP-PINS.

Map size, 22 x 14 in., mounted on map-pin board. Shows all broadcasting cities, distance scale, relay and time divisions. Guide gives all call signals, locations, stations, wave lengths, etc. Price complete, 85c. Map-pins, 10c per doz. Any color. Above booklet with folded paper map, 35c. At your dealer or direct.

AMERICAN MAP CO.

MAP MAKERS PUBLISHERS
Maps of Every Description
7 WEST 42ND ST. Dept. M. NEW YORK
Representatives Wanted

Add to Radio Satisfaction by Keeping Correct Radio Records

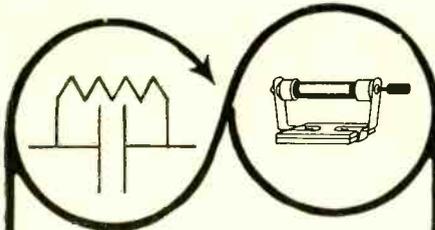
Where I Go By Radio

The Easily Kept Record System. Every Line Complete Record When, Where, How and What you "Tuned In." Book also contains Accurate List Radio Stations, and other useful features.

Popular Edition, space 300 records, Two for \$1.00
Holiday Edition, space 700 records.....\$1.00

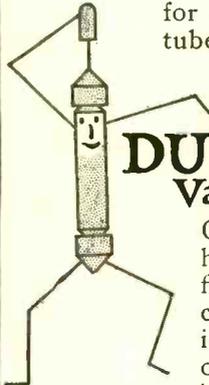
Get from your News-stand, Book or Radio Dealer or order today direct.

**Radio Dept., Progress Press
Box A, Union, S. C., U. S. A.**



**Only
Variable Grid Leak
to fit all sets**

Accurate control for every detector tube in the land now possible with



**DURHAM
Variables**

Cartridge style, having one-finger plunger control, snaps into the place of present fixed leak. No panel-drilling or wire change.

- No. 101 for storage batt. tubes
- No. 201-A for dry-cell tubes



**Typical sets improved with
DURHAM VARIABLE GRID LEAK**

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|--------------|---------|
| Radlofas | Mu-Rad |
| Westinghouse | Grabe |
| Crosley | Kennedy |
| Federal | Ace |
| Eagle | Paragon |

and all Neutrodynes

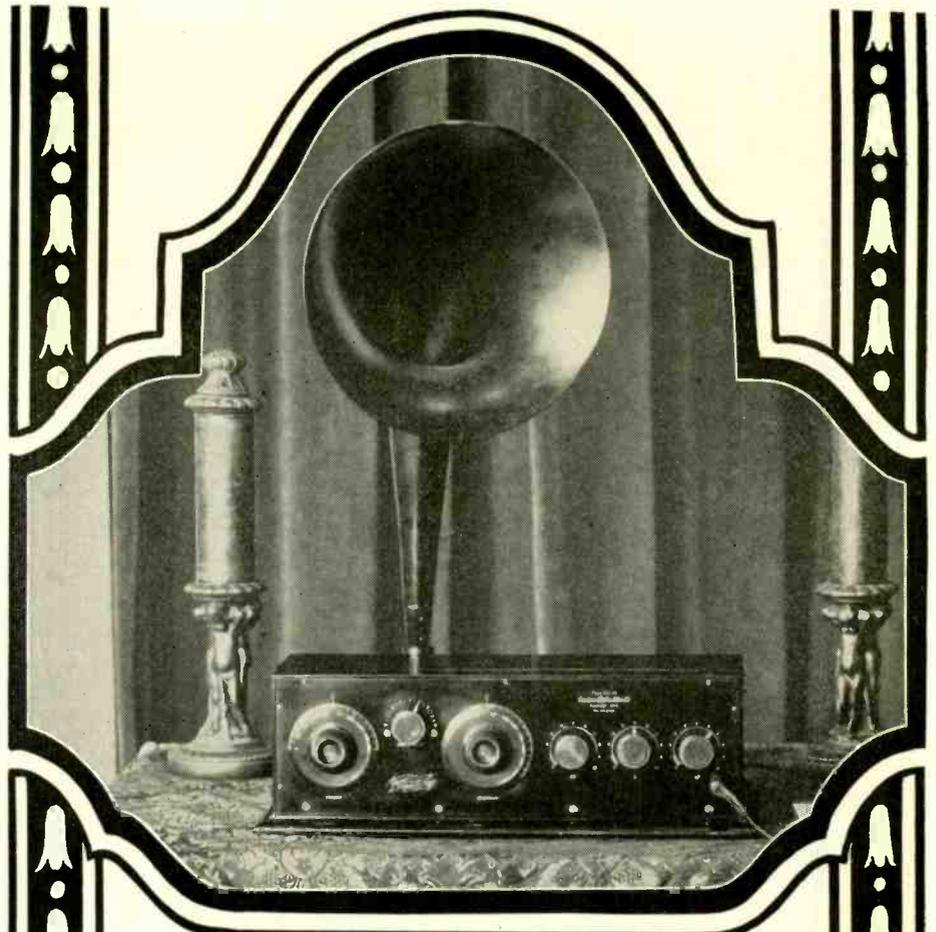
Only 75c. at dealers; or 80c. postpaid

Free folder "G" gives details. Get yours from dealer or write

Satisfaction Guaranteed

DURHAM & CO., Inc.
1936 Market St., Philadelphia

Dealers: Every detector tube needs a DURHAM—the easiest to install, use—and sell.



Radiodyne

NO LOOPS

"The Voice of the Nation"

NO ANTENNA

The air is your theatre, college, church, and newspaper if you own a Radiodyne. New York, Cuba, San Francisco and Honolulu can be picked up clear and distinct without interference from nearby stations.

The RADIODYNE is ready for operation by simply grounding to a water pipe or radiator, and throwing a few feet of wire on the floor.

Uses any standard tubes—dry cell or storage battery. Extremely selective. Simple to operate—**Only two controls**—you can tune in on any program you select—any wavelength from 200 to 700 meters. For use in apartments, boats, automobiles, railroad trains, etc., the RADIODYNE is enjoyable where other receiving sets would not be practical.

Price \$150.00

Write for illustrated folder which describes the RADIODYNE in detail. Every radio fan will be interested in this new type (antennalless) receiving set.

WESTERN COIL & ELECTRICAL CO.

316 5th St.

Racine, Wisconsin

RUSONITE
RADIO CRYSTAL

Entire Surface Sensitive
The Recognized Standard Crystal Rectifier

Used all Over The World

Hundreds of Thousands of Satisfied Users. Rusonite Has Revolutionized Crystal Radio Reception.

"THE PERFECT SYNTHETIC CRYSTAL"

Guaranteed

Price mounted 50c

RUSONITE CATWHISKER 14K. GOLD

Supersensitive; will not oxidize

Price 25c

Order from your dealer or direct from
Rusonite Products Corporation
15 Park Row, New York, N.Y.

THE SUNDAY
RADIO ADDRESSES
of the

REV. S. PARKES CADMAN

are now being reprinted

in the

CHRISTIAN HERALD

As You Gaze at the Stars—

The gentle calm of a bright starry night fills us with mystery. Little did we dream a while back that today, far and wide in the unknown, thousands of voices, hurled by electrical energy, are rushing at unheard of speed through space to all points of the compass.

A person here, a group there—in fact, in a million or more homes people are anxiously tuning in on their radio's groping in the air, hoping to catch the sound of a far away station. Scarcely a sound, a slight turn, a faint noise, another adjustment and then clear and clearer comes voices, a quartet is singing; so clear and distinct come the soft gentle melody that the listeners close their eyes, the singers seem to be in the very room with them.

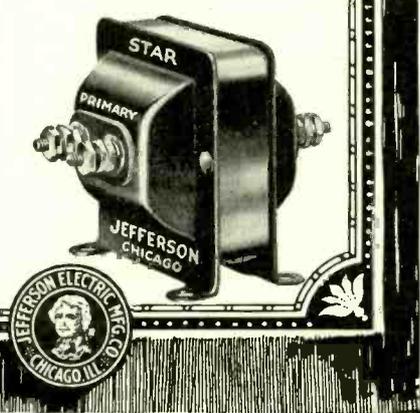
If you desire clearer reception, greater volume and the elimination of howling and distortions, install Jefferson transformers in your set.

There's a Jefferson Transformer for every circuit.

Write for amplification data and interesting descriptive literature.

JEFFERSON ELECTRIC MFG. CO.

431 So. Green St., Chicago, Ill.



out the life of the tube, and should any gas develop during the life of the tube, the "getter" absorbs it. Thus the vacuum of these new tubes is never destroyed.

Inasmuch as these tubes are relatively new it is hoped that the data here presented may be of value to those who have begun to use them. A big stride forward has been made in reducing the cost of operation on receiving tubes, and amateurs who are interested in transmitting are beginning to wonder whether such improvements cannot likewise be made on the transmitting tubes. A 5-watt tube takes about 2.5 amperes to run the filament, which is pretty high, and it would be a considerable saving if the filament power consumption could be reduced as with the receiving tubes. We look forward to something like this.

What Are the Opportunities in Radio Factories?

(Continued from page 53)

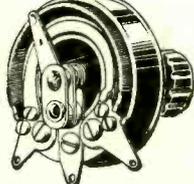
for you if you get ahead. If you grumble with them now, they'll be grumbling at you then. Those in charge think they are doing what is best, just as you'll be doing what you think is best later on. If the other men feel that you trust those over you, they'll trust you when you are over them. No one dares to make a mistake intentionally.

You will probably keep on building sets and making experiments at home. It is very handy to pick up a few parts here and there with so many lying around. But don't do it. Don't let even a soldering lug stray into your pocket. Everyone knows who is taking things. The men even admit it to each other. At the start, you have no direct responsibility to the company for the actions of the others. It is different matter, though, when you are foreman. Then, if you catch a man stealing, you can't afford to have him say, "Well, you used to take things yourself!"

The same thing is true of your workmanship. Suppose you are made an inspector. If you have been slipping things by, the others know about it, and they won't understand it if you are strict with them. They will think—"You're pretty wise now you're an inspector." Next thing you'd be in so much trouble that you would be put back on the bench, with another man at the inspection table.

There are plenty of chances in the radio factories for men who want to make good, and good salaries to be made. Shops all over the country are growing, for radio equipment has taken its place as a staple product for which there is a steady demand. Don't feel that, in another year or two the business will drop off and your time will be wasted. Rather, decide at once and

PREMIER DOUBLE DISCONNECT "POTENTIOMETER"
(Trade Mark)



One outstanding feature is the Double circuit breaker, which automatically disconnects A and B battery circuits, thus positively eliminating A battery drain (as heretofore present in all Potentiometers) and at the same time absolutely preventing accidental burning out of tubes with B battery voltage.

Genuine Nichrome wire wound. Bakelite base. Silver etched dial. Price, 250 ohm, \$2.50; 500 ohm, \$3.00.

Our Free Bulletin No. 92 gives complete list of Premier Radio parts priced right. Ask your dealer.

Premier Electric Company
3808 RAVENSWOOD AVE. CHICAGO

CATALOG L-25-148 PAGES FREE!

Latest Reflex Neutrodyne and Super-Heterodyne Circuits. 40 Diagrams, latest Hook-ups. Largest Complete Stock.

SPECIAL American Reflex Super-Sensitive Crystal, 35c ea. Hot as Hot, Every Spot. Hear stations clearly. GUARANTEED ONE YEAR.

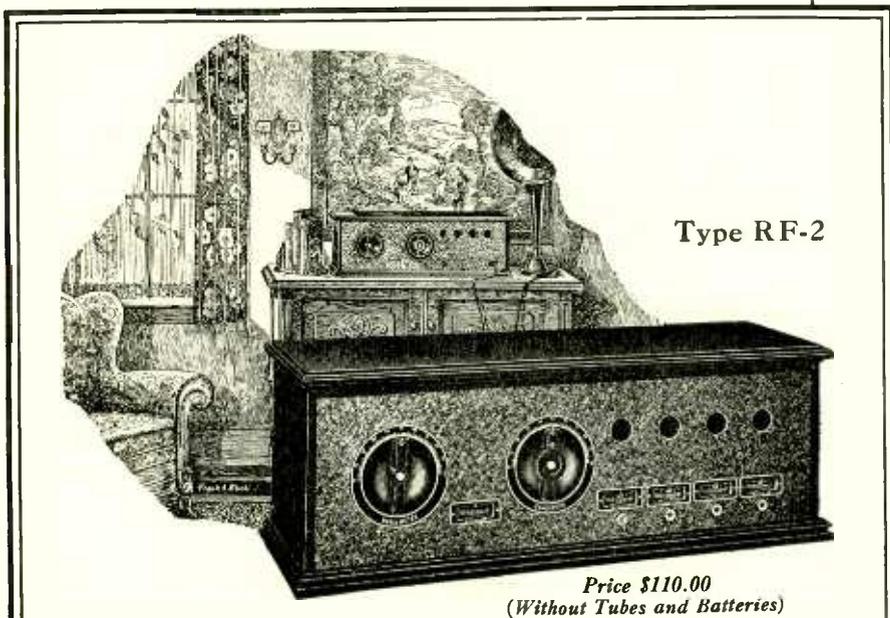
Jobbers and Dealers write for Quantity Discounts.

AMERICAN RADIO MFG. CO.
WHOLESALE DISTRIBUTORS
Dept. U 6 WEST 14TH ST. KANSAS CITY, MO.

get busy if you are going to take up this work. Particularly at this time of the year you must not wait too long or the summer lay-off will begin. Above all, don't worry for fear that the field is over-crowded. For every job there may be ten applicants. Unfortunately, or fortunately for you, about one in twenty of those who think they are capable are good enough to be kept on the payroll. That's why a man who goes into it seriously and has the right attitude toward his work can so easily out-distance the others.

Of course, we all eat. Some of us

support families. However much we want to work in a radio factory, we can't do it for love. A beginner of small experience cannot start off at much more than fifteen dollars a week, or twenty dollars for a skilled beginner. Experienced assemblers generally get twenty-five to thirty dollars a week. A man of extra ability, who can handle experimental assemblies and layouts, may get forty dollars. Inspectors get about thirty dollars, running as high as fifty dollars if they have had technical experience in correcting faults as well as finding them.



Type RF-2

Price \$110.00
(Without Tubes and Batteries)

Pride of Possession—

Ownership of the new Eisemann Broadcast Receiver imparts a sense of keen satisfaction.

Little is left to be desired—not simply because of distinctive appearance, but by reason of the remarkable performance of the RF-2.

New distance records have been reported almost daily since the introduction of this latest receiver.

A transformer coupled tuned radio frequency circuit is employed, with two stages of audio frequency amplification.

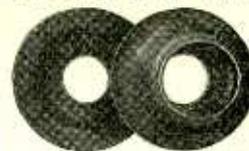
ASK YOUR DEALER

Descriptive Literature on Request

EISEMANN MAGNETO CORPORATION
William N. Shaw, President
38 Thirty-Third Street Brooklyn, N. Y.



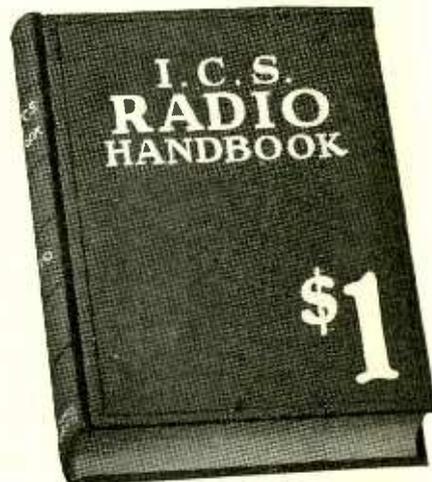
RADIOPHONE EAR CUSHIONS



You need them. Eliminate all annoyance from pressure against ears. Exclude all outside noises.

Easily installed. Will fit any head-piece receiver. Postpaid in U. S. The pair \$1.00. Three pair for \$2.50. Send purchase price and you will be supplied.

RUBBER SALES COMPANY,
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At last! A practical authoritative book on RADIO

514 pages. Price only \$1
Compiled by HARRY F. DART, E.E.

Formerly with the Western Electric Co., and
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THE most complete book of its kind ever published. Written, compiled and edited by practical radio experts of national reputation. Packed with concise, sound information useful to every radio fan—from beginner to veteran hard-boiled owl. Hundreds of illustrations and diagrams to make every point clear. Note this *partial* list of contents:

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Send \$1 to-day and get this 514-page I. C. S. Radio Handbook before you spend another cent on parts. Money back if not satisfied.

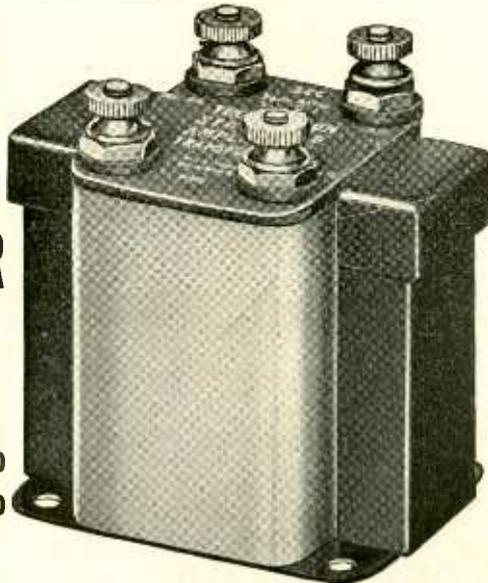
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I enclose One Dollar. Please send me—postpaid—the 514-page I. C. S. Radio Handbook. It is understood that if I am not entirely satisfied I may return this book within five days and you will refund my money.

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AUDIO FREQUENCY

3½ TO 1 RATIO	\$4.00
6 TO 1 “	\$4.50

Every manufacturer claims that his product is the “best” in the world. But the quality of scientific apparatus is not a matter of claims and opinions, but of facts.

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are names that rank supreme in the receiving set world. The superiority of their apparatus does not depend on opinion, but is the result of careful construction and scientific selection of parts. All three use the Thordarson Super Audio Frequency Amplifying Transformer, for, after exhaustive tests, it was found to be most in keeping with the high quality of their sets.

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MacMillan, preparing for his North Pole expedition, sought the most efficient and durable radio equipment obtainable. His engineers specified Thordarson transmission equipment because Thordarson can be relied upon for serviceable distant transmission.

When selecting your apparatus bear in mind the choice of these experts.

THORDARSON

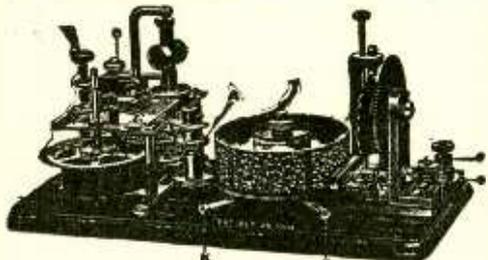
ELECTRIC MFG. CO.

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Learn the Code at Home with the Omnigraph

“Just Listen—The Omnigraph will do the teaching”



THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Codes—right in your own home—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute. THE OMNIGRAPH is not an experiment. For more than 15 years it has been sold all over the world with a money back guarantee. THE OMNIGRAPH is used by several Depts. of the U. S. Govt.—In fact, the Dept. of Commerce uses THE OMNIGRAPH to test all applicants applying for a Radio license. THE OMNIGRAPH has been successfully adopted by the leading Universities, Colleges and Radio Schools. Send for FREE Catalog describing three models. \$14 to \$30. DO IT TODAY.

THE OMNIGRAPH MFG. CO.
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If you own a Radio Phone set and don't know the Code—you are missing most of the fun

Beyond that—it depends upon your willingness to work. But if you forget all I have said, at least remember this: If you want to run a factory of your own, first practice in some other man's factory, and let him pay you to get the experience.

\$ **8⁰⁰**

A phone plus a FIBERTONE makes a beautiful musical instrument.

The highest tonal quality undisturbed by either metallic noises or distortion is best obtainable with a fiber horn. This one factor is the reason for Fibertone's popularity. And the low price for such fineness is a sensation of the radio world. The beautiful crystalline finish of the Fibertone fits it for any place where the finer things of the home are seen.

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Take This Loop on Trial

Ten days to test out this remarkable loop right in your own home. The only loop aerial of its kind. Flat as an atlas, extremely compact and all enclosed in polished Bakelite, with binding posts for various wave meter lengths. Select the type for your set, and send C. O. D. order Now. Your money refunded if you decide to return it.

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Dept. W. Asbury Park, N. J.

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L. S. BRACH MFG. CO.,
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SOLDERALL
Metal in Paste Form



Handy Tubes
Every Electrical Connection Needs
Solderall for Perfect Reception
The Only Convenient Metal Solder

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REGENERATIVE RECEIVER
Licensed under Armstrong U. S. Patent No. 1113149. For resale to amateurs only, 30 customers report receiving Scotland during Radio Week. A complete 3,000-mile Armstrong Regenerative Tuner for \$25. Use it with any make bulb, WD11 or 12, or dry battery operation as well as storage battery. Complete with bulb, batteries, phones, etc. **\$37.50**

Circulars free. This set received the Chicago American regional prize of \$350.
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A condenser short circuited will create no end of trouble. Better to think of the plates first, and buy a Heath Radiant Condenser, with the PERMANENTLY F-L-A-T Plates. Guaranteed non-warping. Write for Interesting Booklet and Name of Nearest Dealer.

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Separate reducing gear control gives a hairline adjustment. No backlash!

LIST PRICES

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All including 2 1/4" dial and knob.
13 Plate, \$5.00; 25 Plate, \$5.50; 45 Plate, \$6.50.

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Genuine Condensite Dials 65c Extra.
Jobbers and Dealers: Write Immediately for Proposition.

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Real Radio Sets of today—the kind that last long and work best—are insulated with genuine Empire Oiled Tubing.

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NA-ALD
DE LUXE SOCKET

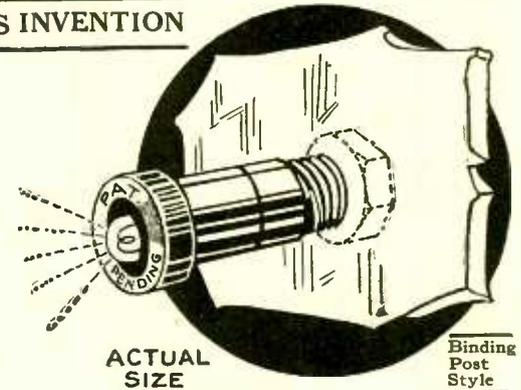
The laminated phosphor bronze contacts of the Na-ald De Luxe Socket press firmly on both the ends and sides of tube prongs, keeping the surface clean and insuring clear reception. Moulded of genuine Bakelite, this socket expresses the very highest quality in appearance and workmanship. Booklet "What to Build?" packed with each socket. Alden Manufacturing Company Largest makers of Radio sockets and dials in the world. Springfield, Mass. Dept. A 52 Willow Street



De Luxe Contact
Na-ald De Luxe No. 400

RADIO'S REAL MARVELOUS INVENTION

Positively Prevents Blowing Out Radio Tubes



The impossible has been done. Most radio owners have thought that it was impossible to prevent the accidental blowing-out of expense radio tubes. Now You CAN

Prevent Blowing Tubes. The KANT-BLO Protective Unit has been perfected, tested and fully approved by the most noted radio authorities.

Kant-Blo SIGNAL

SWITCH BINDING POST

One KANT-BLO Protects any Set regardless of kind or number of Tubes, or "A" and "B" Voltage.

"Lights on any Short Circuit"

Simply replace your present Binding Post or Switch with the KANT-BLO Protective Unit, and no matter how many short circuits develop in your radio set the tubes will not blow out. Only one KANT-BLO Signal of either style is needed to protect any number of tubes. And the KANT-BLO Signal will protect all tubes whether the "A" Battery is on or off, and regardless of the amount of voltage of your "B" batteries. Insist on KANT-BLO Signals when you build or buy a new Radio Set.

The KANT-BLO Signal will light and let you know that there is a short circuit, in order that you may examine the wiring and locate the short circuit at once. This saves not only the tubes but saves wearing out the batteries.

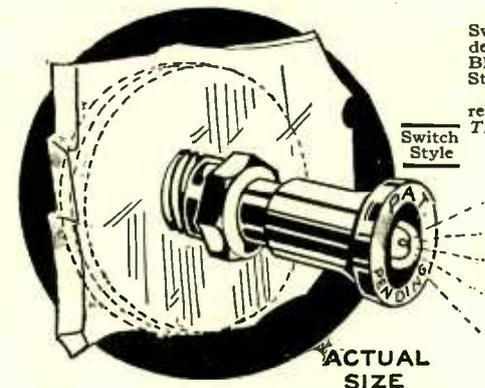
Easily Installed

The KANT-BLO Signal is installed easily. Simply takes the place of either the "A" Battery Switch or one "B" Battery Binding Post now on set.

Money-Back Guarantee

KANT-BLO Signals—both Binding Post Style and Switch Style—are at all the best radio stores. If your dealer is out of stock send us \$1.80 for a KANT-BLO Binding Post Style, or \$2.80 for the Switch Style, and we will see that your order is filled.

If you are not fully satisfied your money will be refunded upon receipt of returned KANT-BLO. USE THE COUPON.

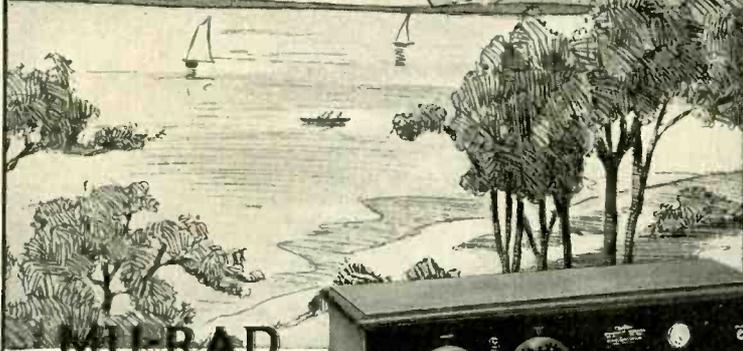


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Enclosed is money-order for for which please send me KANT-BLO Signals of the Type, at \$1.80 for Binding Post Style, and \$2.80 for Switch Style. If I am not fully satisfied with the KANT-BLO Signal I will return same within 10 days and you will return my money.

Name.....
Address.....

Establishing a New Horizon for Radio!



**MU-RAD
RECEIVERS**
MA-15



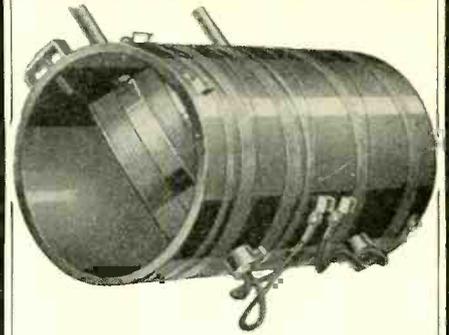
STILL FURTHER beyond the accepted bounds of radio reception, this long-range MU-RAD Receiver, MA-15, has extended the domain of radio entertainment. To the easy operation and high selectivity of the MU-RAD design, is added a still greater mastery of illimitable spaces together with pure, clear loud speaker volume. All this with only a handy 2 foot loop! The standard MU-RAD circuit—two stages of audio and three stages of radio frequency amplification with detector.

Guaranteed range with 2 foot loop~1000 miles

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PEERLESS DOUBLE TUNING COIL

The last word in properly designed tuning units. An instrument of quality and durability. Wave length that takes in all popular broadcasting stations. Price \$6.00 postpaid. Dealers and jobbers write for prices.

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**NO MORE
CABINETS**

JUST APPLY
FLAT MAHOG-
ANY OR PLATE
GLASS COVERS
TO THE NEW

**Quinby
Radio Frames**

(PATENT APPLIED FOR)

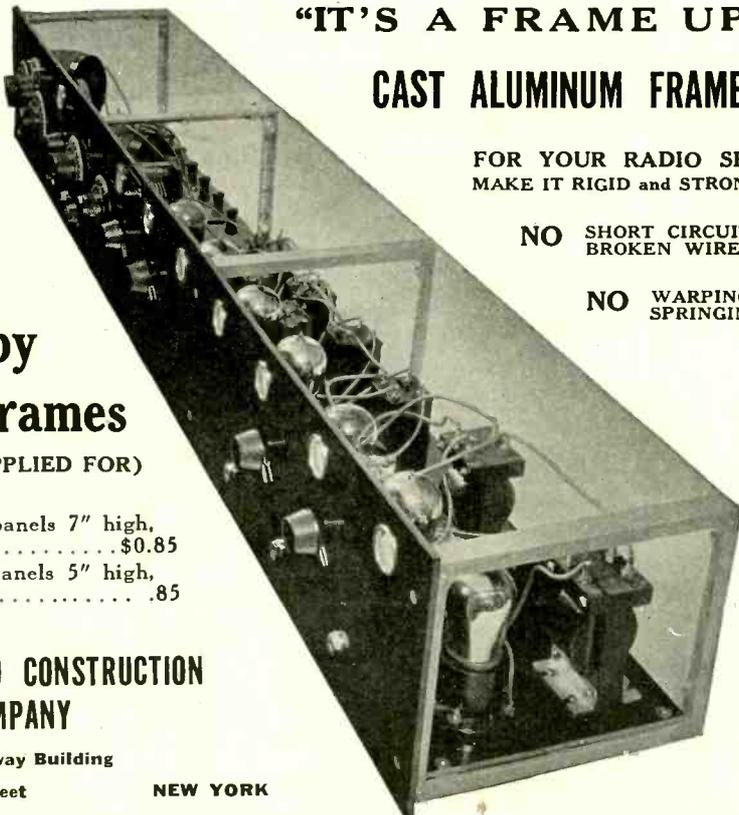
SIZE "A" for panels 7" high,
each\$0.85
SIZE "B" for panels 5" high,
each85

**QUINBY RADIO CONSTRUCTION
COMPANY**

Subway Building

87 West 181st Street

NEW YORK



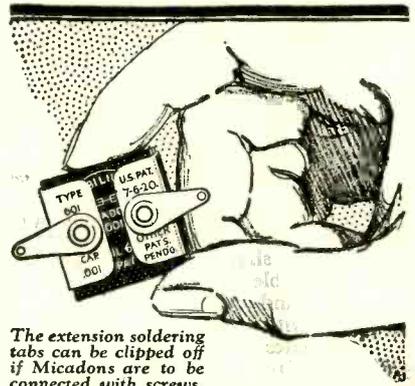
"IT'S A FRAME UP"

CAST ALUMINUM FRAMES

FOR YOUR RADIO SET
MAKE IT RIGID and STRONG

NO SHORT CIRCUITS
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NO WARPING
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The extension soldering tabs can be clipped off if Micadons are to be connected with screws.

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for every circuit**

The Dubilier Micadon is the standard fixed condenser of radio manufacturers and amateurs. Its capacity is permanent.

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HERE'S what we say about "Red-Heads"—they're EXTRA-ORDINARY radio receivers. We believe they're the best receivers on the market today. Superlatives are easy to say and hard to back up. Here's how we back up ours. We GUARANTEE that you'll like "Red-Heads." You take no risk in buying them. We'll refund your money plus postage if you don't agree with us after trial. "Red-Heads" are the lowest priced, high-grade, aluminum-backed receivers on the market. Nine years of receiver experience are behind their quality.

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MODEL "F" \$6.50
Complete 3000-Ohm set with cord and head band; aluminum back; brown-red ear caps; small, light-weight; exquisitely sensitive and fine-toned.

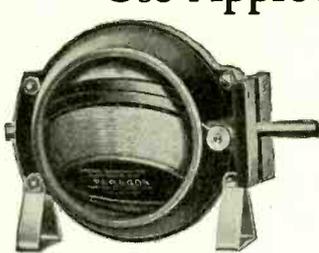
"RED-HEAD" Jr. \$5.00
Complete 2000-Ohm set of new design; a remarkable production with the same workmanship and guarantee as on our standard Model "F."

THE GUARANTEE
Money back if after 7 days' trial you're not satisfied that "Red-Heads" are the BEST receivers on the market at the price.

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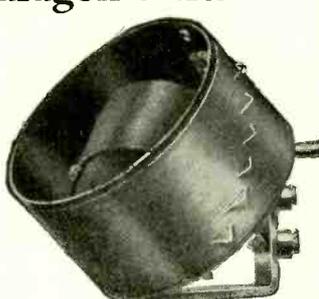
Since 1915 Pioneers in Radio—year after year striving to achieve one purpose—better and better radio receivers.

Use Approved Paragon Parts



Variometer No. 60

Reduces dielectric losses to the minimum. Combines coils surrounded by air with essential mechanical strength. Gives an inductance ratio of about ten to one and wavelength ratio from maximum setting of about three to one. Price \$5.00.



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Coils are double silk-covered wire wound on moulded black, Condensite tubes with highly polished finish. Only multiple turn taps are brought out in the primary. Single turn taps and switch for same are unnecessary. Price \$3.50.



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Rugged, heatproof, easily connected. Has positive contact. Base of polished black Condensite. Tubing moulded in. Terminals permit quick and convenient connections and are readily accessible. Satisfactory in every respect. Price \$1.00.

Write for illustrated catalog of Paragon Radio Parts
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PARAGON

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RADIO PRODUCTS

Atlas

TRADE MARK

RADIO-REPRODUCTION LOUD SPEAKER

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Mono—TIME-LAG FUSES—Multiple
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WIRELESS PRESS, Inc. 326 Broadway New York

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Be a RADIO EXPERT. Make big money. Win success in this new uncrowded field. Trained men needed. Learn quickly, at home in spare time, to construct, install, operate, repair, maintain and sell radio equipment.

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FREE Wonderful tube receiving set of latest design. Range of over 1000 miles. Write today for "RADIO FACTS."

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4513 Ravenswood Ave., Dept. G-4 Chicago

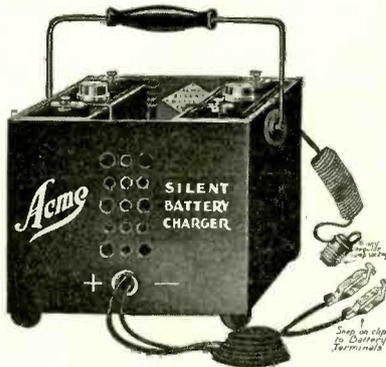
At Last!

a real SILENT—Super BATTERY CHARGER

at a price every fan can afford, only

\$10.50

At your dealer's or postpaid on receipt of price.
**charges both "A"-"B" Batteries
FULLY GUARANTEED**



The Acme Battery Charger contains no bulbs, no glass, no contacts, no moving parts. It never needs adjustment, is fool-proof, silent and practically indestructible. Charges both "A" and "B" Batteries properly without overheating or overcharging. Stops charging automatically when your battery reaches full strength. Simple and efficient—absolutely the last word in battery charging.

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Your search for quality ends here!

The high quality of the Howard Radio Products is not a matter of "chance." Howard Radio merchandise is manufactured with extreme care and precision—by persistent efforts applied to the minutest details.

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STANDARD RHEOSTAT
This Rheostat gives perfect satisfaction under constant service. Special heat resistant base and knob. Fits all tubes—5½, 25 and 40 ohm...\$1.16
Our new Rheostat with special dial is now ready—it requires but one hole for mounting. 6½, 25 and 40 ohm with special dial.....\$1.20
Also made with micrometer attachment.

When you ask your radio man for a Howard Product you are getting the best. Your search for quality Radio Merchandise is ended, for Howard Products carry the guarantee of satisfactory performance.

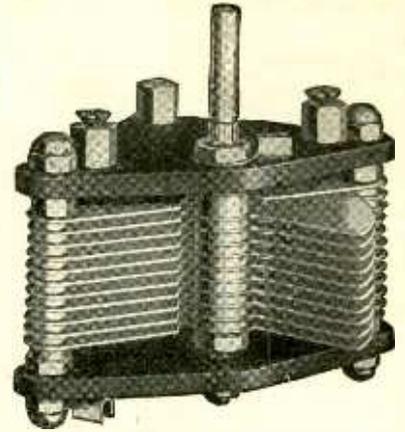


HOWARD

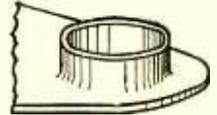
MULTI TERMINAL PLUG
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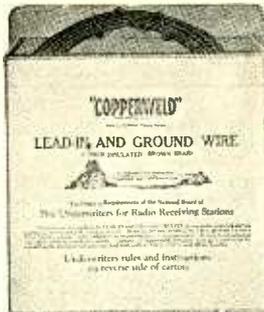


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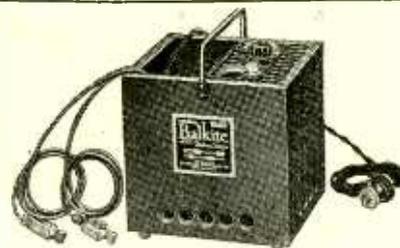
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 - O—single-turn modulating loop wrapped tightly around inductance coil A;
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Complete with instructions

Price, \$75.00

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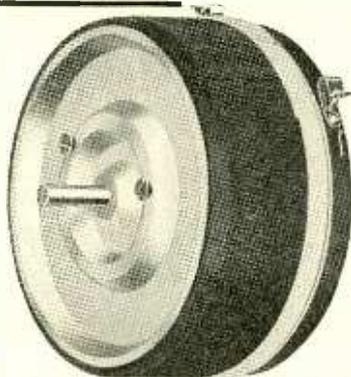
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DX Stations can be elusive. While you are groping for "out-of-town" you seem to get everything but what you want. "Horn-in" is a favorite stunt among Radio Broadcasters. They mean no harm, but that doesn't help any when they cut in on you. Haven't you often wondered how you could eliminate this interference? Well—it can be done! The Ferbend Wave Trap absolutely traps out the offending station and leaves you *only* what you want. Our guarantee is very plain in this regard. Read it!

We guarantee that the Ferbend Wave Trap, when properly connected to any workable receiving set, will tune out any interfering Station.



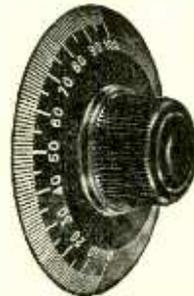
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TRADE MARK
Wave Trap
PATENT APPLIED FOR

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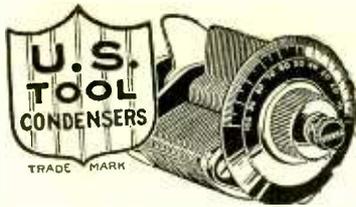
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COMPACT
ALWAYS RELIABLE**

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Low Dielectric Losses
100% Guarantee**

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Types C S 114-23 Plate Plain of Capacity 0.00055 Mfd.

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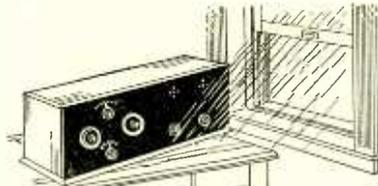
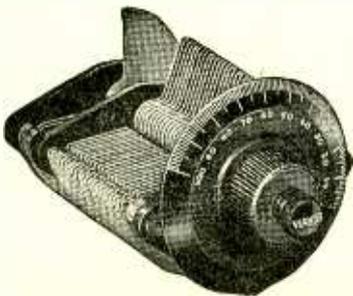
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SUPERDYNE
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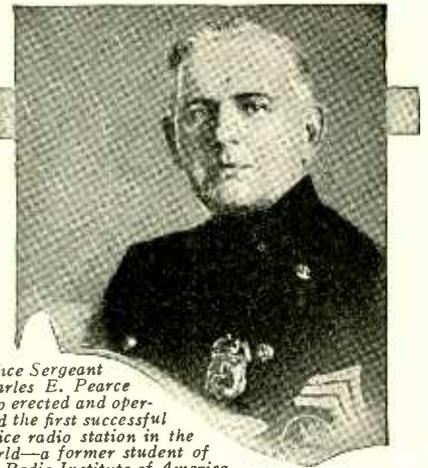
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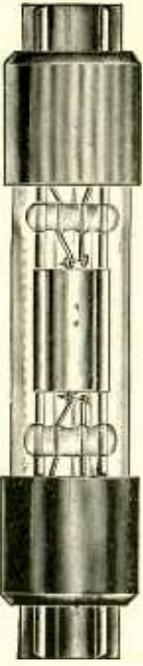
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\$5 EACH complete with mounting clips ready to mount on your set; no sockets or extra equipment required.

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Our Variometers, Couplers, mica fixed Condensers, and Variable Grid Leaks are real precision instruments.

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STA-RITE RADIO BATTERIES SAVE YOU 60%

And Guarantee You in Writing 2 Years of Better Battery Performance

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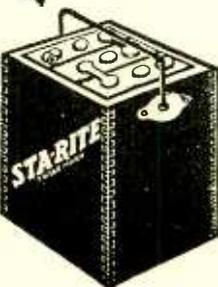
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\$25 for \$10



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BEL-CANTO
Acoustical
Amplifier**

**DIRECT FROM
MANUFACTURER TO YOU**

YOU cannot buy the Bel-Canto through any dealer, only direct from us. We save you these three profits—Distributor, Jobber and Dealer.

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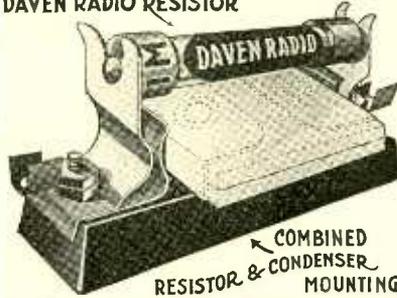


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This combination mounting also accommodates the DAVEN RADIO RESISTOR. DAVEN RESISTORS are constant and correct in value and positively insure clear, noiseless and distortion-free reception and amplification.

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Get all the fun there is to be had from your wireless set. Learn to read the dots and dashes and double your pleasure.

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Provide the ideal instruction

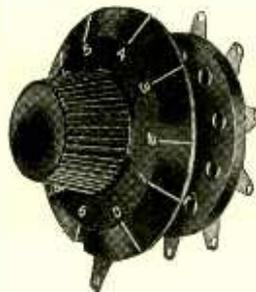
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Count**



\$1.25

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- 8 ACS W. R. Cox, 902 Pierpont Ave., Cleveland, O.
- 8 ADL F. L. Brewer, 89 S. Judson St., Gloversville, N. Y.
- 8 ADZ C. Davis, 239 Pearl St., Coldwater, Mich.
- 8 AEE M. F. Osborn, 316 S. Clinton St., Olean, N. Y.
- 8 AEW W. A. Herbert, 112 Westinghouse, Wilmerding, Pa.
- 8 AFF G. W. Troutwine, 236 W. Fulton St., Gloversville, N. Y.
- 8 AFL Charles Roberts, 157 Park St., Buffalo, N. Y.
- 8 AFP J. Morgan, 122 Railroad St., Wanamie, Pa.
- 8 AFZ C. E. Welscher, Norton Laboratories, Lockport, N. Y.
- 8 AGE A. Campbell, Chestnut Ridge, Lockport, N. Y.
- 8 AGS E. B. Huffman, 4 Gray Apts., Second St., Florida, O.
- 8 AHF A. F. Seiberling, Stan Hywet Hall, N. Portage Path, Akron, O.
- 8 AHM R. F. Wirsching, 1104 Oxford Ave., Dayton, O.
- 8 AHN S. Calate, 13 Reed Park St., Rochester, N. Y.
- 8 AHQ A. H. Noble, Capac, Mich.
- 8 AHR J. D. Huntley, 707 S. Main St., Clyde, O.
- 8 AHX L. D. Evans, 41 Merritt St., Battle Creek, Mich.
- 8 AIU C. Weiss, 1106 Genesee St., Buffalo, N. Y.
- 8 AKH H. R. Caster, 103 W. Patriot St., Sugarct, Pa.
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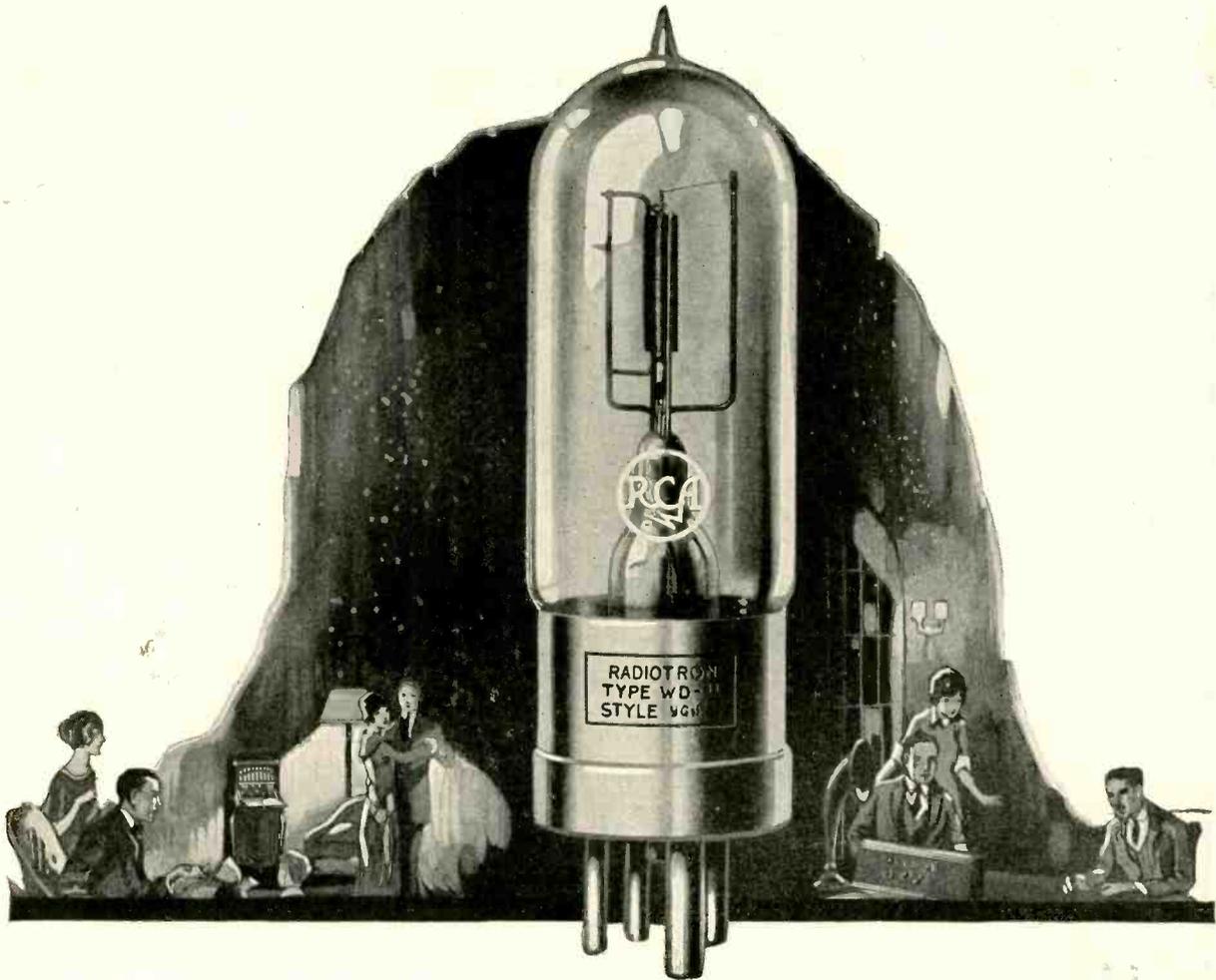
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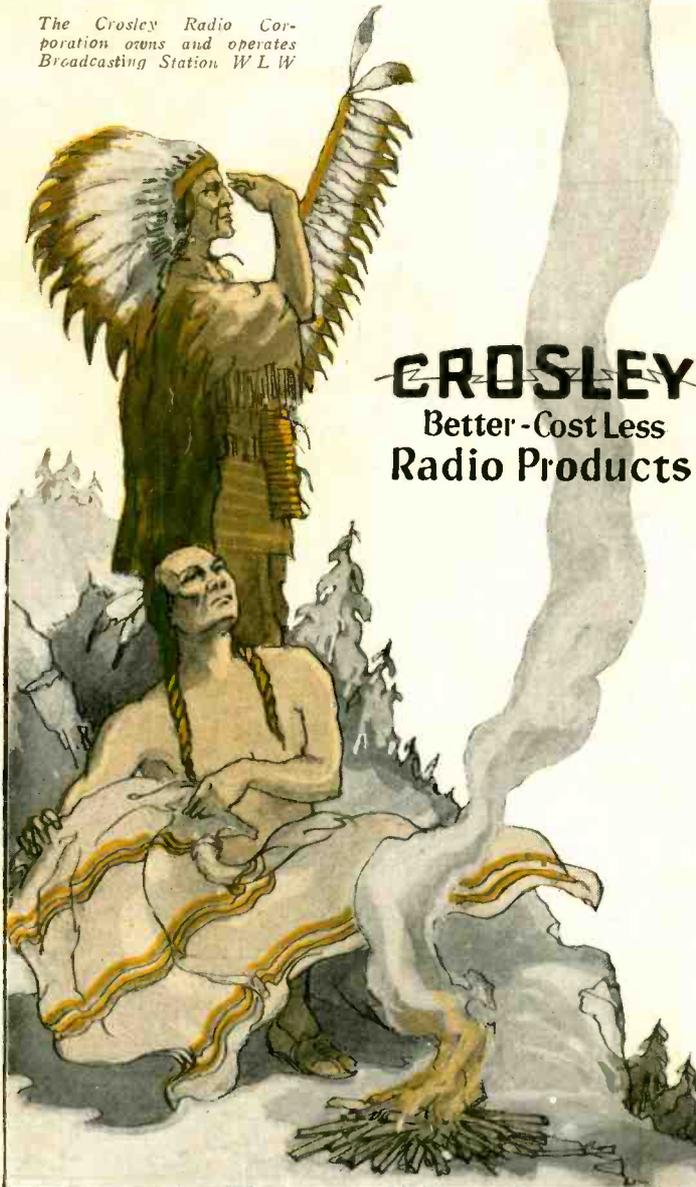
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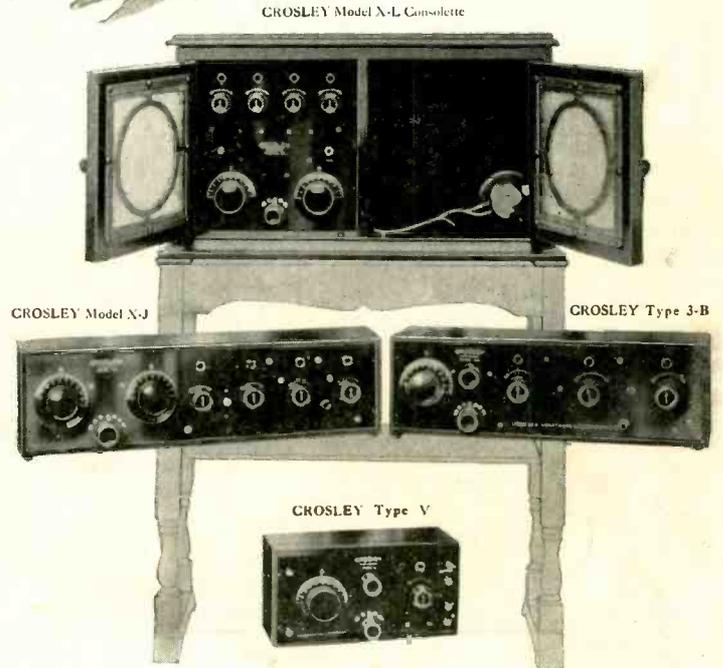
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